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Fibre-cement siding shingles

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Contents

	Page
1 Scope	1
2 Normative references	1
3 Composition	1
4 General appearance and finish	1
5 Characteristics	1
5.1 Geometrical characteristics	1
5.2 Mechanical characteristics	2
5.3 Physical characteristics	2
6 Tests	2
6.1 Acceptance tests	2
6.2 Type-tests	5
7 Marking	6
8 Conformity with standards	6
8.1 Conformity with requirements	6
8.2 Evidence of conformity of consignment of finished products	6

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Annexes

A Receiving inspection for products which are not subject to third party certification	8
B Bibliography	9

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 9384 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 siding shingles

1 Scope

This International Standard specifies the characteristics and establishes methods of control and test as well as acceptance conditions for fibre-cement siding shingles, which are not covered by ISO 880.

It applies to shingles 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 880:1981, *Asbestos-cement siding shingles*.

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

3 Composition

Siding shingles are flat elements for external cladding, formed by overlapping or juxtaposition of these elements.

Fibre-cement shingles consist essentially of an inorganic hydraulic binder²⁾ 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.

4 General appearance and finish

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

The shingles may be supplied holed for fixing.

5 Characteristics

5.1 Geometrical characteristics

5.1.1 Thickness

The method of measuring thickness is specified in 6.1.3.

The nominal thickness shall be specified by the manufacturer.

5.1.2 Tolerances on nominal dimensions

a) on length and width: ± 3 mm

b) on thickness:

— smooth shingles: $\begin{matrix} +25 \\ -10 \end{matrix}$ %

— shingles with textured face: ± 25 %

1) National standards may include shingles 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 shingles. The heat-rain test should always be conducted on full-size shingles and the dimensions of the test rig should be adapted accordingly.

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

5.1.3 Straightness of sides (if applicable)

The straightness of sides shall be ± 2 mm on the absolute value on both length and width.

5.2 Mechanical characteristics³⁾

When tested as specified in 6.1.4, the shingles shall have a minimum modulus of rupture, R_f , at least equal to the values in table 1. This shall be the average of the values obtained from testing the test specimen in both directions.

Table 1

Category	Minimum modulus of rupture, R_f
	MPa
I	8
II	15

National standards may adopt only one category depending on local conditions and/or regulations.

5.3 Physical characteristics³⁾

5.3.1 Apparent density

The manufacturer shall specify the minimum apparent density of the shingles.

When tested as specified in 6.1.5, the shingles shall have an apparent density equal to or greater than this value.

5.3.2 Frost resistance test

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

When tested as specified in 6.2.2, any visible cracks, delamination or other defects in the shingles shall not be of a degree such as to affect their performance in use.

5.3.3 Heat-rain

When tested as specified in 6.2.3, any visible cracks, delamination or other defects in the shingles shall not be of a degree such as to affect their performance in use.

5.3.4 Warm water

When tested as specified in 6.2.4,

- a) any visible cracks, delamination or other defects in the shingles 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 6.2.4.5, greater than or equal to 0,75.

6 Tests

6.1 Acceptance tests

6.1.1 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.

Acceptance tests as described in 6.1.2 to 6.1.5 shall be performed on shingles 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⁾

6.1.2 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 5.1.2.

6.1.3 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.

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.

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.

The arithmetic mean of four measurements taken at one point on each side of the shingles shall be within the tolerances fixed in 5.1.2.

6.1.4 Bending test (obligatory)

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

6.1.4.1 Apparatus

6.1.4.1.1 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 (see figure 1):

- 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.
- 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).

