BS EN 492:2012

BSI Standards Publication

# Fibre-cement slates and fittings — Product specification and test methods

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## National foreword

This British Standard is the UK implementation of EN 492:2012. It supersedes BS EN 492:2004, which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee B/542, Roofing and cladding products for discontinuous laying, to Subcommittee B/542/4, Fibre reinforced cement sheeting for roofing.

A list of organizations represented on this committee can be obtained on request to its secretary.

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EUROPEAN STANDARD

NORME EUROPÉENNE

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# EN 492

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English Version

# Fibre-cement slates and fittings - Product specification and test methods

Ardoises en fibres-ciment et leurs accessoires en fibres-ciment - Spécification du produit et méthodes d'essai

Faserzement-Dachplatten und dazugehörige Formteile - Produktspezifikation und Prüfverfahren

This European Standard was approved by CEN on 4 August 2012.

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# Foreword

This document (EN 492:2012) has been prepared by Technical Committee CEN/TC 128 “Roof covering products for discontinuous laying and products for wall cladding”, the secretariat of which is held by IBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2013 , and conflicting national standards shall be withdrawn at the latest by April 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 492:2004.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

In comparison with the previous edition of the standard, the following sections have been changed or added: 2, 3.6, 3.7, 5.1.1, 5.3.3, 5.5.3, 6.3.2, 6.4, 7.3.4.4, 7.3.5.4, 7.5.1.2, 7.5.2.2, Annex A, Annex D.

Annex ZB concerning the EC Directive 76/769/EEC has been deleted.

A distinction has been made between product appraisal (type tests) and routine quality control requirements (acceptance tests).

The performance of a roof or another building part constructed with these products depends not only on the properties of the product as required by this standard, but also on the design, construction and installation of the components as a whole in relation to the environment and conditions of use.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

## 1 Scope

This European Standard specifies the technical requirements and establishes methods of control and test as well as acceptance conditions for fibre-cement slates and their fibre-cement fittings for one or more of the following uses:

— roofing;

— internal wall finishes;

— external wall and ceiling finishes.

This European Standard applies to fibre-cement slates with a height dimension *h* (see Clause 4) not exceeding 850 mm for overlapping assembly. For the purpose of this European Standard, fibre-cement slates have been classified according to their bending moment.

This European Standard covers fibre-cement slates reinforced with fibres of different types as specified in 5.1.1.

This European Standard does not include calculations with regard to works, design requirements, installation techniques, wind uplift or rain proofing of the installed products.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

CEN/TS 1187:2012, *Test methods for external fire exposure to roofs*

EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*

EN 13501-5, *Fire classification of construction products and building elements — Part 5: Classification using data from external fire exposure to roofs tests*

EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*

EN ISO 1716, *Reaction to fire tests for products — Determination of the gross heat of combustion (calorific value) (ISO 1716)*

ISO 2602, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3951-1, *Sampling procedures for inspection by variables — Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1**
**acceptance test**
test to establish whether a batch of products conforms to a specification and which is performed on samples drawn either from continuous production or from a consignment

Note 1 to entry: Test methods and specification limit values are specified in this standard. Sampling levels and acceptance criteria are given in 6.3.2.

**3.2**
**type test**
test carried out to demonstrate conformity with the requirements of this standard or for the approval of a new product and/or when a fundamental change is made in formulation and/or method of manufacture, the effects of which cannot be predicted on the basis of previous experience

Note 1 to entry: The test is performed on the product as delivered, but is not required for each production batch.

**3.3**
**acceptable quality level *(AQL)***
quality level which in a sampling plan corresponds to a specified, relatively high probability of acceptance

Note 1 to entry: It is the maximum percent defective (or maximum number of defects per 100 units) that for purposes of sampling inspection can be considered satisfactory as a process average.

Note 2 to entry: A sampling scheme with an *AQL* of 4 % means that batches containing up to 4 % defective items have a high probability of acceptance.

**3.4**
**as delivered**
same condition as the producer intends to supply the product after completing all aspects of the process including maturing and, when appropriate, painting

**3.5**
**upper face**
face normally exposed to the weather

**3.6**
**under face**
reverse of upper face

**3.7**
**NT**
fibre-cement slates and fittings of type NT cover products made using a non-asbestos technology

**3.8**
**ambient laboratory conditions**
laboratory conditions which are a temperature of (23 ± 5) °C and a relative humidity of (50 ± 20) %

## 4 Symbols and abbreviations

$b$ dimension of the specimen (length or width) measured parallel to the test machine supports in millimetres

one of the coefficients of the regression line (Annex B)

$d$ apparent density of the fibre-cement slate in grams per cubic centimetre

$e$ thickness of the fibre-cement slate in millimetres

$F$ load at rupture in newtons

$h$ dimension of the fibre-cement slate measured perpendicular to the line of fixing which is at or nearest to the horizontal plane of the roof (see Annex C, Figures C.1 and C.2), in millimetres

$l_s$ span between the centres of the test machine supports in the bending moment test in millimetres

$m$ mass of the specimen after drying in grams

$M$ bending moment at rupture in newton metres per metre

$M_{fi}$ bending moment (average of both directions) at rupture of the specimen from the $i^{th}$ pair tested after the type test (second lot) in newton metres per metre

$M_{fci}$ bending moment (average of both directions) at rupture of the specimen from the $i^{th}$ pair tested for reference in the type test (first lot) in newton metres per metre

$R$ average ratio of the bending moments at rupture before and after the type test

$R_i$ individual ratio of the bending moments at rupture of the $i^{th}$ pair of specimens before and after a type test

$R_L$ lower estimate of the mean of the ratios at 95 % confidence level of the bending moments at rupture before and after the type test

$s$ standard deviation of the values in the appropriate calculation

$V$ volume of the specimen in cubic centimetres

$x_o$ actual result obtained when dry testing

$x_{std}$ minimum value to be used as the specification for the dry method of test. This value is calculated at the 97,5 % lower confidence level from the value $y_{std}$ specified for the wet method of test in this document

$y_o$ value calculated from the value obtained from a specimen tested dry, which is the estimate at the 97,5 % lower confidence level of the value expected from a specimen tested wet

$y_{std}$ minimum value specified in the standard for wet testing.

# 5 Product requirements

## 5.1 General

### 5.1.1 Composition

Fibre-cement slates and fittings shall consist essentially of cement or a calcium silicate formed by chemical reaction of a siliceous and a calcareous material, reinforced by fibres. The cement shall comply with EN 197-1 or with technical specifications relevant in the country of use.

This European Standard covers fibre-reinforced cement slates and fittings of type NT.

The reinforcing fibres shall take one or more of the following forms:

— discrete elements randomly dispersed,

— continuous strands or tapes,

— nets or webs.

Process aids, fillers and pigments which are compatible with the composite may be added.

#### 5.1.2 Appearance and finish

The exposed face of the fibre-cement slates may be with or without texture. The fibre-cement slates may be coloured or left in their natural colour. The fibre-cement slates may also receive adherent coloured or uncoloured coatings on their surface.

The fibre-cement slates may be supplied with holes for fixing.

On exposure, the surface and/or its coating will be affected by weathering which may vary with site location, aspect, pitch of roof and duration of exposure. Any deterioration in this respect shall not detract from the minimum mechanical and physical characteristics as specified in this document or from the function of the fibre-cement slate as a durable element.

The fittings shall have a general appearance and finish compatible with the fibre-cement slates with which they are to be used. They may be supplied with holes for fixing.

### 5.2 Dimensions and tolerance

#### 5.2.1 General

The manufacturer shall specify the shapes, sizes and configuration of edges.

NOTE See 5.6 for designation and information.

Fittings shall have nominal dimensions and shapes determined by the manufacturer and appropriate to the corresponding fibre-cement slates.

#### 5.2.2 Thicknesses

The actual fibre-cement slate thickness determined in accordance with 7.2 shall be not less than that shown in Table 1.

The nominal thickness shall be specified by the manufacturer.

The nominal thickness of the fittings shall be not less than the corresponding nominal thickness of the fibre-cement slates with which the fittings are to be used.

#### 5.2.3 Tolerances on nominal dimensions

The maximum dimensional variation when measured as specified in 7.2 shall be as follows:

— Length and width: ± 3 mm;

— Thickness: $^{+25}_{-10}$ % of the nominal value.

For fittings that replace fibre-cement slates (e.g. ventilation fibre-cement slates) the tolerances shall be the same as those on the fibre-cement slates.

For other fittings (e.g. ridges) the tolerances shall be specified by the manufacturer.

## 5.3 Physical requirements and characteristics for fibre-cement slates

### 5.3.1 General

Mechanical and material properties are determined on products as delivered, wherever practicable. The results shall be identified as applying to coated or uncoated material.

NOTE See 6.3 for statistical interpretation.

### 5.3.2 Apparent density

The manufacturer's literature shall specify the minimum apparent density of the fibre-cement slates. The fibre-cement slates shall have an apparent density equal to or greater than that specified by the manufacturer when tested in accordance with 7.3.1.

### 5.3.3 Mechanical characteristics

When tested in accordance with 7.3.2, the fibre-cement slates shall have a minimum average bending moment per metre width in newton metres per metre as specified in Table 1.

The minimum bending moment at rupture in the weaker direction shall be not less than 60 % of the values specified in Table 1 for the average in both directions.

**Table 1 — Minimum bending moment per metre and minimum thickness**

| ***Height h*** **(mm)** | **Minimum thickness *e*[a] (mm)** | **Minimum bending moment, average of the two directions (Nm/m)** |
|---|---|---|
| $h \leq 350$ | 2,8 | 30 |
| $350 < h \leq 450$ | 3,0 | 40 |
| $450 < h \leq 600$ | 3,5 | 45 |
| $600 < h \leq 850$ | 4,0 | 55 |
| [a] *e* is the arithmetic mean of four measurements (according to 7.2.4). | | |

### 5.3.4 Water impermeability

When tested in accordance with 7.3.3, traces of moisture may appear on the under face of the fibre-cement slate, but in no instance shall there be any formation of drops of water.

## 5.4 Durability requirements

### 5.4.1 General

Mechanical and material properties are normally determined for as delivered products. The results shall be identified as applying to coated or uncoated material. Performance of the coating in the tests specified in 5.4.2 and 5.4.3 shall not be considered in the assessment of the product.

### 5.4.2 Freeze-thaw

When tested in accordance with 7.4.1 after 100 freeze-thaw cycles, the ratio $R_L$ as defined in 7.4.1.4 shall be not less than 0,75.

### 5.4.3 Heat-rain

When tested in accordance with 7.4.2 after 50 heat-rain cycles, any visible cracks, delamination or other defects in the fibre-cement slates shall not be of such degree as to affect their performance in use.

Water tightness is assessed according to 5.3.4.

Warping and bowing are visually assessed.

### 5.4.4 Warm water

When tested in accordance with 7.3.4, after 56 days at 60 °C, the ratio $R_L$ as defined in 7.3.4.4 shall be not less than 0,75.

### 5.4.5 Soak-dry

When tested in accordance with 7.3.5, after 50 soak-dry cycles, the ratio $R_L$ as defined in 7.3.5.4 shall be not less than 0,75.

## 5.5 Fire and safety

### 5.5.1 External fire performance

When subject to regulatory requirements, the external fire performance of the slates shall be declared in accordance with 7.5.1.

