INTERNATIONAL STANDARD

**ISO 8336**

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# Fibre-cement flat sheets

*Plaques planes en fibres-ciment*



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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 8336 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.

# Fibre-cement flat sheets

## 1 Scope

This International Standard specifies the characteristics and establishes methods of control and test as well as acceptance conditions for fibre-cement flat sheets.

It covers sheets intended for external applications such as cladding façades, curtain walls, soffits, lost casing, etc., and sheets intended for internal use such as partitions, floors, ceilings, etc., with a wide range of properties appropriate to the type of application. These sheets may have either a smooth or textured surface.

This International Standard does not apply to the following products:

a) boards of Portland or equivalent cement reinforced with fibrous wood particles;

b) non-combustible fibre-reinforced boards of calcium silicate or cement for insulation and fire protection;

c) gypsum plasterboard;

d) asbestos-cement flat sheets;

e) asbestos-cement slates and siding shingles;

f) fibre-cement slates and siding shingles.

## 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 390:1993, *Products in fibre-reinforced cement — Sampling and inspection.*

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

## 3 General composition

Fibre-cement flat sheets consist essentially of an inorganic hydraulic binder[1] or a calcium silicate binder formed by the chemical reaction of a siliceous material and a calcareous material reinforced by organic fibres and/or inorganic synthetic fibres.[2]

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

## 4 Classification

Flat sheets covered by this International Standard are divided into two types.

### 4.1 Type A

Type A sheets are intended for external applications where they may be subjected to the direct action of sun, rain and/or snow. They may be supplied coated

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

2) For the purposes of this International Standard, fibres include:

— discrete elements randomly dispersed,

— continuous strands or tapes,

— nets and webs.

or uncoated. Type A sheets shall comply with the requirements of the type-tests in clause 6.

The sheets are further classified into three categories according to their modulus of rupture.

The manufacturer shall declare the type and category of his product in his literature.

### 4.2 Type B

Type B sheets are not subjected to the type-tests and are intended for internal applications and external applications where they will not be subjected to the direct action of sun, rain and/or snow.

The sheets are further classified into five categories according to their modulus of rupture.

The manufacturer shall declare the type and category of his product in his literature.

NOTE 1 If sheets of type B are used in external applications where they are directly exposed to the weather but are protected (e.g. coating or impregnation), the weather resistance of the product is determined by the quality of the protection. Specification of this protection and methods for control and test are outside the scope of this International Standard.

## 5 Acceptance characteristics

### 5.1 Dimensional and geometrical characteristics

#### 5.1.1 Nominal length and width

**5.1.1.1** Flat fibre-cement sheets are normally available in nominal lengths up to 3 000 mm and nominal widths up to 1 250 mm. Sheets of greater nominal lengths and widths may be supplied.

**5.1.1.2** Preferred nominal dimensions for length and width may be specified in national standards taking into account that the dimensions of the sheets are determined largely by the purpose for which they are intended.

NOTE 2 The nominal dimensions (width and length) specified in national standards may be increased by 20 mm to 30 mm (oversize sheets) for application where the sheet is required to be cut by the user.

#### 5.1.2 Thickness

Flat fibre-cement sheets are normally available in thicknesses from 3 mm to 30 mm, although thicknesses outside this range may be supplied. Preferred thicknesses may be specified in national standards.

#### 5.1.3 Tolerances on dimensions

Tolerances on nominal dimensions are as follows:

a) on length and width (indicated by $d$):

$d \leqslant 1\,000$ mm: $\pm$ 5 mm

1 000 mm $< d \leqslant$ 1 600 mm: $\pm$ 0,5 %

$d >$ 1 600 mm: $\pm$ 8 mm

These tolerances do not apply to oversize sheets.

The measurement method is given in 8.1.1.2.

b) on thickness, $e$:

$e \leqslant 6$ mm: $\pm$ 0,6 mm

$e >$ 6 mm: $\pm$ 10 %

For sheets without texture on the exposed face the maximum difference between extreme values of the thickness measurements within one sheet shall not exceed 15 % of the maximum measured value.

The measurement method is given in 8.1.1.3.

NOTE 3 Tighter tolerances may be adopted by agreement between the manufacturer and the purchaser.

#### 5.1.4 Tolerances on shape

##### 5.1.4.1 Straightness of edges

The tolerance on the straightness of edges is 3 mm/m for the relevant dimension (length or width). The measurement method is given in 8.1.1.4.

##### 5.1.4.2 Squareness of edges

The tolerance on squareness of sheets is 4 mm/m. The measurement method is given in 8.1.1.5.