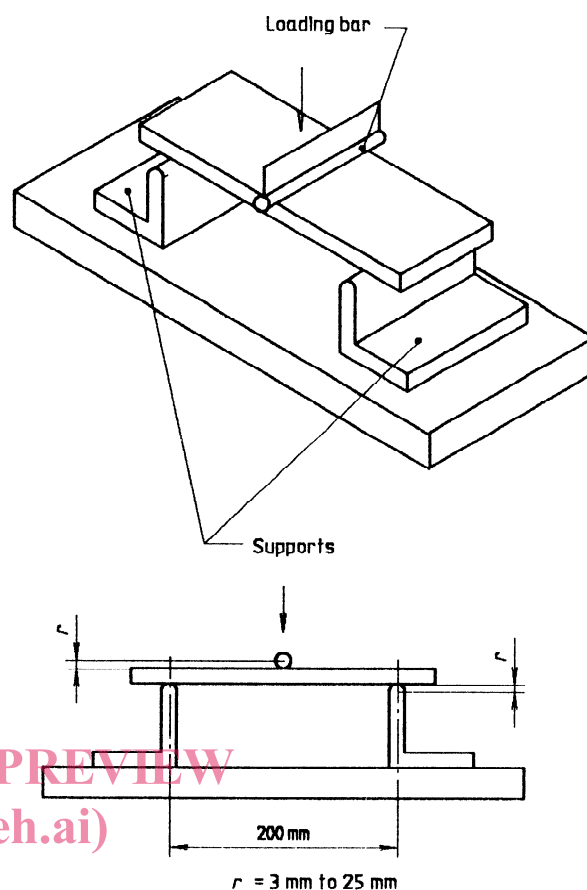


Figure 1

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

6.1.4.2 Procedure

Arrange the shingle with the weatherface in compression and load the test piece along its centreline by means of the loading bar.

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

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

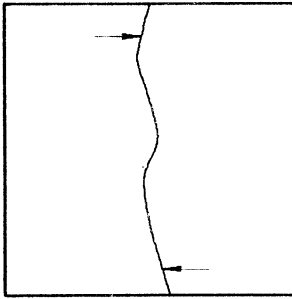


Figure 2

Reassemble the broken pieces.

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

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

For shingles with a textured face, see footnote 6).

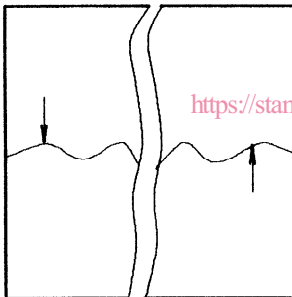


Figure 3

$$R_f = \frac{M}{W}$$

where

M is the bending moment, in newton metres, given by the formula

$$M = \frac{Pl}{4}$$

in which

P is the breaking load, in newtons;

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

W is the modulus of section, in cubic millimetres, given by the formula

$$W = \frac{be^2}{6}$$

where

e is the average value of the thickness of the shingle for smooth shingles (arithmetic mean of four measurements) measured along the breaking sections, in millimetres (see 6.1.4.2), and the nominal thickness for relief shingles⁶⁾,

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

The bending moment of rupture, R_f , is the arithmetic average of the values obtained in each of the two directions on the same shingle.

The result of the test is considered to be satisfactory if it conforms with the requirements of 5.2.

6.1.5 Apparent density (obligatory)

6.1.5.1 Procedure

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

6.1.4.3 Expression of results

The modulus of rupture, R_f , in megapascals, is given by the formula

6) The thickness of face-textured shingles, e , should be determined by measuring their volume using the hydrostatic method:

$$e = \frac{V}{S}$$

where

V is the volume, in cubic millimetres;

S is the area, in square millimetres, of the sample.

Other thickness measurement methods which can be correlated with this hydrostatic method are acceptable.

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.

6.1.5.2 Expression of results

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

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

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 5.3.1.

6.2 Type-tests

6.2.1 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.

6.2.2 Freeze-thaw (optional)

6.2.2.1 Preparation of specimens

Sample five shingles as delivered by the producer.

6.2.2.2 Apparatus

6.2.2.2.1 Freezer unit having forced air circulation capable of cooling the air to a temperature of $-20\text{ °C} \pm 2\text{ °C}$ within 1 h to 2 h with a full load of specimens.

6.2.2.2.2 Water-bath filled with water and maintained at $20\text{ °C} \pm 2\text{ °C}$.

6.2.2.3 Procedure

immerse the specimens in water at ambient temperature ($\geq 5\text{ °C}$) 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 $-20\text{ °C} \pm 2\text{ °C}$ within 1 h to 2 h and holding at this temperature for 1 h, and
- thawing in water to $20\text{ °C} \pm 2\text{ °C}$ within 1 h to 2 h and holding in this condition for 1 h. 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 have been completed, the result of the test is considered as satisfactory if the shingles satisfy the requirements of 5.3.2.

6.2.3 Heat-rain (obligatory)

6.2.3.1 Apparatus

The apparatus consists of any suitable construction with a vertical frame into which the shingles shall be mounted and alternately heated uniformly by radiant heat and sprayed with water.

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

The heating device shall be calibrated in order to maintain a uniform blackbody⁷⁾ surface temperature equal to $70\text{ °C} \pm 5\text{ °C}$ during the heating period. It should provide an approximately uniform power output during this period.

6.2.3.2 Procedure

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

- immersion for 24 h in water at ambient temperature ($\geq 5\text{ °C}$), and
- storage for 7 days in a laboratory atmosphere with separation to allow air circulation.

7) 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 matt 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.