### 5.5.2 Reaction to fire

When subject to regulatory requirements, the reaction to fire of the slates or fittings shall be declared in accordance with 7.5.2.

### 5.5.3 Release of dangerous substances

Materials used in products shall not release any dangerous substances in excess of the maximum permitted levels specified in a relevant European Standard for the material or permitted in the national regulations of the member state of destination.

NOTE See notes in ZA.1 and ZA.3.

## 5.6 Product information

The designation of the fibre-cement slate shall include at least the following:

— type of product NT (see 5.1.1);

— name of the fibre-cement slate;

— height (*h*), size and shape.

The manufacturer shall include the following in his literature:

a) designation of the fibre-cement slate as above;

b) nominal values for:

   1) thickness;

   2) length and width.

c) minimum apparent density;

d) information relevant to the handling and installation.

# 6 Evaluation of conformity

## 6.1 General

The conformity of products with the requirements of this standard shall be demonstrated by:

— initial type testing; and

— factory production control by the manufacturer.

## 6.2 Initial type testing

Type tests shall be carried out on products as delivered. If several formats or sizes of the same nominal thickness are being produced from the same composition and by the same production method, type tests only need to be carried out on one size of each nominal thickness.

All characteristics listed in Table 2 shall be subject to initial type testing, except reaction to fire Class A1 without testing and external fire performance "deemed to satisfy" products.

Initial type testing shall be performed to demonstrate conformity to this standard. Tests previously performed in accordance with the provisions of this standard (same product, same characteristic(s), test method, sampling procedure, same attestation of conformity, etc.) may be taken into account. In addition, initial type testing shall be performed for the approval of a new product, or a fundamental change in formulation or method of manufacture, the effects of which cannot be predicted on the basis of previous experience.

The results of all type tests shall be recorded and held by the manufacturer for at least five years after production of products covered by the type test have ceased production.

Whenever a change occurs in the fibre-cement slate design, the raw material or supplier of components or the production process, which would change significantly one or more of the characteristics, the type test shall be performed for the appropriate characteristic(s).

**Table 2 — Number of slates and fittings and compliance criteria**

| Characteristic | Requirement | Assessment method | Number of samples | Compliance criteria |
|---|---|---|---|---|
| Mechanical resistance (slates) | 5.3.3 | 7.3.2 | Inspection S3 as per ISO 2859-1 | 5.3.3 Table 1 apply 4 % AQL |
| Density (slates) | 5.3.2 | 7.3.1 | 7.3.1 | 5.3.2 and 7.3.1 |
| External fire performance (slates) | 5.5.1 | 7.5.1 | 7.5.1 | 7.5.1 |
| Reaction to fire (slates and fittings) | 5.5.2 | 7.5.2 | 7.5.2 | 7.5.2 |
| Water impermeability (slates) | 5.3.4 | 7.3.3 | 3 test slates | 5.3.4 |
| Dimensional variations (slates and fittings) | 5.2 | 7.2 | Inspection S3 as per ISO 2859-1 | 5.2.2 and 5.2.3 |
| Release of dangerous substances (slates and fittings) | 5.5.3 | 5.5.3 | - | 5.5.3 |
| Warm water (slates) | 5.4.4 | 7.3.4 | 10 samples | 5.4.4 and 7.3.4.4 |
| Soak/Dry (slates) | 5.4.5 | 7.3.5 | 10 samples | 5.4.5 and 7.3.5.4 |
| Freeze-Thaw (slates) | 5.4.2 | 7.4.1 | 10 samples | 5.4.2 and 7.4.1.4 |
| Heat-Rain (slates) | 5.4.3 | 7.4.2 | 11 samples | 5.4.3 and 7.4.2.4 |

## 6.3 Factory Production Control (FPC)

### 6.3.1 General

The manufacturer shall establish, document and maintain a FPC system to ensure that the products placed on the market conform with the stated performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.

A manufacturer who has established a Quality Management System according to EN ISO 9001 and made specific to the requirements of this standard is considered to satisfy the above requirements.

The results of inspections, tests or assessments requiring action shall be recorded, as shall the action(s) taken.

### 6.3.2 Acceptance tests

The specifications of acceptance tests apply to the product as delivered, but may be carried out at an earlier stage of maturity.

Sampling from continuous production testing

— on the base sheet prior to coating,

— in conditions other than in Table 4,

is acceptable provided that it has been statistically established (see Annex B) that compliance with the requirements given in Table 1 is ensured.

Acceptance tests can also be used to confirm that a batch of slates or fittings conform with the standard, e.g. in conjunction with type tests or for receiving inspection.

The tests include:

— measurement of dimensions - length, width and thickness - (methods specified in 7.2);

— measurement of apparent density (slates only, method specified in 7.3.1);

— measurement of mechanical characteristics - bending strength - (slates only; method specified in 7.3.2).

Each limit of specification, for the characteristics in Table 3, shall be subject to an AQL of 4 %. The sampling schemes provided in ISO 2859-1 and 3951-1, with an AQL of 4 % and an inspection level $S_3$, ensure that for large batches approximately 95 % of the items fulfil the requirements.

**Table 3 – Minimum sampling schemes**

| | |
|---|---|
| **Fibre-cement slates** | |
| Length<br>Width<br>Thickness | ISO 2859-1<br>Inspection by attribute<br>Double sampling<br>AQL 4 %<br>Level $S_1$ |
| Apparent density<br>Bending moment | ISO 3951-1<br>Inspection by variable; method s or $\sigma$<br>AQL 4 %<br>Level $S_3$ |
| **Fittings** | |
| Length<br>Width<br>Thickness | The same as for the dimensional characteristics of fibre-cement slates |

### 6.3.3 Equipment

All weighing, measuring and testing equipment shall be calibrated and regularly inspected according to documented procedures, frequencies and criteria.

### 6.3.4 Raw materials and components

The specification of all incoming raw materials and components shall be documented, as shall the inspection scheme for ensuring conformity.

### 6.3.5 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the declared values of all of the characteristics are maintained.

### 6.3.6 Non-conforming products

Non-conforming products shall be separated and handled according to documented procedures.

### 6.4 Inspection of a consignment of finished products

Inspection of a consignment of finished products is not a requirement of this standard but if, in special cases, it is demanded, it may be carried out in accordance with Annex A, ISO 2859-1 and ISO 3951-1.

## 7 Test methods

### 7.1 General

This clause details both acceptance and initial type testing.

### 7.2 Dimensional tests

#### 7.2.1 Preparation of specimen

The test shall be performed on a whole fibre-cement slate as delivered and without conditioning.

#### 7.2.2 Apparatus

**7.2.2.1** **Metal ruler,** accurate to 0,5 mm.

**7.2.2.2** **Micrometer,** accurate to 0,05 mm, having flat circular metal jaws of 10 mm to 15 mm diameter.

#### 7.2.3 Procedure

##### 7.2.3.1 Length and width

For each dimension, take two measurements; take each reading to the nearest 0,5 mm.

##### 7.2.3.2 Thickness

Take four measurements to the nearest 0,1 mm, one at each side of the fibre-cement slates.

#### 7.2.4 Expression and interpretation of results

##### 7.2.4.1 Length and width

Each value shall comply with the tolerance specified in 5.2.3.

##### 7.2.4.2 Thickness

The average of the four measurements shall be not less than the minimum given in Table 1 and shall comply with the tolerances specified in 5.2.3.

### 7.3 Tests for physical performance and characteristics

#### 7.3.1 Apparent density

##### 7.3.1.1 Preparation of specimen

The test specimen shall be a piece of the fibre-cement slate used for the bending test.

#### 7.3.1.2 Apparatus

**7.3.1.2.1** **Ventilated oven**, capable of achieving a temperature of 100 °C to 105 °C with a full load of specimens.

**7.3.1.2.2** **Balance,** accurate to within 0,1 % of the specimen mass and equipped to determine both the immersed mass and the non-immersed mass of the specimen.

#### 7.3.1.3 Procedure

Determine the volume $V$ of the specimen by immersion in water or using another method of equivalent accuracy. In the case of immersion in water, the test specimen shall be saturated in water beforehand.

Determine the mass $m$ of the specimen after drying it in a ventilated oven maintained at 100 °C to 105 °C for 24 h.

#### 7.3.1.4 Expression and interpretation of results

The apparent density is given by the formula:

$$d = \frac{m}{V}$$

where

$d$ is the apparent density in grams per cubic centimetres;

$m$ is the mass of the test specimen after drying in grams;

$V$ is the volume of the test specimen in cubic centimetres.

The result shall conform to the specification of 5.3.2.

### 7.3.2 Mechanical characteristics: Breaking load test

#### 7.3.2.1 Preparation of specimens

The dimensions of the test specimen shall be large enough to ensure that it overlaps each test support by at least 10 % of the span when tested in each direction. The specimen can be square or rectangular.

Testing shall be carried out after wet conditioning except that for quality control purposes dry testing can be carried out providing it has been statistically established (see Annex B) that compliance with the requirements for wet testing given in Table 1 is ensured.

Specimens shall be conditioned in accordance with Table 4.

**Table 4 — Conditioning**

| Test | Conditioning procedure |
|---|---|
| Acceptance test wet | 24 h immersion in water |
| Acceptance test dry | Between 7 d and 14 d in ambient laboratory conditions |
| Type test | Prior to the bending test between 7 d and 14 d in ambient laboratory conditions followed by 24 h immersion in water |

**7.3.2.2 Apparatus**

**7.3.2.2.1 Bending test machine,** with a constant rate of deflection when applying the load (where this facility is not available a constant rate of loading is acceptable) and with an error of accuracy and an error of reproducibility equal to or less than 3 %, comprised of the following (see Figure 1):

**7.3.2.2.1.1 Two parallel supports (one fixed),** set in the same horizontal plane.

The upper face of each support shall be rounded with a radius between 3 mm and 25 mm. The distance $l_s$ between the supports (span) shall be 200 mm except where the specimen dimension is too small to allow an overlap of each test support by at least 10 %, in which case the distance between the supports can be reduced to meet this overlap criteria.

**7.3.2.2.1.2 A loading bar,** having the same radius as the supports and located parallel and equidistant from them.

The loading bar shall be attached to the loading mechanism by means of a flexible joint.

Dimensions in millimetres

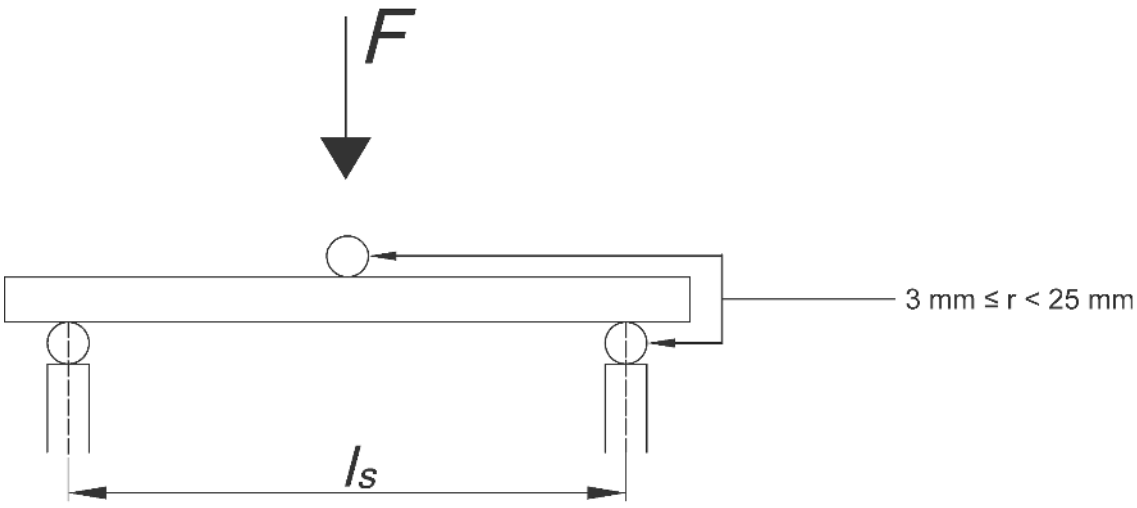



**Figure 1 — Bending test machine**

#### 7.3.2.3 Procedure

Place the test specimen with the upper face in compression and load it to failure along its centre line (see Figure 2) by means of the loading bar. The rate of loading shall be regular and such that maximum load occurs between 5 s and 30 s.