NOTE 4 Tighter tolerances may be adopted by agreement between the manufacturer and the purchaser.

### 5.2 Mechanical and physical characteristics

Where the product is supplied coated, the following mechanical and physical specifications apply to the coated (i.e. finished) product.[3)]

#### 5.2.1 Bending strength

When tested as specified in 8.1.2.1, the minimum modulus of rupture of the sheets, expressed in megapascals, shall be as specified in table 1. The modulus of rupture shall be the average of the values obtained from testing the samples in both directions.

3) When sampling from continuous production, testing of the base sheet prior to coating is acceptable where it can be shown that there is a correlation between the results of tests on sheets with and without the coating.

Type A sheet strengths shall only be specified in the wet condition and the specimens shall be tested in the wet condition.

Type B sheet strengths shall only be specified in the equilibrium condition and the specimens shall be tested in the equilibrium condition.[4)]

NOTE 5 If the manufacturer includes product strengths in his literature, it should be clearly stated whether they are mean or minimum values and they should be determined using the methods specified in 8.1.2.1. The minimum values are based on the same sampling and inspection procedures as for classification in table 1.

**Table 1 — Minimum modulus of rupture**

Values in megapascals

| Category | Minimum MOR | |
|---|---|---|
| | Type A sheets | Type B sheets |
| 1 | — | 4 |
| 2 | — | 7 |
| 3 | 7 | 10 |
| 4 | 13 | 16 |
| 5 | 18 | 22 |

### 5.2.2 Apparent density

The manufacturer shall specify in his literature the minimum apparent density for each category of sheet and when tested in accordance with the method specified in 8.1.2.2, the density shall be not less than this value.

### 5.2.3 Other characteristics

The manufacturer shall provide such technical data as is necessary to confirm the suitability of the product for any particular recommended application.

## 6 Type characteristics

This clause applies to type A sheets only.

These tests shall be carried out on products as delivered. Where the tests are carried out on coated products, this shall be stated in the report.

### 6.1 Bending strength

When tested as specified in 8.2.1, in equilibrium and wet conditions, the average modulus of rupture of each individual piece of the finished products shall not be less than the values for the appropriate category specified in table 1.

In addition the mean modulus of rupture under wet conditions shall be not less than 50 % of the mean modulus of rupture under equilibrium conditions.

### 6.2 Water permeability

When tested as specified in 8.2.2, traces of moisture may appear on the underside of the sheet, but in no instance shall there be formation of drops of water.

### 6.3 Frost resistance[5)]

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

When sheets are tested as specified in 8.2.3, after 50 freeze-thaw cycles, the limit $L_i$ of the average ratio $\bar{r}$, as defined in 8.2.3.4, shall not be less than 0,75.

### 6.4 Warm water[5)]

If national standards specify a warm water test according to 8.2.4, the specimen shall comply with the following requirements.

When sheets are tested as specified in 8.2.4, the limit $L_i$ of the average ratio $\bar{r}$, as defined in 8.2.5.4, shall be greater than 0,75.

### 6.5 Heat-rain[5)]

This test is carried out on the finished product.

When sheets are tested as specified in B.5, any visible cracks, delamination or other defects in the sheets shall not be of a degree such as to affect their performance in use.

### 6.6 Soak-dry

When sheets are tested as specified in 8.2.5, the limit $L_i$ of the average ratio $\bar{r}$, as defined in 8.2.5.4 shall be greater than 0,75.

## 7 Tests

### 7.1 Acceptance tests

The objective of an acceptance test is to establish whether a batch of products conforms to a specification. The tests shall be performed on samples drawn either from continuous production or from a consignment. (See also clause 10.)

4) When sampling from continuous production, these tests may be conducted on dry or saturated specimens provided a relationship can be established between the equilibrium values and the dry or saturated values.

5) These requirements do not apply to surface coatings.

The acceptance tests shall be carried out at the manufacturer's works on sheets and test specimens cut from sheets as delivered.

The following acceptance tests shall be carried out:

a) dimensional and geometrical characteristics (compulsory), see 8.1.1;

b) bending strength (compulsory), see 8.1.2.1;

c) density (compulsory), see 8.1.2.2.

## 7.2 Type-tests

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 effects of which cannot be predicted on the basis of former experience.

The test shall be 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.

When type-tests are carried out, the product shall also be subjected to the acceptance tests to ensure that it complies with the requirements of this International Standard.

The following type-tests shall be carried out:

a) bending strength (compulsory), see 6.1;

b) water permeability (compulsory), see 6.2;

c) freeze-thaw (optional), see 6.3;

d) warm water (optional), see 6.4;

e) soak-dry (compulsory), see 6.6.

