INTERNATIONAL STANDARD

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Fibre-cement slates and fittings

Ardoises et leurs accessoires en fibres-ciment

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Annexes

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

International Standard ISO 9125 was prepared by Technical Committee ISO/TC 77, *Products in fibre reinforced cement*.

Annex A forms an integral part of this International Standard. Annex B is for information only.

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Fibre-cement slates and fittings

1 Scope

This International Standard specifies the characteristics and establishes methods of control and test as well as acceptance conditions for fibre-cement slates and their fittings, for use mainly as roofing and cladding materials, which are not covered by ISO 395.

It applies to slates of dimensions not exceeding 600 mm × 600 mm.[1)]

2 Normative references

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

ISO 390:1977, *Asbestos-cement products — Sampling and inspection.*

ISO 395:1983, *Asbestos-cement slates.*

ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval.*

3 Slates

3.1 Composition

Fibre-cement slates consist essentially of an inorganic hydraulic binder[2)] or a calcium silicate formed by a chemical reaction of a siliceous and a calcareous material, reinforced by organic fibres and/or inorganic synthetic fibres.

Process aids, fillers and pigments which are compatible with the fibre-cement may be added.

3.2 General appearance and finish

The exposed face of the slates may be smooth or textured. The slates may be coloured or left in their natural colour. The slates may also receive coloured or clear coatings that are compatible with the base material.

The slates may be supplied holed for fixing.

3.3 Characteristics

3.3.1 Geometrical characteristics

3.3.1.1 Shapes, sizes and edges

The preferred shapes, sizes and configuration of slate edges shall be specified in national standards.

3.3.1.2 Thicknesses

The average slate thickness, determined according to 3.4.3, shall not be less than that shown in table 1.

1) National standards may include slates with dimensions exceeding 600 mm. In this case, all tests with the exception of the heat-rain test should be carried out on elements cut from such slates. The heat-rain test should always be conducted on full size slates and the dimensions of the test rig should be adapted accordingly (see 3.5.4). Such larger elements may also be used as fittings.

2) National standards may specify the binder to be used.

Table 1

Dimensions in millimetres

Sizes of slates	Minimum slate thickness
Sizes falling within the rectangle of 350 × 250	2,5
Sizes exceeding the rectangle of 350 × 250 and falling within the rectangle of 450 × 300	3
Sizes exceeding the rectangle of 450 × 300	3,5

The nominal thickness shall be specified by the manufacturer.

3.3.1.3 Tolerances on nominal dimensions

a) on length and width: ± 3 mm

b) on thickness: $^{+25}_{-10}$ %

3.3.2 Mechanical characteristics[3)]

When tested as specified in 3.4.4, the slates shall have a minimum bending moment according to table 2. This bending moment shall be the average of the values obtained from testing the test specimen in both directions.

Table 2

Sizes mm	Minimum bending moment, M_f N.m/m Category I	Category II
⩽ 350 × 250	10	18
between 350 × 250 and 450 × 300	14	25
> 450 × 300	20	33

Minimum values in the weaker direction shall not be less than 60 % of the value in table 2.

National standards may adopt only one category depending on the methods of installation (e.g. pitch, free span and overlap) and local conditions and/or regulations.

3.3.3 Physical characteristics[3)]

3.3.3.1 Water permeability

When tested as specified in 3.5.2, traces of moisture may appear on the underside of the slate, but in no instance shall there be any formation of drops of water.

3.3.3.2 Apparent density

The manufacturer shall specify the minimum apparent density of the slates. When tested as specified in 3.4.5, the slates shall have an apparent density equal to or greater than this value.

3.3.3.3 Frost resistance test

If local climatic conditions justify it or if national standards specify this test, the specimen shall comply with the following requirements.

When tested as specified in 3.5.3, any visible cracks, delamination or other defects in the slates shall not be of a degree such as to affect their performance in use.

3.3.3.4 Heat-rain

When tested as specified in 3.5.4, any visible cracks, delamination or other defects in the slates shall not be of a degree such as to affect their performance in use.

3.3.3.5 Warm water

When tested as specified in 3.5.5,

a) any visible cracks, delamination or other defects in the slates shall not be of a degree such as to affect their performance in use;

b) the finished product shall exhibit a ratio $\bar{r}$ as defined in 3.5.5.5 not less than 0,75.

3.4 Acceptance tests

3.4.1 General

The objective of an acceptance test is to establish whether a batch of products conforms to a specification. The tests are performed on samples drawn either from continuous production or from a consignment.

NOTE 1 Test methods and specification limit values are defined in this standard. Sampling levels and acceptance criteria are defined in ISO 390.

3) Mechanical and physical properties are normally determined on product as-delivered. The results are to be identified as applying to coated or uncoated material. Failure of the coating does not constitute failure of the product.

Acceptance tests as described in 3.4.2 to 3.4.5 shall be performed on slates as delivered.