Reassemble the broken specimen without turning it over.

Submit the reassembled specimen to another test with the line of load application at right angles to that of the first test (see Figure 3).

Record the load at rupture $F$.

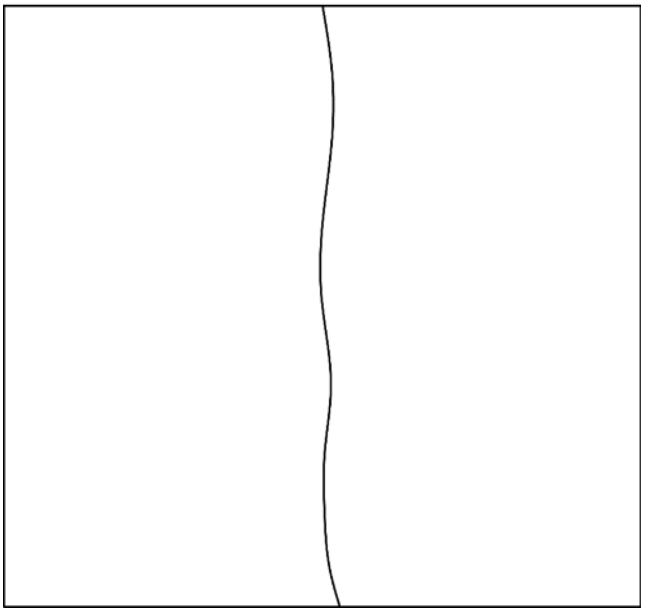


**Figure 2 — Sample after first bending**

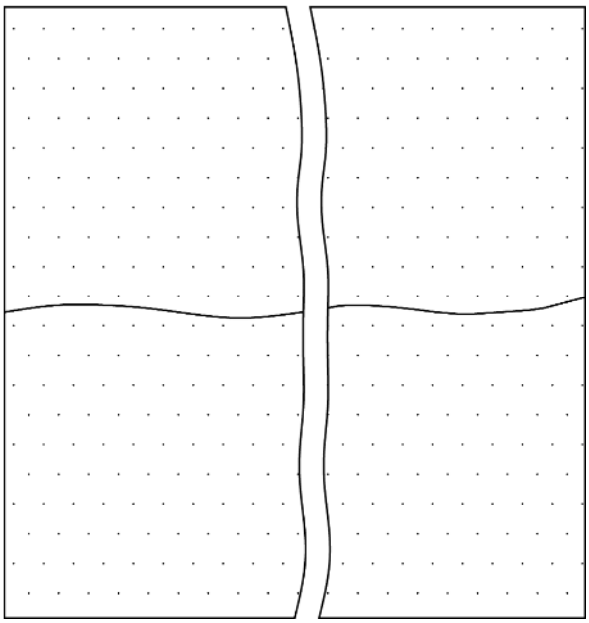


**Figure 3 — Sample after second bending**

#### 7.3.2.4 Expression and interpretation of results

The bending moment at rupture for each direction is given by the following formula:

$$M = \frac{F \times l_s}{4 \times b}$$

where

$M$ is the bending moment at rupture, in newton metres per metre;

$F$ is the load at rupture, in newtons;

$l_s$ is the span between the centres of the supports, in millimetres;

$b$ is the dimension of the specimen (length or width) measured parallel to the supports, in millimetres.

Calculate the bending moment for both the average of the two directions and for the weaker direction.

For specimens tested wet, the results of the test shall conform to the specification of 5.3.3.

For specimens tested dry, either:

— calculate the corresponding wet values $y_o$, using the method in Annex B, in which case $y_o$ shall conform to Table 1 (see 5.3.3), or

— calculate the appropriate revised value for the specifications $x_{std}$, using the method in Annex B in which case the dry results shall conform to the revised value.

#### 7.3.3 Water impermeability

##### 7.3.3.1 Preparation of specimens

Sample three fibre-cement slates and keep them for at least seven days in ambient laboratory conditions.

##### 7.3.3.2 Apparatus

**7.3.3.2.1 Vertical transparent tube,** 300 mm long with a minimum bore of 35 mm.

##### 7.3.3.3 Procedure

Seal the vertical transparent tube to the middle of the upper face of the test specimen supported horizontally for inspection.

Fill the tube with water to a height of approximately 250 mm, measured from the upper surface of the test specimen.

Leave for 24 h in ambient laboratory conditions.

Examine the under face of the test piece after 24 h.

##### 7.3.3.4 Expression and interpretation of results

After visual assessment, the result shall conform to the specification of 5.3.4.

#### 7.3.4 Warm water

##### 7.3.4.1 Preparation of specimens

Sample ten fibre-cement slates as delivered. Cut ten pairs of specimens to suit the bending test in 7.3.2.

Both specimens of a pair shall be cut from the same fibre-cement slate and each given the same number for later comparison of results.

##### 7.3.4.2 Apparatus

**7.3.4.2.1 Water bath,** with a temperature control at (60 ± 2) °C;

**7.3.4.2.2 Bending test machine,** as described in 7.3.2.2.

##### 7.3.4.3 Procedure

Divide the paired specimens to form two lots of ten specimens each.

Submit the first lot of ten specimens to the bending test in accordance with 7.3.2 including the conditioning procedure (see Table 4).

At the same time, immerse the second lot of ten specimens in water at 60 °C saturated with product of the same composition.

Maintain at (60 ± 2) °C for (56 ± 2) days.

Carry out the bending test as specified in 7.3.2 including the conditioning procedure (see Table 4).

#### 7.3.4.4 Expression and interpretation of results

For each pair of specimens, i (i = 1 to 10), calculate the individual ratio, $R_{\mathrm{i}}$, as follows:

$$R_{\mathrm{i}} = \frac{M_{\mathrm{fi}}}{M_{\mathrm{fci}}}$$

where

$M_{\mathrm{fi}}$ is the bending moment at rupture of the specimen from the $\mathrm{i}^{\mathrm{th}}$ pair tested after warm water immersion (the second lot);

$M_{\mathrm{fc\,i}}$ is the bending moment at rupture of the specimen from the $\mathrm{i}^{\mathrm{th}}$ pair tested for reference (the first lot).

Calculate the average, $R$, and standard deviation, *s*, of the individual ratios, $R_{\mathrm{i}}$.

Calculate the lower estimation, $R_{\mathrm{L}}$, of the mean of the ratios at 95 % confidence level as follows (ISO 2602):

$$R_{\mathrm{L}} = R - 0{,}58s$$

The result shall conform to the specification of 5.4.4.

### 7.3.5 Soak-dry

#### 7.3.5.1 Preparation of specimens

Sample ten fibre-cement slates as delivered. Cut ten sets of paired specimens to suit the bending test in 7.3.2.

Both specimens of a pair shall be cut from the same fibre-cement slate and given the same number for later comparison of results.

#### 7.3.5.2 Apparatus

**7.3.5.2.1 Ventilated oven,** with temperature control to (60 ± 5) °C and a relative humidity of < 20 % with full load of specimens.

The 20 % humidity shall be achieved for at least 3 h prior to the conclusion of the 6 h drying.

**7.3.5.2.2 Bath,** filled with water at ambient temperature (> 5 °C).

**7.3.5.2.3 Bending test machine,** as described in 7.3.2.2.

#### 7.3.5.3 Procedure

Divide the paired specimens to form two lots of ten specimens each.

Submit the first lot of specimens to the bending test in accordance with 7.3.2 including the conditioning procedure (see Table 4)

At the same time, submit the second lot to fifty soak-dry cycles as follows:

— immerse in water at ambient temperature above 5 °C for 18 h,

— dry in a ventilated oven of (60 ± 5) °C and relative humidity lower or equal to 20 % for 6 h.

If necessary, an interval of up to 72 h between cycles is allowed. During this interval, specimens shall be stored in immersed conditions.

After fifty cycles, carry out the wet bending test in accordance with 7.3.2 including the conditioning procedure (see Table 4).

#### 7.3.5.4 Expression and interpretation of results:

For each pair of specimens, i (i = 1 to 10), calculate the individual ratio, $R_{i,}$ as follows:

$$R_i = \frac{M_{fi}}{M_{fci}}$$

where

$M_{fi}$ is the bending moment at rupture of the specimen from the $i^{th}$ pair tested after the soak-dry cycling (the second lot);

$M_{fci}$ is the bending moment at rupture of the specimen from the $i^{th}$ pair tested for reference (the first lot).

Calculate the average, $R$, and standard deviation, *s*, of the individual ratios, $R_i$.

Calculate the lower estimation, $R_{L,}$ of the mean of the ratios at 95 % confidence level as follows (ISO 2602):

$$R_L = R - 0{,}58s$$

The result shall conform to the specification of 5.4.5.

## 7.4 Tests for climatic performance

### 7.4.1 Freeze-thaw

#### 7.4.1.1 Preparation of specimens

Sample ten fibre-cement slates as delivered. Cut ten pairs of specimens to suit the bending test in 7.3.2.

Both specimens of a pair shall be cut from the same fibre-cement slate and given the same number for later comparison of results.

#### 7.4.1.2 Apparatus

**7.4.1.2.1 Freezer unit,** having forced air circulation with air temperature control of (- 20 ± 4) °C and capable of reaching this temperature within 1 h to 2 h with a full load of specimens.

**7.4.1.2.2 Water bath,** filled with water and maintained at (20 ± 4) °C.

**7.4.1.2.3 Bending test machine,** as described in 7.3.2.2.

#### 7.4.1.3 Procedure

Divide the paired specimens to form two lots of ten specimens each.

Submit the first lot of specimens to the bending test as described in 7.3.2 including the conditioning procedure (see Table 4).

At the same time, immerse the second lot of specimens in water at ambient temperature (> 5 °C) for 48 h.

Then subject the second lot of specimens to 100 of the following freeze-thaw cycles:

— cool (freeze) in the freezer which shall reach a temperature of (-20 ± 4) °C within 1 h to 2 h and hold at this temperature for a further 1 h,

— heat (thaw) in the water bath which shall reach a temperature of (20 ± 4) °C within 1 h to 2 h and hold at this temperature for a further 1 h.

During both the cooling and heating (freezing and thawing) cycles, position the specimens to enable free circulation of the conducting medium (air in the freezer or water in the bath) around them.

Each freeze/thaw cycle shall take between 4 h and 6 h but an interval of 72 h maximum may be taken between cycles during which the specimens shall be stored in water at 20 °C.