## 7.3 Systems tests

The heat-rain test (optional) should be carried out in accordance with annex B.

# 8 Test methods

## 8.1 Acceptance tests

### 8.1.1 Geometrical tests

#### 8.1.1.1 Apparatus

a) Smooth, flat, rigid inspection surface of production quality and of dimensions appropriate to the dimensions of the sheets.

Two metal rules shall be fixed at right angles along adjacent edges of the inspection surface. The straightness of each metal rule shall be at least 0,3 mm/m and the right angle shall be accurate to at least 0,1 % (less than 1 mm deviation from normal per metre of length) or 0,001 rad.

Alternatively a portable square may be used. The same requirements for straightness and angularity apply.

b) Suitable metal rulers, capable of being read to 0,5 mm.

c) Dial gauge, reading at least to 0,05 mm, with flat parallel metal jaws, between 10 mm and 15 mm in diameter.

#### 8.1.1.2 Measurement of width and length

For each dimension, carry out three measurements, i.e. one in the middle and one at approximately 50 mm from either end. Avoid taking the measurement over a local deformation which could be considered as a visual defect.

Smooth any rough areas.

Take each reading to the nearest 0,5 mm.

Report the individual results. Assess the results against the tolerances given in 5.1.3.

#### 8.1.1.3 Measurement of thickness

Carry out three measurements across the width at one end of the smooth or textured sheet with the dial gauge as indicated in figure 1. Take each reading to an accuracy of 0,05 mm.

Report the individual results. Calculate the arithmetic mean and difference between extreme values. Assess the results against the tolerances given in 5.1.3.

NOTE 6 If the face texture does not allow a sufficiently accurate measurement of the thickness, the thickness of face-textured products is determined from volume measurement by water displacement where the test piece has been saturated before measurement. The thickness is given by the formula

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

where

$e$ is the average thickness of the test piece;

$V$ is the volume determined by water displacement;

$l$ is the specimen length;

$b$ is the specimen width.

Alternative methods for determination of the average thickness of textured specimens may be used provided they can

be proven, on average, to yield a thickness measurement within ± 2 % of that determined from volume measurement by water displacement.

#### 8.1.1.4 Measurement of straightness of edges

Apply each of the edges to the relevant arm of the square.

Measure to the nearest 0,5 mm, by means of a steel rule, the greatest separation between the edge of the sheet and the arm of the square. Report the results.

Assess each result against the tolerance given in 5.1.4.1.

#### 8.1.1.5 Measurement of out-of-squareness of sheet

Place each of the four corners of the sheet in succession between the arms of the square, keeping one side against the full length of the large arm and the other side in contact with the small arm.

In this position, measure to the nearest 0,5 mm the greatest distance of the sheet edge from the small arm of the square.

Report each result. Assess the results against the tolerances given in 5.1.4.2.

### 8.1.2 Mechanical and physical tests

#### 8.1.2.1 Bending strength

##### 8.1.2.1.1 Shapes and dimensions of test pieces

The test specimens shall be of the following shapes:

a) for sheets of thicknesses $e \leqslant 9$ mm: two square specimens per sheet;

b) for sheets of thicknesses $e > 20$ mm: four rectangular specimens per sheet;

c) for sheet thicknesses in the range $9 \text{ mm} < e \leqslant 20$ mm, the test specimens may be either square or rectangular.

Dimensions of the test specimens are specified in table 2.

##### 8.1.2.1.2 Cutting specimens

The test specimens shall be cut from the same part of the sheet. One possible layout is shown in figure 2 (the distance of 200 mm is indicative). Other cutting layouts may be used provided that an equal number of specimens are cut perpendicular and parallel to the manufacturing direction.