Sampling and acceptance shall be conducted in accordance with ISO 390 which specifies an AQL of 4 %.[4)]

When a continuous series of lots is considered, the acceptable quality level (AQL), for the purposes of sampling inspection, is the limit of a satisfactory process average.[5)]

3.4.2 **Measurement of length and width** (obligatory)

The length and width shall be measured by suitable metal rulers capable of being read to 0,5 mm.

For each dimension take two measurements.

Take each reading to the nearest 0,5 mm.

Verify that each value is within the tolerance given in 3.3.1.3.

3.4.3 **Measurement of thickness** (obligatory)

The thickness shall be measured by means of a micrometer reading to 0,05 mm, having flat circular metal jaws of 10 mm diameter.

The arithmetic mean of four measurements taken at one point on each side of the slate shall be not less than the minimum provided for in table 1 and shall be within the tolerances fixed in 3.3.1.3.

3.4.4 **Bending test** (obligatory)

The test shall be carried out on full size slates or cut specimens. Before testing, they shall be immersed in water at ambient temperature (at least 5 °C) for 24 h (except for slates of category 1 where the time of immersion shall be reduced to 2 h) and tested immediately after removal from the water.

3.4.4.1 Apparatus

3.4.4.1.1 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) comprising:

a) **Two rigid parallel supports** set in the same horizontal plane and longer than the sample width. The upper face of each support shall be rounded with a radius between 3 mm and 25 mm. The distance between the supports shall be 200 mm provided the sample is large enough. For smaller samples the distance between the supports can be reduced but shall not be less than 18 times the nominal thickness. The sample dimensions shall always exceed the distance between the supports by more than 20 mm.

b) **Loading bar** having the same radius as the support and located parallel and equidistant from them. It shall be attached to the driving mechanism by means of a flexible joint (see figure 1).

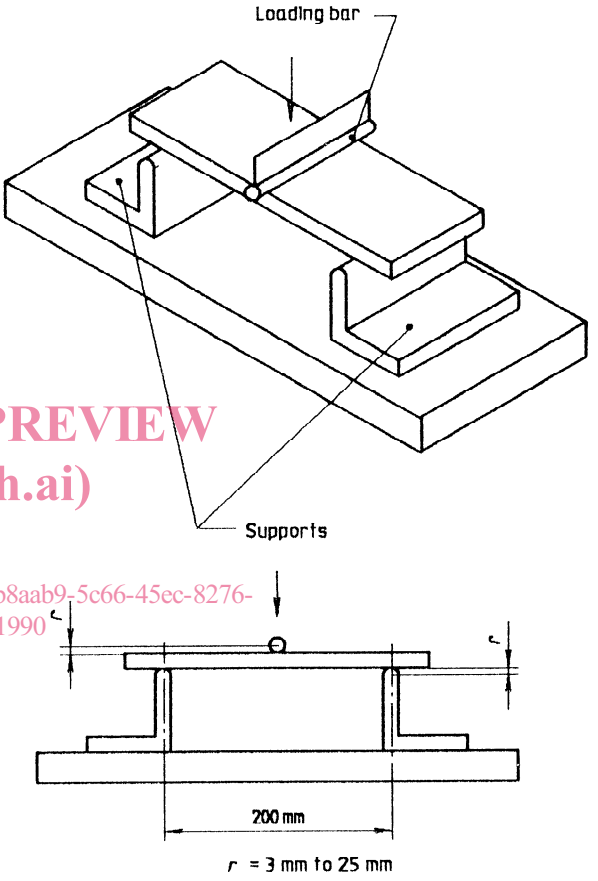

Figure 1

3.4.4.1.2 Micrometer, reading to 0,05 mm with flat metal jaws not less than 10 mm in diameter.

3.4.4.2 Procedure

Arrange the slate with the weatherface in compression and load the test piece along its centre line by means of the loading bar.

The speed of loading shall be regular and such that breakage occurs between 5 s and 30 s.

4) For the number of samples, see ISO 390.

5) A sampling scheme with an AQL of 4 % means that batches containing up to 4 % defective items have a high probability of acceptance.

For smooth-faced slates, measure the thickness at two points along the section of breakage as indicated in figure 2.

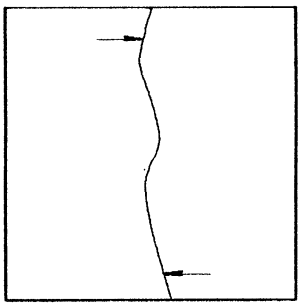

Figure 2

Reassemble the broken pieces.

Submit the reassembled slate to another bending test with the line of load application at right-angles to that of the first test.

For smooth-faced slates, measure the thickness of the slate at two points along the new section of breakage as indicated in figure 3.

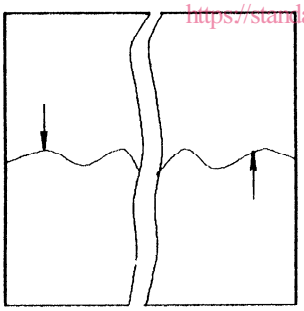

Figure 3

3.4.4.3 Expression of results

The bending moment at fracture, M_f, in newtons metre per metre is given by the formula

$$M_f = \frac{Pl}{4b}$$

where

P is the breaking load, in newtons;

l is the distance between the centres of the support, in millimetres;

b is the dimension of the slate (length or width) measured parallel to the support, in millimetres.