Control of the freeze/thaw cycles can be automatic or manual. Continuous automatic cycling is preferable. For manual control, record the completion of each cycle.

After the 100 cycles carry out the bending test as specified in 7.3.2 including the conditioning procedure (see Table 4).

#### 7.4.1.4 Expression and interpretation of results

For each pair of specimens, i (i = 1 to 10), calculate the individual ratio, $R_i$, as follows:

$$R_i = \frac{M_{fi}}{M_{fci}}$$

where

$M_{fi}$ is the bending moment at rupture of the specimen from the $i^{th}$ pair after freeze-thaw cycling (the second lot);

$M_{fci}$ is the bending moment at rupture of the specimen from the $i^{th}$ pair tested for reference (the first lot).

Calculate the average, $R$, and standard deviation, $s$, of the individual ratio, $R_i$.

Calculate the lower estimation, $R_L$, of the mean of the ratios at 95 % confidence level as follows (ISO 2602):

$$R_L = R - 0{,}58s$$

The result shall conform to the specification of 5.4.2.

### 7.4.2 Heat-rain

#### 7.4.2.1 Preparation of specimens

The test shall be carried out on at least eleven full size fibre-cement slates as delivered.

#### 7.4.2.2 Apparatus

**7.4.2.2.1 Frame,** inclined at (25 ± 5)° placed in a space without draught but suitably ventilated.

**7.4.2.2.2 Heating device,** capable of maintaining the specified uniform temperature on the surface of the tested elements.

The heating device shall have a power output regulated by means of a black body temperature sensor located at the central area of the test rig where the maximum temperature is expected, i.e. at the closest distance underneath a heating unit.

The temperature at this location shall be regulated at (70 ± 5) °C and shall be reached after 15 min of heating.

At any time, the difference between black body temperature in the centre and black body temperatures near the corners of the test rig (also measured underneath heating units) shall not exceed 15 °C.

**7.4.2.2.3 Water sprinkling device,** with an output of approximately 2,5 l/(m².min), delivering water at ambient temperature (over 5 °C).

The area of the frame shall be at least 1,50 m x 1,50 m.

NOTE For this test, an aluminium plate of 1 mm thickness painted with a matt black paint is used as a black body; the measurement device being a thermocouple or a similar device fixed on the surface of the aluminium plate.

#### 7.4.2.3 Procedure

Condition the specimens by storing them to allow them to reach equilibrium for seven days in a laboratory atmosphere.

Fix at least eleven fibre-cement slates according to the manufacturer's instructions.

Inspect the fibre-cement slates before cycling commences for appearance, signs of damage due to transportation, fixing and handling. Any damaged slate shall be replaced.

Submit the upper face of the fibre-cement slates to fifty wetting and heating cycles in accordance with Table 5.

**Table 5 — Heat-rain cycle**

| Cycles | Duration |
|---|---|
| Wetting 2,5 l/($m^2$.min) | 2 h 50 min |
| Pause | 10 min |
| Heating (70 ± 5) °C | 2 h 50 min |
| Pause | 10 min |
| Total | 6 h |

After the fifty heat-rain cycles, inspect the fibre-cement slates for the following:

— cracking (longitudinal, transverse and at the fixing points);

— delamination;

— other visible defects.

#### 7.4.2.4 Expression and interpretation of results

The result of the visual assessment shall conform to the specification of 5.4.3.

## 7.5 Test for fire performance

### 7.5.1 Test for external fire performance

#### 7.5.1.1 Slates satisfying the requirements for the external fire performance, due to the deemed to satisfy list

Slates covered by this European Standard are considered "deemed to satisfy without the need of testing" in relation to the requirements for external fire performance, provided that they meet the definitions given in Commission Decision 2000/553/EC.

NOTE Member States may have national “deemed to satisfy” lists going further than that given in Decision 2000/553/EC.

#### 7.5.1.2 Other slates

Slates not covered by 7.5.1.1 shall be tested and classified in accordance with EN 13501-1. The slates to be tested shall be installed, in addition to the general provisions given in CEN/TS 1187, in a manner representative of their intended use in accordance with the manufacturer’s specifications.

### 7.5.2 Test for reaction to fire

#### 7.5.2.1 Slates and fittings satisfying the requirements for the fire reaction Class A1 without the need for testing

Slates or fittings containing 1 % or less organic substances by mass or volume, whichever is the most onerous, are considered to satisfy the requirements for performance Class A1 of the characteristics reaction to fire, in accordance with the provisions of EC Decisions 96/603/EC, as amended, without the need for testing.

#### 7.5.2.2 Other slates and fittings

##### 7.5.2.2.1 General

Slates and fittings not covered by 7.5.2.1 shall be tested and classified in accordance with EN 13501-1. Where the test method requires, the slates or fittings to be tested shall be installed, in addition to the general provisions given in the test method, in a manner representative of their intended use in accordance with the manufacturer's specifications.

##### 7.5.2.2.2 Mounting and fixing provisions for EN 13823

###### 7.5.2.2.2.1 End use applications

The end uses covered by the standardized mounting and fixing are fibre cement slates and fittings used as the external layer for discontinuously laid roof coverings, used as internal and external wall finishes and used as external ceiling finishes. In these end uses, slates are fixed to timber battens or metal profiles with mechanical devices in a pattern of double or single overlapping. The side of the slates directed away from the fire is in contact with a ventilated cavity which is closed by either a rigid or flexible underlayer or a structural wall or ceiling construction.

###### 7.5.2.2.2.2 Test specimen

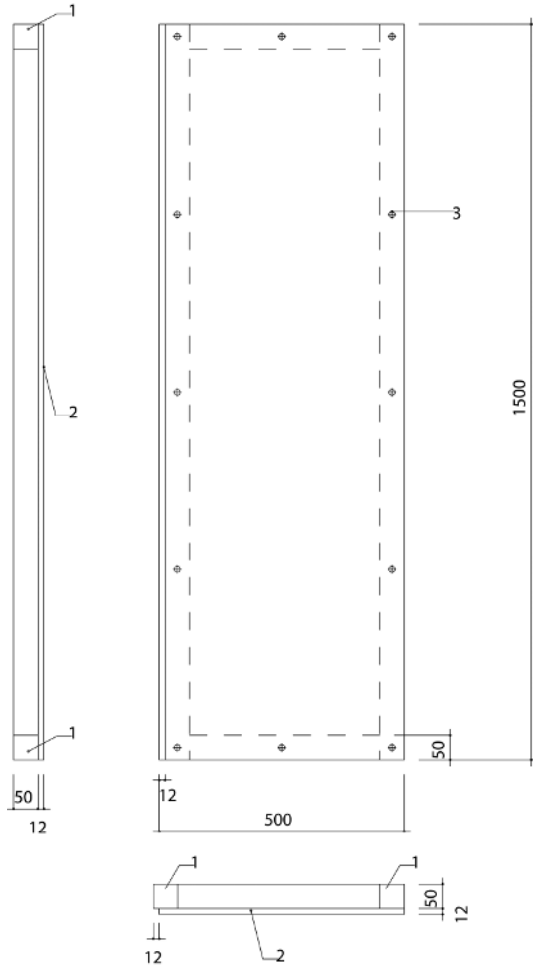
Products used for the construction of the test assembly are fibre cement slates with standard dimensions of length, width and thickness. They are cut to size to accommodate the dimensions of the test assembly. They include all facings and/or coatings that are normally applied to the product as it is placed on the market.

###### 7.5.2.2.2.3 Test assembly

###### 7.5.2.2.2.3.1 Dimensions

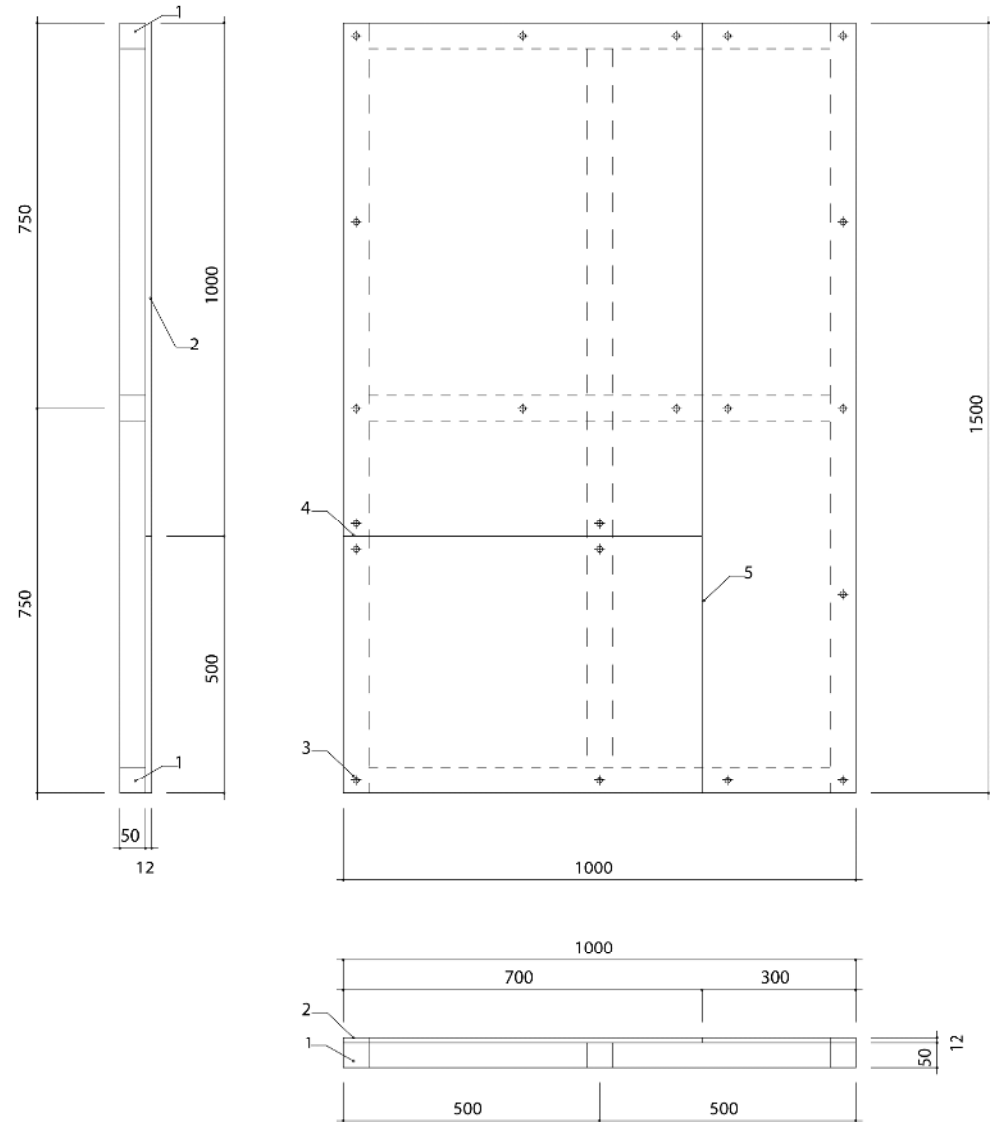
The test assembly is a corner set up made of two timber frame supporting constructions each, with a height of 1,5 m. One frame forms a long wing (1,0 m); the other frame forms a short wing (0,5 m). Further information is given in Figures 4, 5, 6 and 7.