Dimensions in millimetres

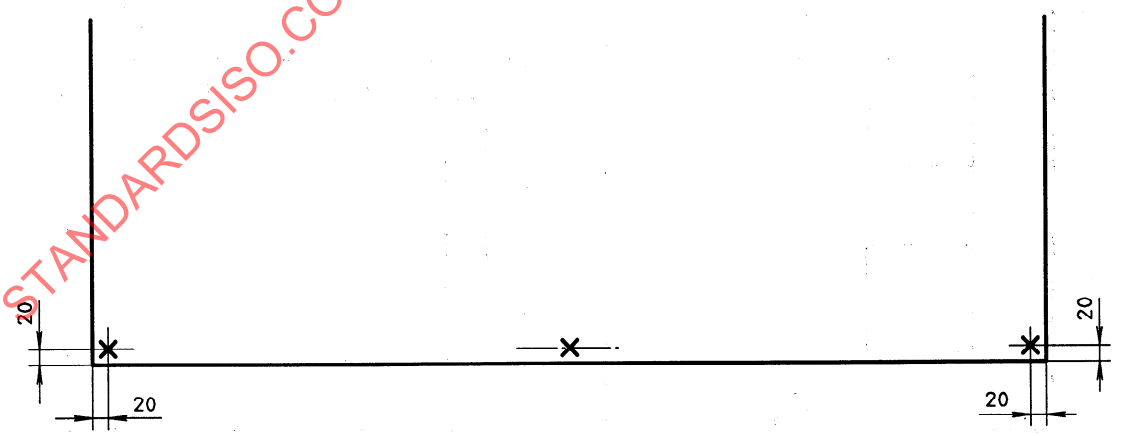


**Figure 1 — Measurement of thickness**

**Table 2 — Specimen dimensions**

Dimensions in millimetres

| Specimen shape | Dimensions of test specimen | |
|---|---|---|
| | Length | Width |
| Square | 250 | 250 |
| Rectangular | Test span + 40 [1] | 100 min. |

1) The distance between supports may be reduced for narrow products where full size specimens cannot be obtained provided the distance is not less than 18*e* where *e* is the thickness of the specimen, in millimetres.

#### 8.1.2.1.3 Conditioning for equilibrium strength

Place the test specimens for 7 days in a controlled atmosphere of 23 °C ± 5 °C and (50 ± 10) % relative humidity, and in such a manner that all faces are adequately ventilated.

#### 8.1.2.1.4 Conditioning for wet strength

Immerse the test specimens in water at a minimum temperature of 5 °C for 24 h.

For nominal thicknesses greater than 20 mm, the conditioning period shall be 48 h.

The test specimens shall be tested immediately upon removal from the water.

#### 8.1.2.1.5 Apparatus

The apparatus includes the following items:

a) Bending test machine (see figure 3) 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 %, comprising:

   1) two parallel supports, one rigid and one self-aligning, the distance between the supports, *a*, being a function of the thickness of the test piece (see table 3). The upper faces of the supports shall be rounded and shall have a radius *r* between 3 mm (minimum) and 25 mm (maximum);

   2) a loading bar identical to the two supports shall be situated above the specimen so that it is parallel to the supports and at an equal distance from each.

b) A micrometer reading to at least 0,05 mm with flat parallel metal jaws between 10 mm and 15 mm in diameter.