The bending moment M_f is the arithmetic average of the values obtained in each of the two directions on the same slate. The result of the test is considered to be satisfactory if it conforms with the requirements of 3.3.2.

3.4.5 Apparent density (obligatory)

3.4.5.1 Procedure

The test piece should preferably be a piece of the slate used for the bending test.

Determine the mass by drying out the test piece in an oven maintained at 100 °C to 105 °C until the difference between two consecutive weighings made at an interval of not less than 2 h is less than 0,2 % of the last value.

Determine the volume by immersion in water or some other method having an equivalent accuracy. In the case of immersion in water, the test piece shall be saturated in water beforehand.

3.4.5.2 Expression of results

The apparent density, ϱ, in grams per cubic centimetre, is given by the formula

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

where

m is the mass, in grams, of the test piece after drying;

V is the apparent volume, in cubic centimetres, of the test piece.

The result of the test piece is considered to be satisfactory if it conforms to the requirements of 3.3.3.2.

3.5 Type-tests

3.5.1 General

A type-test is concerned with the approval of a new product and/or a fundamental change in formulation and/or method of manufacture.

The test is performed on the as-delivered product.

The test is required to demonstrate conformity of a generic product to a specification but is not required for each production batch.

3.5.2 **Water permeability** (obligatory)

3.5.2.1 Preparation of specimens

The water permeability shall be checked on three slates. The specimens shall be kept in a laboratory atmosphere for at least 5 days at a temperature of 23 °C ± 5 °C.

3.5.2.2 Apparatus

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

3.5.2.3 Procedure

The vertical transparent tube is sealed to the middle of a test piece placed horizontally on a transparent container. The tube is filled with water and maintained at a height of about 50 mm, measured from the upper surface of the test piece, and the level is maintained constant. Place the specimens in a laboratory atmosphere at 23 °C ± 5 °C and 50 % ± 10 % relative humidity. The duration of the test shall be 24 h. The result of the test is considered to be satisfactory if it conforms to the requirements of 3.3.3.1.

3.5.3 **Freeze-thaw** (optional)

3.5.3.1 Preparation of specimens

Sample five slates as delivered by the producer.

3.5.3.2 Apparatus

3.5.3.2.1 Freezer unit having forced air circulation capable of cooling the air to a temperature of − 20 °C ± 2 °C within one to two hours with a full load of specimens.

3.5.3.2.2 Water-bath filled with water and maintained at 20 °C ± 2 °C.

3.5.3.3 Procedure

Immerse the specimens in water at ambient temperature ⩾ 5 °C until the difference between two consecutive weighings taken at 24 h intervals is less than 0,5 %. Then subject the specimens to 50 freeze-thaw cycles consisting of:

— cooling in air down to − 20 °C ± 2 °C within one to two hours and holding at this temperature for 1 h, and

— thawing in water to 20 °C ± 2 °C within one to two hours and holding in this condition for one hour. If essential, specimens can be held in this condition for 72 h.

Each freeze-thaw cycle shall take between 4 h and 6 h in total.

After the 50 cycles are complete the result of the test is considered as satisfactory if the slates satisfy the requirements of 3.3.3.3.

3.5.4 **Heat-rain** (obligatory)

3.5.4.1 Apparatus

The apparatus shall consist of any suitable construction with an inclined frame into which the slates shall be mounted and alternately heated uniformly by radiant heat and sprayed with water.

The total area of the slate to be tested shall be approximately square, from 1 m² to 3 m² depending on the slate size and shall contain not less than 11 full slates.

The inclination of the frame shall be 35° ± 10°.

The heating device shall be calibrated in order to maintain a uniform blackbody[6] surface temperature equal to 70 °C ± 5 °C during the heating period. It should provide an approximately uniform power output during this period.

3.5.4.2 Procedure

The test shall be carried out on full size slates as delivered. The test specimens shall be submitted to a preliminary conditioning as follows:

— immersion for 24 h in water at ambient temperature (⩾ 5 °C), and

— storage for 7 days in a laboratory atmosphere with separation to allow air circulation.

The slates shall be fixed according to national standards or codes or, in their absence, manufacturer's recommendations.

The specimens shall be fixed on the frame according to national regulations or, failing this, to the manufacturer's laying instructions.

The fixed slates shall be submitted to 25 test cycles of heat-rain, with each part of the cycle having the following duration:

— rain: 2 h 50 min

6) For the definition of a blackbody, see ASTM E 638-78, clause 4.4. For this test an aluminium plate of 1 mm thickness painted with mat black paint will be used as a blackbody.

The measurement device is a thermocouple or a similar device fixed on the surface of the aluminium plate.