Dimensions in millimetres; tolerances: 2 %, unless otherwise specified in text



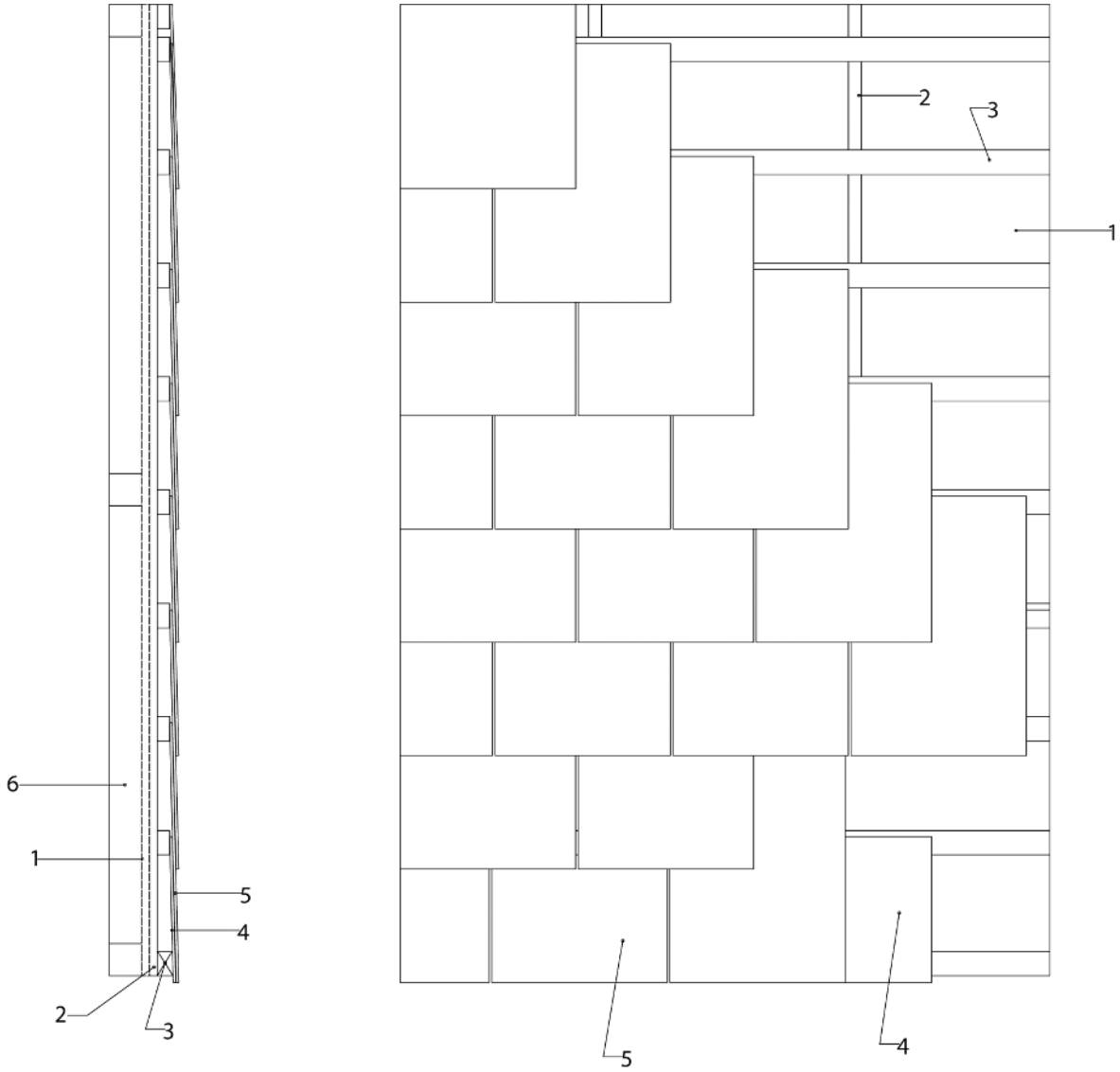

**Key**
1 timber member (50 ± 1) mm × (50 ± 1) mm
2 substrate (non-FR treated particle board), thickness (12 ± 1) mm
3 nail

**Figure 4 — Timber frame and substrate short wing**



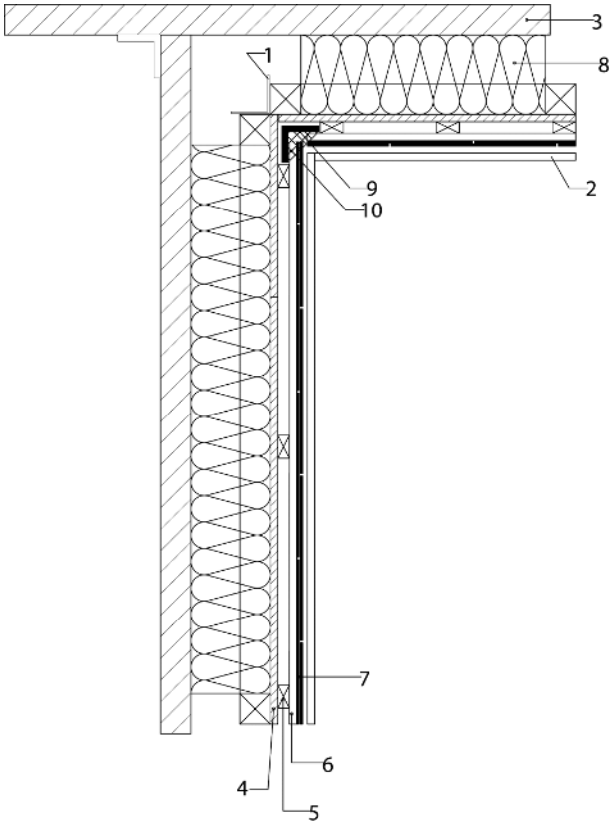

**Key**
1 timber member (50 ± 1) mm × (50 ± 1) mm
2 substrate (non-FR treated particle board), thickness (12 ± 1) mm
3 nail
4 horizontal joint
5 vertical joint

**Figure 5 — Timber frame and substrate long wing**




**Key**
1 substrate (non-FR treated particle board), thickness (12 ± 1) mm
2 timber counter batten (20 ± 1) mm
3 timber batten (19 ± 1) mm × (38 ± 1) mm
4 under eave slates
5 slate for testing, e.g. rectangular, hook-fixing, double covering
6 timber frame

**Figure 6 — Product fixing to long and short wing**




**Key**

1 metal bracket or profile for connecting both frames
2 U-channel
3 backing sheet
4 substrate
5 timber counter batten
6 tile laths
7 slates for testing
8 mineral wool filling space between substrate and backing sheet
9 metal angle
10 compressed high temperature ceramic fibre blanket

**Figure 7 — Corner set-up**

#### 7.5.2.2.2.3.2 Supporting construction, substrate and thermal insulation

Both long and short wing frames are made out of timber, (50 ± 1) mm × (50 ± 1) mm, or larger available standard section sizes for vertical and horizontal members, providing sufficient stability for the frames is obtained. They are nailed or screwed together. A substrate is fixed to these frames which is representative for a normal underlayer or wall construction.

For the standardized mounting and fixing of fibre cement slates, a non-FR-treated particle board for internal use (see EN 312) is used with a nominal density of (680 ± 50) kg/m³, a nominal thickness of (12 ± 2) mm and class D in accordance with EN 13501-1. The substrate shall have the dimensions of the frame. It is installed with a cold butted vertical and horizontal joint in it and it is fixed with nails to the supporting construction. The joints shall be at the locations as indicated in Figure 5.

When mounted into the test rig the space between the test rig backing board and the substrate shall be filled with mineral wool insulation with a nominal density of (70 ± 20) kg/m³ and class A2-s1,d0 according to EN 13501-1.

A 80 mm x 80 mm x 2 mm (maximum dimensions) metal angle shall be put in front of the timber counter battens and behind the timber battens and the slates to close the open joint between the two frames (see Figure 7).

#### 7.5.2.2.2.3.3 Timber battens and fixing of the slates

To the non-FR-treated particle board substrate, a number of vertical untreated counter battens are nailed with a thickness of (20 ± 1) mm. To these battens, horizontal laths (untreated tile laths) are nailed. Dimensions of the tile laths are (19 ± 1) mm × (38 ± 1) mm. The distance between the tile laths depends on the slate format that is to be tested. In this way, the thickness of the air layer behind the slates is (39 ± 2) mm.

The fibre cement slates are fixed with copper hooks or nails depending on the normal fixing of the slate and are laid in a pattern of overlapping which is normal for the type of slate that is to be tested.

#### 7.5.2.2.2.3.4 Product orientation

For all end use applications, the testing is performed in vertical position. Products with identical surface finishes on both sides have to be tested at one side only. Products with different surface finishes or coatings on different sides shall be tested on both sides or with the side representative for the worst performance directed to the fire. The worst performance is normally obtained with the side having the finish with the highest organic content per m² surface or with the side with the darkest colour. The side with the highest organic content shall be derived from the composition of the different finishing layers or by determining their PCS value according to EN ISO 1716, taking account of the respective applied dry weights of the finishing layers.

In case both sides are tested, the classification of the side with the worst performance can be used for the classification of the product, or the classification of each of the sides can be declared separately. In case only one side is tested, the classification of that side can be used for the classification of the product.

#### 7.5.2.2.2.3.5 Product direction

The product shall be mounted such that the line corresponding to the roof pitch or the vertical wall line is directed vertically in the test specimen.

#### 7.5.2.2.2.3.6 Joints/overlaps

The fibre cement slates are laid in a pattern of overlapping which is normal for the type of slate that is to be tested. The sizes of the overlaps are as in practice. At the bottom of the frames behind the first row of slates, a row of so called under eave slates is used as in practice. They are cut from the same product.

### 7.5.2.2.2.4 Number of tests

#### 7.5.2.2.2.4.1 Preliminary tests

Perform one test using slates with the largest surface area and then perform the next test using slates with the smallest surface area. Decide which case gives the worst test results. This worst case is then tested for classification and is the basis for the classification of the whole product range.

#### 7.5.2.2.2.4.2 Classification tests

Three valid tests are required for classification. The products used for the construction of the three test assemblies are taken from standard production lots. The normal manufacturing tolerances apply.

NOTE This is for example the case for the overall thickness and thickness of finishes or coating layers.

#### 7.5.2.2.2.5 Field of application for the obtained classification

The classification is based on the results of testing of three assemblies of the same product subject to the normal manufacturing tolerances. The classification therefore applies to fibre cement slates of the same mix formulation[1)] for the base sheet, with the same dimensions, the same thickness, the same density and with the same facing or coating thickness as used for the test and within a range determined by the normal manufacturing tolerances.