Dimensions in millimetres

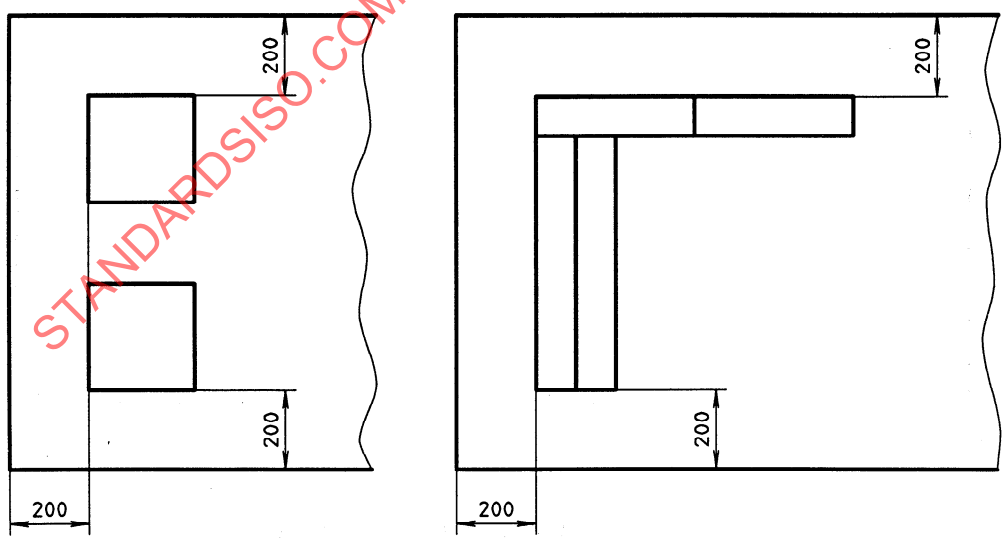


**Figure 2 — Cutting of test specimens**

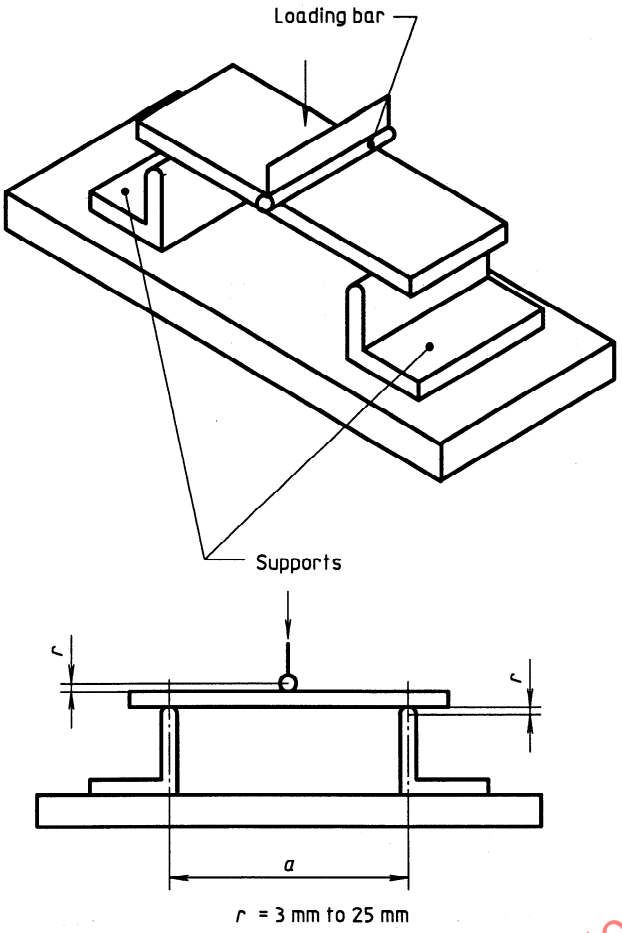


**Figure 3 — Bending test machine layout**

**Table 3 — Distance between supports (test span)**

Dimensions in millimetres

| Test specimen | Distance between axes of supports, $a$ [1] |
|---|---|
| Square | 215 |
| Rectangular | 18$e$ min. |
| NOTE — For square specimens other distances between supports may be used provided compatibility can be demonstrated between results obtained with the different test spans and results obtained with the standard spans. | |
| 1) The distance between the axes of the supports may be reduced for narrow products, where full size specimens cannot be obtained, provided the distance is not less than 18$e$ where $e$ is the thickness of the specimen, in millimetres. | |

#### 8.1.2.1.6 Procedure

Arrange the test piece with the underside against the supports and load the test piece along its centreline by means of the loading bar.

Load the specimen such that breakage occurs within 10 s to 30 s. A constant rate of deflection is preferred. Where this facility is not available a regular rate of loading is acceptable.

Measure the thickness at two points for smooth specimens and four points for textural specimens along the section of breakage as indicated in figure 4.

For square test specimens, re-assemble the broken pieces.

Submit the re-assembled test specimens to a second bending test with the line of load application at right angles to that of the first test. Measure the thickness of the test piece at two points for smooth sheets or four points for textured sheets along the new section of breakage as indicated in figure 4.

Where rectangular test specimens are used, the strengths in the two directions are obtained by testing each of the appropriate specimens (see figure 4).

#### 8.1.2.1.7 Expression and interpretation of results

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

$$R_f = \frac{3Pl}{2be^2}$$

where

$P$ is the breaking load, in newtons;

$l$ is the distance between axes of supports, in millimetres;

$b$ is the width of the test piece, in millimetres;

$e$ is the average thickness of the test piece (arithmetic average of two measurements for smooth and four measurements for textured), in millimetres.

The modulus of rupture of the sheet shall be the arithmetic mean of the four values (two values in each direction).

Assess the results against the specifications of 5.2.2.