The classification also applies to fibre cement slates:

— of the same format or type (e.g. rectangular), but with different dimensions (e.g. length and width) as long as the classification is based on the worst performance when testing the largest and the smallest surface area slate (see 7.5.2.2.2.4); different formats or types such as diamonds or curved shapes require separate testing;

— of the same format, but with different overlapping lengths;

— of the same format, but with corner cuts;

— with a thickness equal to or greater than that used for the test;

— with a different surface texture (smooth or embossed);

— with a density, determined in accordance with 5.3.2, within a range of ± 0,15 g/cm³ of the density used in the test;

— with a double overlapping pattern when testing was performed with a single overlapping pattern;

— fixed with all other types of mechanical devices such as metal (excluding aluminium) nails, screws or hooks at slightly different locations when testing was performed with copper fixings;

— with nails or nail and hook fixing when testing was performed with hook fixing;

— used in combination with a different substrate (e.g. an underlayer of rigid or flexible sheets or a wall or ceiling construction) as long as the substrate has a reaction to fire class D or better in accordance with EN 13501-1;

— used in combination with a substrate of different density and/or thicknesses as long as it remains of at least class D;

— with a substrate normally laid with overlapping horizontal and vertical joints or interlocking joints;

— without thermal insulation behind the substrate or with other types of class A2-s1,d0 according to EN 13501-1 insulation materials;

— in vertical wall finishes, in ceiling finishes and in pitched roofs with pitches ranging from 5° up to 65°;

— without finishes or with different finishes or coatings (e.g. different colours) as long as the test was performed considering the worst case as explained in 7.5.2.2.2.3.4 and 7.5.2.2.2.4;

— fixed to timber or metal structures (where the timber is the worst case for classification of the product).

Fibre cement slate fittings are generally not flat and cannot be tested in the Single Burning Item test following the prescriptions of EN 13823. However, as these fittings are made of the same composition and with the

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[1)] Mix formulation is the type formula and does not include differences such as raw material variations.

same finishes as the slates they are used with, they shall be given the same classification as the one obtained for the slates.

## 8 Marking, labelling and packaging

The packaging of fibre-cement slates and fittings shall be marked with at least the following:

a) manufacturer's identification;

b) number of this European Standard;

c) size and/or name (for fibre-cement slates only);

d) date of manufacture;

e) "NT";

f) trade name.

A minimum of 15 % of the fibre-cement slates in each delivered unit shall be durably marked with at least items a), d) e) and f) from the above list, and a minimum of 50 % of fittings with a), e) and f).

Where ZA.3 covers the same requirements as this clause, the requirements of this clause should be met.

# Annex A
(normative)

# Consignment inspection sampling

When tenders and/or orders specify it, the acceptance sampling shall be carried out in lot(s) of the consignment in accordance with the test programme of this product standard, unless there is a special agreement. Therefore, the test programme necessarily covers the characteristics as specified in Table 2.

Details related to the application of the sampling clause shall be established.

After agreement on the sampling procedure, sampling shall be carried out in the presence of the parties. Unless otherwise agreed, the maximum and minimum inspection lots shall be 20 000 and 3 000 fibre-cement slates and 1 500 and 200 fittings respectively for all sizes.

The tests shall be carried out by the laboratory of the manufacturer or by an independent laboratory selected by mutual agreement. In case of dispute, the tests shall be carried out in the presence of both parties.

When non-destructive tests are carried out and the result of the sampling inspection does not meet the acceptance tests requirements of this standard, the tests shall be required on each item of the consignment. The units of the consignment which do not meet the requirements when tested one by one can be refused and disposed of, unless otherwise agreed.

# Annex B
(normative)

# Statistical method for determining the corresponding wet values or revised dry specifications for the bending moment when carrying out the dry method of test for quality control purposes

## B.1 Procedure

Sample at least twenty slates. Cut them into paired specimens for the bending moment test described in 7.3.2.

Both specimens of a pair shall be cut from the same slate and each given the same number.

Test one set of specimens wet and one set of specimens dry for bending test in accordance with 7.3.2.

From the paired results, determine whether there is a correlation between them at the 97,5 % confidence level using the method in B.2.

If there is no significant correlation then dry testing cannot be used. If the correlation is positive then continue as follows:

a) determine the regression line using the method described in B.3;

b) determine either of the following:

— a wet value for each specimen from the obtained dry value, using the method described in B.4;

— a revised minimum value to be used as the specification for dry testing corresponding to the appropriate minimum value for wet testing as specified in this standard using the method described in B.5.

## B.2 Determination of the correlation between the results of testing wet and dry specimens

Calculate the coefficient of correlation between wet and dry values from the following formula:

$$r = \frac{\sum_{1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\left\{ \sum_{1}^{n} (x_i - \bar{x})^2 \sum_{1}^{n} (y_i - \bar{y})^2 \right\}^{1/2}} \qquad \text{(B.1)}$$

where

$n$ is the number of paired specimens;

$x_i$ is the individual value of the $i^{th}$ specimen tested dry;

$y_i$ is the individual value of the $i^{th}$ specimen tested wet;

$\bar{x}$ is the mean of the values of $x_i$ for i = 1 to $n$;

$\bar{y}$ is the mean of the values of $y_i$ for i = 1 to $n$.

Calculate the value of *t* from the following formula:

$$t = \left| \frac{r}{\sqrt{1 - r^2}} \right| \sqrt{n - 2} \tag{B.2}$$

Compare *t* to the Student's coefficient $t_{0,025/n-2}$.

If $t > t_{0,025/n-2}$, then there is a significant relationship between the results of wet and dry testing and the regression line is straight. Dry testing can be carried out for quality control purposes:

— when $n = 20$, then $t_{0,025/n-2} = 2,101$;

— for $n > 20$, refer to Student's *t* tables.

## B.3 Determination of the regression line

The equation of the regression line is:

$y = a + bx$

Calculate the values of *a* and *b* from the following formulae:

$$b = \frac{\sum_1^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_1^n (x_i - \bar{x})^2} \tag{B.3}$$

$$a = \bar{y} - b\bar{x} \tag{B.4}$$

A plot of the regression line is shown in Figure B.1.

## B.4 Determination of a value for wet testing from an obtained value for dry testing

Calculate the residual standard deviation (also called the standard error of the estimate) from the following formula:

$$s = \sqrt{\frac{\sum_1^n (y_i - a - bx_i)^2}{n - 2}} \tag{B.5}$$

Calculate the value for wet testing from the following formula using the obtained dry value $x_O$:

$$y_o = (a + bx_o) - s\, t_{0,025/n-2} \sqrt{\frac{n+1}{n} + \frac{\left(x_0 - \bar{x}\right)^2}{\sum_1^n \left(x_i - \bar{x}\right)^2}} \qquad \text{(B.6)}$$

where

$x_o$ is the actual result obtained when dry testing;

$y_o$ is the value calculated from $x_o$ which is the estimate at the lower 97,5 % confidence level of the value expected from wet testing:

— when $n = 20$, then $t_{0,025/n-2} = 2{,}101$;

— for $n > 20$, refer to Student's $t$ tables.

For routine quality control testing, individual values of $y_o$ can be calculated each time or alternatively by substituting a suitable range of values for $x_o$ in Formula (B.6) a plot of $x_o$, $y_o$ can be made (see Figure B.1) from which future values can be read.

## B.5 Determination of the minimum value specified for dry testing $x_{std}$ corresponding to the minimum value specified for wet testing in this standard $y_{std}$

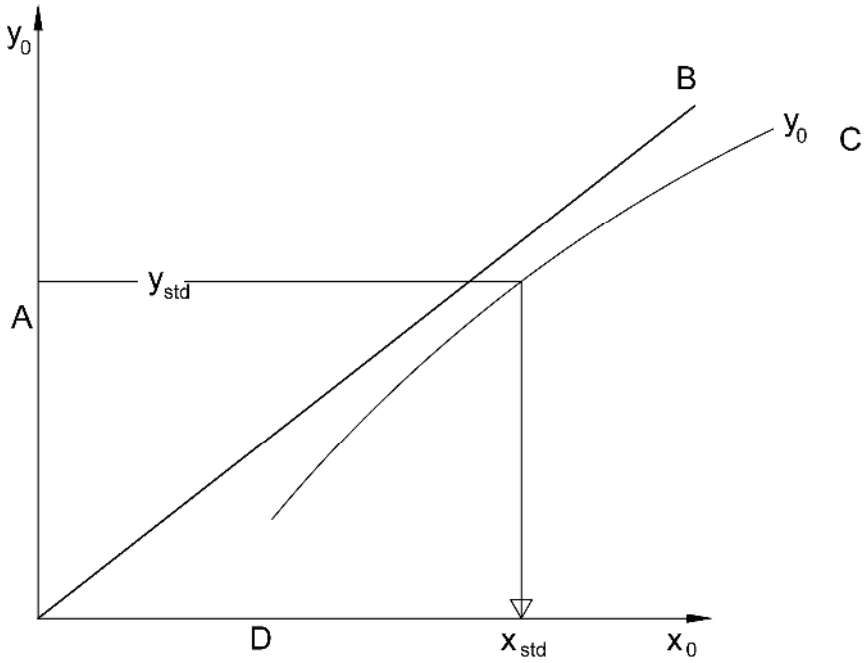
Plot the line for $y_o$, $x_o$ by substituting a suitable range of values for $x_o$ in Formula (B.6).

Read the value for $x_{std}$ corresponding to the value for $y_{std}$ from the graph (see Figure B.1),

where

$y_{std}$ is the minimum value specified in the standard for wet testing;

$x_{std}$ is the minimum value to be specified for dry testing calculated from $y_{std}$ at the 97,5 % lower confidence level.