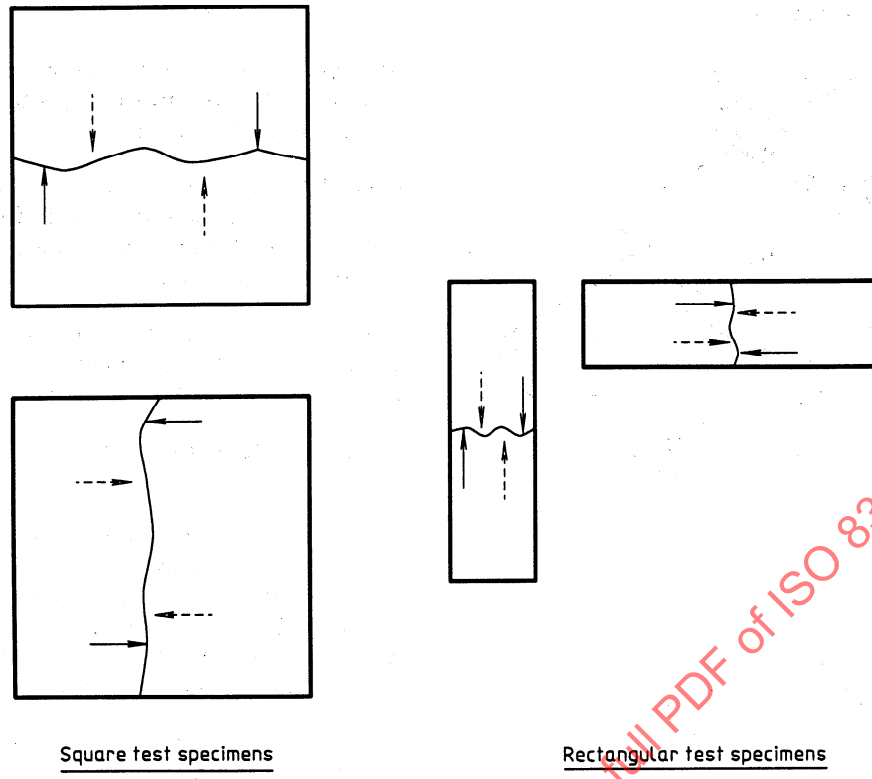


**Figure 4 — Measurement of thickness of specimens**

#### 8.1.2.2 Apparent density

##### 8.1.2.2.1 Preparation of specimens

The test specimens shall be cut from sheets as delivered.

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

##### 8.1.2.2.2 Apparatus

The apparatus includes the following items:

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

b) Weighing scale accurate to within 0,1 %, and equipped to determine the immersed mass of the specimen as well as the non-immersed mass.

##### 8.1.2.2.3 Procedure

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

Determine the mass by drying out the test specimens in a ventilated oven maintained at 100 °C to 105 °C for 24 h.

##### 8.1.2.2.4 Expression and interpretation of results

The density, $\rho$, in grams per cubic centimetre, is given by the formula

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

where

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

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

Assess the results against the specifications of 5.2.2.

### 8.2 Type-tests

#### 8.2.1 Bending strength

##### 8.2.1.1 General

This test method is designed to assess the equilibrium modulus of rupture and wet modulus of rupture, and the ratio of these.

#### 8.2.1.2 Preparation of specimens

Twenty specimens shall be cut from at least five sheets. Sheets which have provided specimens for other type-tests may be used.

Specimen dimensions shall be as required for the bending test in accordance with 8.1.2.1.1. The specimens shall be marked with the sheet number from which they were cut and separated into two identical groups of 10 specimens each, one for equilibrium strength testing and one for wet strength testing.

In case of rectangular specimens care should be taken that each batch shall contain five specimens cut in one direction and five specimens cut in the other direction.

The test specimens shall be conditioned in accordance with the provisions of 8.1.2.1.3 and 8.1.2.1.4, as appropriate.

#### 8.2.1.3 Test equipment and procedure

The bending strength test shall be carried out in accordance with the provisions of 8.1.2.1.

#### 8.2.1.4 Expression and interpretation of results

The equilibrium modulus of rupture shall be the arithmetic mean of the test results obtained in the equilibrium condition. The wet modulus of rupture shall be the arithmetic mean of the test results obtained in the wet condition.

Assess the results against the specifications of 6.1.

### 8.2.2 Water permeability

#### 8.2.2.1 Preparation of specimen

Three test specimens shall be cut, i.e. one from each of three sheets. Sheets used to provide specimens for other type-tests may be used or other sheets may be taken.

Specimen dimensions shall be 600 mm × 500 mm minimum except for narrow products when the dimensions shall be 600 mm × the maximum possible width.

#### 8.2.2.2 Equipment

A suitable frame shall be sealed on top of the specimen. The frame dimensions shall be 550 mm × 450 mm minimum. A narrow frame of the same length shall be used for narrow products.

#### 8.2.2.3 Specimen conditioning

The specimens shall be kept in a controlled environment for at least 7 days at ambient temperature (exceeding 5 °C).

#### 8.2.2.4 Procedure

Place and seal the frame on top of the face of the specimen and fill with water to a height of 20 mm above the face of the sheet. Place the specimens in a controlled environment at 23 °C ± 5 °C and (50 ± 10) % relative humidity. The duration of the test shall be 24 h.

#### 8.2.2.5 Expression and interpretation of results

Examine the underface after 24 h and verify that it conforms to the specification of 6.2.

### 8.2.3 Freeze-thaw

#### 8.2.3.1 Preparation of specimens

Sample five sheets as delivered by the producer. Cut 10 sets of paired specimens to suit the bending test (see 8.2.1).

Each pair of specimens shall be cut from one sheet and given the same number for later comparison of results.

#### 8.2.3.2 Apparatus

The apparatus is the same as for the bending test.

In addition, for this test, cooling units shall be used which — when filled completely with test pieces — ensure a test piece temperature of – 20 °C 2 h after starting freezing. The freezing chamber shall be equipped with an air circulation unit.

#### 8.2.3.3 Procedure

Submit one lot of 10 specimens to the bending test according to 8.2.1 and at the same time submit the other lot of 10 specimens to the following freeze-thaw test.

At the same time immerse the specimens in water at 5 °C until the difference of mass between two consecutive weighings spaced 24 h apart is less than 0,5 %.

Submit the specimens to 50 freeze-thaw cycles consisting of

— cooling in air to – 20 °C ± 2 °C in not less than 1 h and not more than 2 h. The specimens shall then be held at – 20 °C ± 2 °C for 1 h (see notes in 8.2.3.4);

— thawing in water to reach + 20 °C ± 2 °C within 1 h to 2 h maximum; the specimens shall be maintained in water at 20 °C ± 2 °C for 1 h and then freezing shall recommence (see notes in 8.2.3.4).

Each freeze-thaw cycle shall have a minimum cycle time of 4 h and a maximum of 6 h.

The temperature specified above refers to the freezing cavity.

At the end of this period, place the specimens in a laboratory atmosphere for 7 days.

Examine the specimens with the naked eye in order to detect possible cracks, delamination or other defects, and record any observation.

After preliminary conditioning, carry out the bending test as specified in 8.1.2.1.

#### 8.2.3.4 Expression and interpretation of results

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

$$r_i = \frac{R_{fi}}{R_{fci}}$$

where

$R_{fi}$ is the modulus of rupture of the $i^{th}$ test specimen after 50 freeze-thaw cycles;

$R_{fci}$ is the modulus of rupture of the $i^{th}$ reference test specimen (from the first lot).

Calculate the average, $\bar{r}$, and standard deviation, $s$, of the individual ratios $r_i$ (see ISO 2602). Calculate the 95 % lower confidence limit, $L_i$, of the average ratio $\bar{r}$, as follows:

$$L_i = \bar{r} - 0{,}58s$$

Assess the results against the specifications of 6.3.

NOTES

7 Freeze-thaw cycles may be controlled automatically or manually. Continuous automatic cycling is preferred.

Manual supervision of freeze-thaw cycles shall record completion of each cycle.

8 An interval between cycles (72 h maximum) is permissible. During this interval specimens should be stored in warm conditions (+20 °C).

9 During both freezing and thawing the specimens should be positioned to enable free circulation of the conducting medium (air or water) around each.

10 An alternative method in which the saturation of the specimen during cycling is ensured by sealing the saturated specimens in plastics bags may be used where suitable automatic equipment for the preferred method is not available.

### 8.2.4 Warm water

This test investigates the possible degradation of the products by keeping them in warm water for a protracted period. This test is a comparative one and is only significant for products as delivered.

#### 8.2.4.1 Preparation of specimens

Sample 10 sheets as delivered by the producer. Cut 10 sets of paired specimens to suit the bending test specified in 8.1.2.1.

Each specimen pair shall be cut adjacent from the one sheet and given the same number for later comparison of results.

#### 8.2.4.2 Apparatus

The apparatus includes the following items:

a) water bath capable of temperature control to 60 °C ± 2 °C;

b) testing equipment for determination of bending strength as described in 8.1.2.1.5 a).

#### 8.2.4.3 Procedure

Divide the paired specimens to form two sets of 10 specimens each.

Submit the first lot of 10 specimens to the wet bending test according to 8.1.2.1.

Immerse the 10 specimens of the second lot in water at 60 °C ± 2 °C saturated with product of the same composition, for 56 days ± 2 days.

At the end of this period place the specimens in a laboratory atmosphere for 7 days.

After preliminary conditioning, carry out the wet bending test as specified in 8.1.2.1.

#### 8.2.4.4 Expression and interpretation of results

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

$$r_i = \frac{R_{fi}}{R_{fci}}$$

where

$R_{fi}$ is the modulus of rupture of the $i^{th}$ pair of specimens after immersion in warm water;

$R_{fci}$ is the modulus of rupture of the $i^{th}$ pair of reference specimens (from the first lot).