**Key**
A wet values
B regression line
C (from Formula (B.6))
D dry values

**Figure B.1 – Regression line for wet/dry values with lower confidence level**

# Annex C
(informative)

# Examples

## C.1 Examples of dimension *h*

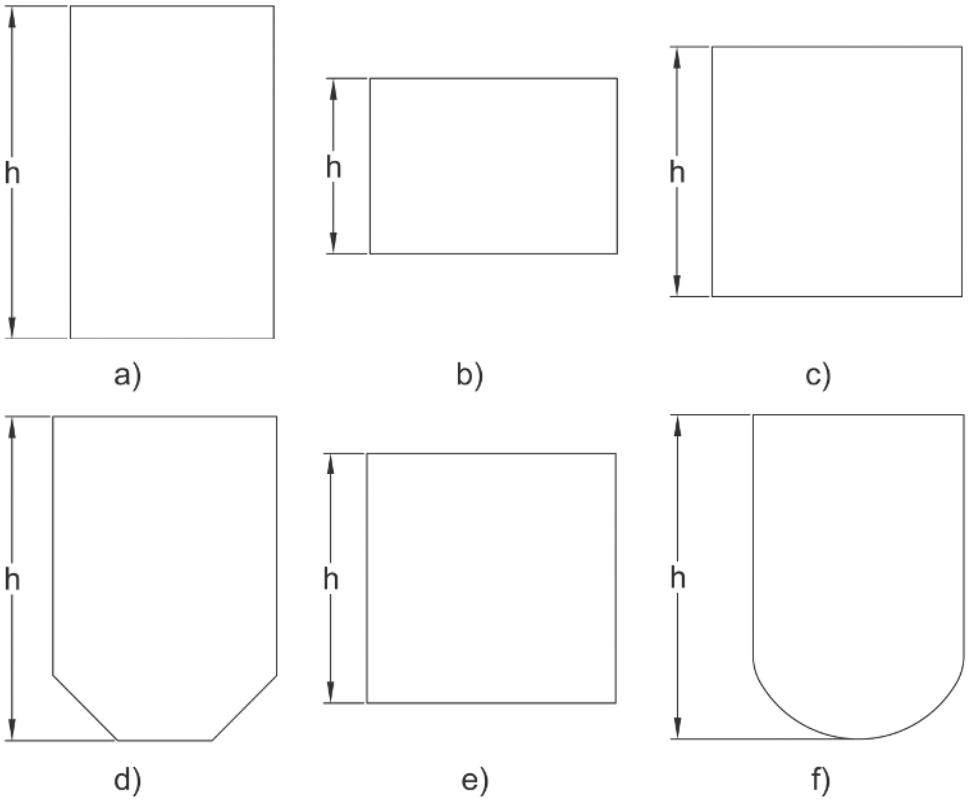



**Figure C.1 — Examples of dimension *h***

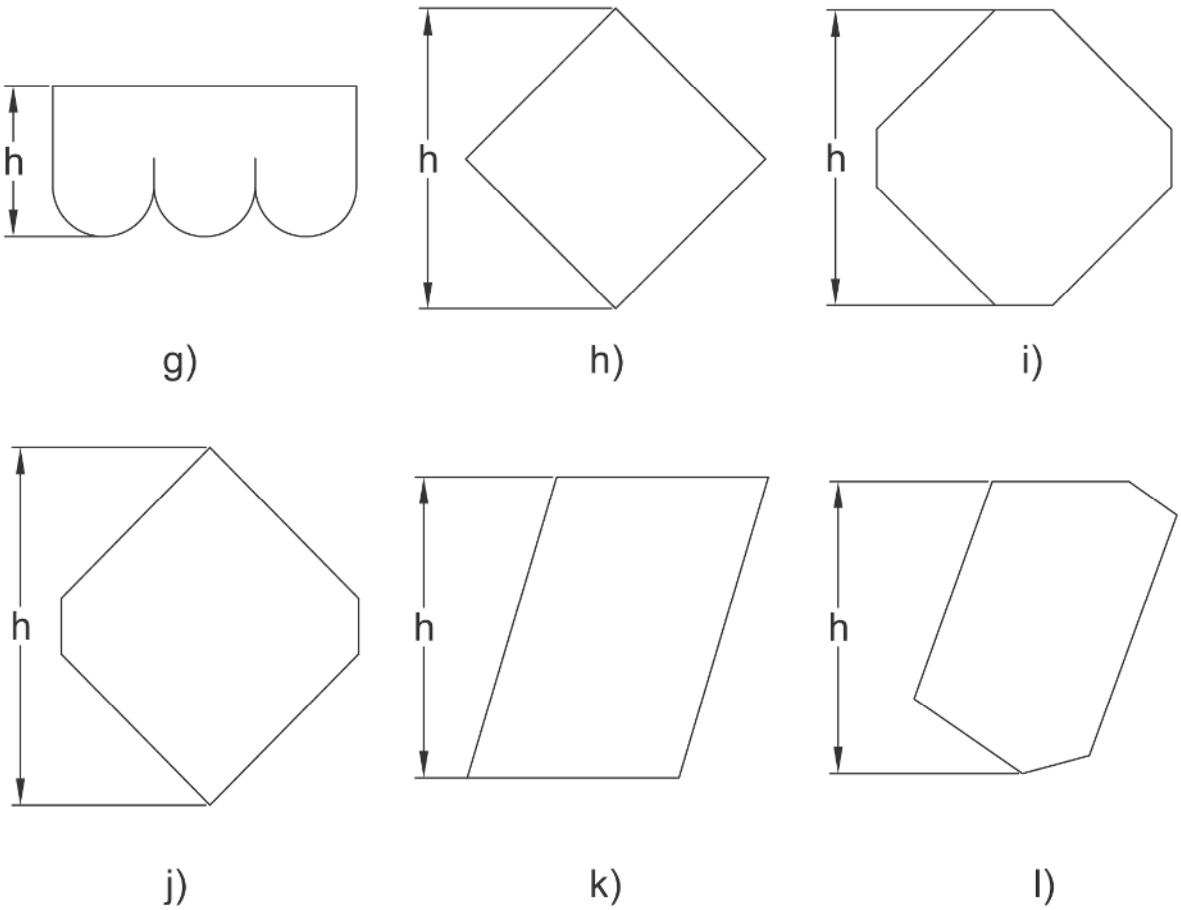



**Figure C.1 — Examples of dimension *h (continued)***

## C.2 Examples of fibre-cement slates installed showing lines of fixing

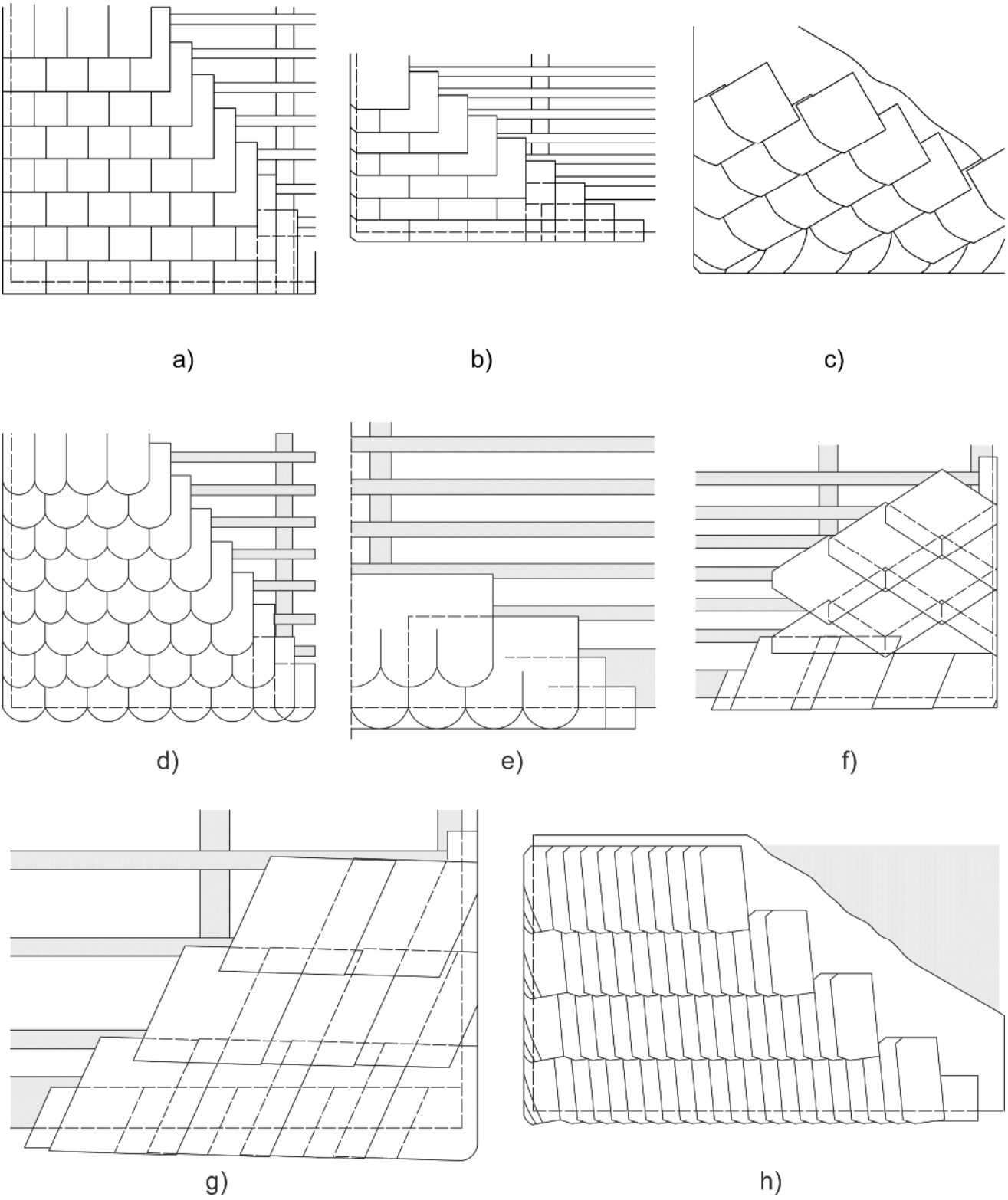



**Figure C.2 — Examples of fibre-cement slates installed showing lines of fixing**

# Annex D
(normative)

# Requirements of Decision 2001/671/EC regarding the external fire performance of roof coverings expressed following the classes defined in EN 13501-5

If tested to one or more of the methods in CEN/TS 1187, products shall be classified according to the appropriate class(es) of Table D.1.

The classifications according to the three test methods are identified as follows:

CEN/TS 1187:2012 test 1 : $X_{ROOF}$ (t1), where t1 = Burning brand alone;

CEN/TS 1187:2012 test 2 : $X_{ROOF}$ (t2), where t2 = Burning brand + Wind;

CEN/TS 1187:2012 test 3 : $X_{ROOF}$ (t3), where t3 = Burning brand + Wind + Radiation.

**Table D.1 — Classes of external fire performance for roofs/roof coverings**

| Test method | Class[a] | Classification criteria |
|---|---|---|
| CEN/TS 1187:2012 Test 1 | $B_{ROOF}$ (t1) | All the following conditions shall be satisfied:<br>- external and internal fire spread upwards < 0,700 m;<br>- external and internal fire spread downwards < 0,600 m;<br>- maximum burned length external and internal < 0,800 m;<br>- no burning material (droplets or debris) falling from exposed side;<br>- no burning/glowing particles penetrating the roof construction;<br>- no single through opening > 2,5 x $10^{-5}$ $m^2$;<br>- sum of all through openings < 4,5 x $10^{-3}$ $m^2$;<br>- lateral fire spread does not reach the edges of the measurement zone;<br>- no internal glowing combustion;<br>- maximum radius of fire spread on 'horizontal' roofs, external and internal < 0,200 m. |
| | $F_{ROOF}$ (t1) | No performance determined |
| CEN/TS 1187:2012 Test 2 | $B_{ROOF}$ (t2) | For both test series at 2 m/s and 4 m/s wind speed:<br>- mean damaged length of the roofing and underlay ≤ 0,550 m;<br>- maximum damaged length of the roofing and underlay ≤ 0,800 m. |
| | $F_{ROOF}$ (t2) | No performance determined |
| CEN/TS 1187:2012 Test 3 | $B_{ROOF}$ (t3) | $T_E \geq 30$ min and $T_P \geq 30$ min |
| | $C_{ROOF}$ (t3) | $T_E \geq 10$ min and $T_P \geq 15$ min |
| | $D_{ROOF}$ (t3) | $T_P > 5$ min |
| | $F_{ROOF}$ (t3) | No performance determined |
| NOTE $T_E$: critical external fire spread time: $T_P$: critical time to fire penetration. | | |
| [a] The number of classes is still under review and can be amended as soon as the necessary information is available. See EN 13501-5. | | |

# Annex ZA
(informative)

# Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

## ZA.1 Scope and relevant characteristics

This European Standard has been prepared under Mandates M/121 "Internal and external wall and ceiling finishes" and M/122 "Roof coverings, rooflights, roof windows and ancillary products" given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard shown in this annex meet the requirements of the mandates given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the Fibre cement slates and fittings covered by this European Standard for their intended use.

**WARNING — Other requirements and other EU Directives, not affecting the fitness for intended use may be applicable to Fibre cement slates and fittings falling within the scope of this standard.**

NOTE 1 In addition to any specific clauses relating to dangerous substances contained in this standard, there might be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (accessed through: http://ec.europa.eu/enterprise/construction/cpd-ds/).

This annex establishes the conditions for the CE marking of the Fibre cement slates and fittings intended for the uses indicated in Tables ZA.1.1 to ZA.1.2 and shows the relevant clauses applicable.