Calculate the average, $\bar{r}$, and standard deviation $s$, of the individual ratios $r_i$ (see ISO 2602). Calculate the 95 % lower confidence limit, $L_i$, of the average ratio $\bar{r}$, as follows:

$$L_i = \bar{r} - 0{,}58s$$

Assess this ratio against the specifications of 6.4.

#### 8.2.5 Soak-dry

##### 8.2.5.1 Preparation of specimens

Sample 10 sheets as delivered by the producer. Cut 10 sets of paired specimens to suit the bending test in 8.1.2.1.

Each pair of specimens shall be cut adjacent from one sheet and given the same number for later comparison of results.

##### 8.2.5.2 Apparatus

The apparatus includes the following items:

a) ventilated oven capable of achieving a temperature of 60 °C ± 5 °C and a relative humidity of less than or equal to 20 % with a full load of specimens;

b) bath filled with water at ambient temperature of more than 5 °C;

c) testing equipment for determination of bending strength as defined in 8.1.2.1.5 a).

##### 8.2.5.3 Procedure

Divide the paired specimens to form two lots of 10 specimens each. After the conditioning procedure, submit the first lot of 10 specimens to the bending test as described in 8.1.2.1.

At the same time submit the second lot to 25 soak-dry cycles consisting of

— immersion in water at ambient temperature (more than 5 °C) for 18 h;

— drying in a ventilated oven of 60 °C ± 5 °C and relative humidity of less than 20 % for 6 h.

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

After 25 cycles, place the specimens in a laboratory atmosphere for 7 days.

At the end of this period, carry out the wet bending test as specified in 8.1.2.1.

##### 8.2.5.4 Expression and interpretation of results

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

$$r_i = \frac{R_{fi}}{R_{fci}}$$

where

$R_{fi}$ is the modulus of rupture of the $i^{th}$ test specimen after the soak-dry cycling;

$R_{fci}$ is the modulus of rupture of the $i^{th}$ reference test specimen (from the first lot).

Calculate the average, $\bar{r}$, and standard deviation, $s$, of the individual ratios, $r_i$ (see ISO 2602). Calculate the 95 % lower confidence limit, $L_i$, of the average ratio $\bar{r}$, as follows:

$$L_i = \bar{r} - 0{,}58s$$

Assess the ratio against the specifications of 6.6.

## 9 Marking

Marking of the product or its packaging shall ensure that the manufacturer's product and its classification can be clearly identified. The method of marking shall be stated in the manufacturer's literature.

## 10 Conformity with standards

### 10.1 Conformity with requirements

For the acceptance tests, 95 % in the statistical meaning of the delivered products shall fulfil the requirements of 5.1 and 5.2. The sampling schemes provided in ISO 390 with an AQL of 4 %[6] and an inspection level $S_3$ ensure that for large batches approximately 95 % of the items fulfil these requirements. Other methods may be used provided they give the same level of quality.

For each type-test, in the absence of a fundamental change to the formulation and/or method of manufacture, results from one test performed shall be taken as conformity to the specification.

### 10.2 Evidence of conformity of consignment of finished products

When tenders and/or orders specify receiving inspection, the lots delivered are presumed to be in conformity with the standard.

Inspection of a consignment of finished products should take place only where there is no third-party certification. It is conducted in accordance with ISO 390, which gives an AQL of 4 % with an inspection level $S_3$, and according to annex A.

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

# Annex A
(normative)

## Receiving inspection[7] for products which are not subject to third-party certification

**A.1** When tenders and/or orders specify it, the receiving inspection is carried out in lot(s) of the consignment according to the test programme of this product standard, unless there is a special agreement. Therefore, the test programme necessarily covers the acceptance tests.

Details related to the application of the sampling clauses shall be established in agreement between the manufacturer and the purchaser.

**A.2** After agreement on the sampling procedure, sampling shall be carried out, in the presence of both parties, from lot(s) which are to be delivered to the purchaser. If the inspection lot(s) are not yet formed, the manufacturer should present to the purchaser the stock(s) from which the inspection lot(s) can be selected and marked. Failing such an agreement, the maximum and minimum inspection lots shall be 8 000 and 4 000 sheets respectively for all dimensions.

**A.3** The tests shall normally be carried out by an independant laboratory selected by mutual agreement between the manufacturer and the purchaser. The laboratory of the manufacturer can be used. In case of dispute, the tests shall be carried out in the presence of both parties.

**A.4** When non-destructive tests are carried out and the results of the sampling inspection do not meet the acceptance requirements of the product standard, the tests may 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 between manufacturer and purchaser.



7) See ISO 390.