This annex has the same scope as the relevant part in Clause 1 of this standard related to the aspect covered by the mandate and is defined by Tables ZA.1.1 to ZA.1.2

**Table ZA.1.1 — Relevant clauses for roof coverings**

| **Construction product:** | Fibre cement slates and fittings | | |
|---|---|---|---|
| **Intended use (1):** | Discontinuously laid roof coverings for building | | |
| **Essential characteristics** | **Clauses in this European Standard** | **Mandated levels and/or classes** | **Notes** |
| Mechanical resistance | 5.3.3 | - | Does not apply to fittings |
| External fire performance | 5.5.1 | See Annex D | Does not apply to fittings |
| Reaction to fire | 5.5.2 | A1 to F | |
| Water permeability | 5.3.4 | - | Does not apply to fittings |
| Dimensional variations | 5.2.3 | - | |
| Release of dangerous substance | 5.5.3 | - | |
| Durability against warm water | 5.4.4 | - | Does not apply to fittings |
| Durability against soak/dry | 5.4.5 | - | Does not apply to fittings |
| Durability against freeze-thaw | 5.4.2 | - | Does not apply to fittings |
| Durability against heat-rain | 5.4.3 | - | Does not apply to fittings |

**Table ZA.1.2 — Relevant clauses for internal and external wall and ceiling finishes**

| **Construction product:** | Fibre cement slates and fittings | | |
|---|---|---|---|
| **Intended use (2):** | Internal and external wall and ceiling finishes | | |
| **Essential characteristics** | **Clauses in this European Standard** | **Mandated levels and/or classes** | **Notes** |
| Reaction to fire | 5.5.2 | A1 to F | - |
| Water permeability | 5.3.4 | - | Does not apply to fittings |
| Release of dangerous substance | 5.5.3 | - | - |
| Durability against warm water | 5.4.4 | - | Does not apply to fittings |
| Durability against soak/dry | 5.4.5 | - | Does not apply to fittings |
| Durability against freeze-thaw | 5.4.2 | - | Does not apply to fittings. Does not apply to products for internal use |
| Durability against heat-rain | 5.4.3 | - | Does not apply to products for internal use<br>Does not apply to fittings |

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these MSs are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option "No performance determined" (NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

## ZA.2 Procedure for the attestation of conformity of fibre cement slates and fittings

### ZA.2.1 Systems of attestation of conformity

The systems of attestation of conformity of fibre cement slates indicated in:

— Tables ZA.1.1 in accordance with the Decision of the Commission 98/436/EC of 1998-06-22 (*see OJEU L194 of 1998-07-10*), as corrected (*see OJEU L278 of 1998-10-15*) and amended by 2001/596/EC of 2001-01-08 (*see OJEU L209 of 2001-08-02*), as given in Annex III of the mandate M122 for "Roof coverings, roof lights, roof windows and ancillary products",

— Tables ZA.1.2, in accordance with the Decision of the Commission 98/437/EC of 1998-06-30 (*see OJEU L194 of 1998-07-10*), as corrected (*see OJEU L278 of 1998-10-15*) and amended by 2001/596/EC of 2001-01-08 (*see OJEU L209 of 2001-08-02*) as given in Annex III of the mandate M121 for "Internal and external wall and ceiling finishes",

are shown in Table ZA.2 for the indicated intended uses and relevant levels or classes.

**Table ZA.2 — Systems of attestation of conformity**

| Products | Intended uses | Level(s) or class(es) | Attestation of conformity systems |
|---|---|---|---|
| Fibre cement slates and fittings | As roofing covering subject to reaction to fire regulations | A1*, A2*, B* and C*<br>A1**, A2**, B**, C**, D and E<br>(A1 to E)***, F | 1<br>3<br>4 |
| | As roof coverings subject to external fire performance regulations | See EN 13501-5<br>$F_{ROOF}$ | 3<br>4 |
| | As roof coverings subject to regulations on dangerous substances | – | 3 |
| | As roof coverings for all other uses | – | 4 |
| Fibre cement slates and fittings | As internal or external finishes in wall or ceilings subject to reaction to fire regulations | A1*, A2*, B* and C*<br>A1**, A2**, B**, C**, D and E<br>(A1 to E)***, F | 1<br>3<br>4 |
| | As internal or external finishes in walls or ceilings, as relevant, subject to regulations on dangerous substances | – | 3 |
| | As internal or external finishes in walls or ceilings for all other uses mentioned in the mandate | – | 4 |

* Products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material).

** Products/materials not covered by footnote (*).

*** Products/materials that do not require to be tested for reaction to fire (e.g. products/materials of Class A1 according to Commission Decision 96/603/EC).

System 1: See Directive 89/106/EEC (CPD) Annex III.2.(i), without audit testing of samples.

System 3: See Directive 89/106/EEC (CPD) Annex III.2.(ii), Second possibility.

System 4: See Directive 89/106/EEC (CPD) Annex III.2.(ii), Third possibility.

NOTE For the external fire performance, Class $F_{ROOF}$ is defined as no performance determined.

The attestation of conformity of the fibre cement slates and fittings in Tables ZA.1.1 and ZA.1.2 shall be according to the evaluation of conformity procedures indicated in Table ZA.3.1 to ZA.3.3 resulting from the application of the clauses of this European Standard indicated therein.

**Table ZA.3.1 — Assignment of evaluation of conformity tasks for Fibre cement slates and fittings under system 1**

| Tasks | | Content of the task | Evaluation of conformity clauses to apply |
|---|---|---|---|
| Tasks under the responsibility of the manufacturer | Factory production control (FPC) | Parameters related to all characteristics of Table ZA.1.1 and/or ZA.1.2 relevant for the intended end use | 6.3 |
| | Initial type testing by a notified test laboratory | Release of dangerous substance and external fire performance, if relevant | 6.2 |
| | Initial type testing by the manufacturer | All characteristics of Table ZA.1.1 and/or ZA.1.2 relevant for the intended use except reaction to fire performance and release of dangerous substances, as relevant | 6.2 |
| | Further testing of samples taken at factory according to the prescribed test plan | Essential characteristics of Table ZA.1 relevant for the intended use which are declared | 6.3 |
| Tasks under the responsibility of the notified certification body | Initial type testing | Reaction to fire performance (Classes A1*, A2*, B*, C*)[a] | 6.2 |
| | Initial inspection of factory and of FPC | Parameters related to all characteristics of Table ZA.1.1 and/or ZA.1.2 relevant for the intended use, namely reaction to fire | 6.3 |
| | Continuous surveillance, assessment and approval of FPC | Parameters related to all characteristics of Table ZA.1.1 and/or ZA.1.2 relevant for the intended use, namely reaction to fire | 6.3 |

[a] See footnote (*) to Table ZA.2.

**Table ZA.3.2 — Assignment of evaluation of conformity tasks for Fibre cement slates and fittings under system 3**

| Tasks | | Content of the task | Evaluation of conformity clauses to apply |
|---|---|---|---|
| Tasks for the manufacturer | Factory production control (F.P.C) | Parameters related to all characteristics of Tables ZA.1.1 and/or ZA.1.2 relevant for the intended use | 6.3 |
| | Initial type testing by the manufacturer | All characteristics of Tables ZA.1.1 and/or ZA.1.2 relevant for the intended use, i.e. mechanical resistance, water permeability, dimensional variation and durability, other than those shown below | 6.2 |
| | Initial type testing by the notified lab | Reaction to fire (Classes A1**, A2**, B**, C**, D, E), external fire performance other than deemed to satisfy and dangerous substances | 6.2 |

**Table ZA.3.3 — Assignment of evaluation of conformity tasks for Fibre cement slates and fittings under system 4**

| Tasks | | Content of the task | Evaluation of conformity clauses to apply |
|---|---|---|---|
| Tasks for the manufacturer | Factory production control (F.P.C) | Parameters related to all characteristics of Tables ZA.1.1 and/or ZA.1.2 relevant for the intended use | 6.3 |
| | Initial type testing | All characteristics of Tables ZA.1.1 and/or ZA.1.2 relevant for the intended use, i.e. mechanical resistance, water permeability, dimensional variation and durability | 6.2 |

### ZA.2.2 EC Declaration of conformity

*(In case of products with system 1):* When compliance with the conditions of this annex is achieved, the certification body shall draw up a certificate of conformity (i.e. EC certificate of conformity), which entitles the manufacturer to affix the CE marking. The certificate shall include:

— name, address and identification number of the certification body;

— name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

NOTE 1 The manufacturer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use, etc.);

— provisions to which the product conforms (i.e. Annex ZA of this EN);

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions);

— the number of the certificate;

— conditions of validity of the certificate, where applicable;

— name of, and position held by, the person empowered to sign the certificate.

*(In case of products under system 3):* When compliance with the conditions of this annex is achieved, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity (EC Declaration of conformity), which entitles the manufacturer to affix the CE marking. This declaration shall include:

— name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

NOTE 2 The manufacturer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use, etc.) and a copy of the information accompanying the CE marking;

NOTE 3 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

— provisions to which the product conforms (i.e. Annex ZA of this EN);

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions);

— name and address of the notified laboratory(ies);

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorised representative.

*(In case of products under system 4):* When compliance with this annex is achieved, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity (EC Declaration of conformity), which entitles the manufacturer to affix the CE marking. This declaration shall include:

— name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

NOTE 4 The manufacturer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use, etc.) and a copy of the information accompanying the CE marking;

NOTE 5 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

— provisions to which the product conforms (i.e. Annex ZA of this EN);

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions);

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or of his authorised representative.

The above mentioned declaration shall be presented in the official language or languages of the Member State in which the product is to be used.

## ZA.3 CE marking

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EEC and shall be shown on the accompanying commercial documents (e.g. a delivery note). The following information shall accompany the CE marking symbol:

— name or identifying mark and registered address of the producer;

— the last two digits of the year in which the marking is affixed;

— reference to this European standard (EN 492) with date of version;

— description of the product, including generic name, material, and intended use;

— NT (see 5.1.1);

— size (e.g. width, height (h) and thickness);

— reaction to fire class (where relevant) or class F;

— external fire performance class(es) (where relevant), including description of the test assembly, or class $F_{roof}$.

The "No performance determined" (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination.

Figure ZA.1 gives an example of the information to be given on the commercial documents, for a slate intended to be used as a roofing product and internal or externally as a wall covering.

| | |
|---|---|
| CE | *CE marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.* |
| **AnyCo Ltd, PO Box 21, B-1050**<br><br>**12** | *Name or identifying mark and registered address of the producer*<br><br>*Last two digits of the year in which the marking was affixed* |
| **EN 492 : 2012**<br><br>Fibre cement slate for roofing and internal and external wall covering<br>**NT**<br>Width 300 mm, Height 500 mm, Thickness 4 mm<br>Reaction to fire A1<br>External fire performance Deemed to satisfy<br>Dangerous substances NPD | *No. of European Standard with date of version*<br>*Description of product*<br><br>*Information on Essential Characteristics* |

**Figure ZA.1 — Example CE marking information**

In addition to any specific information relating to dangerous substances shown above, the component should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE 1 European legislation without national derogations need not be mentioned.

NOTE 2 Affixing the CE marking symbol means, if a product is subject to more than one directive, that it complies with all applicable directives.

# Bibliography

[1] EN ISO 9001, *Quality management systems — Requirements (ISO 9001)*

[2] EN 312, *Particleboards — Specifications*

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