INTERNATIONAL STANDARD

ISO 9383

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Products in fibre-reinforced cement — Short corrugated or asymmetrical section sheets and fittings for roofing

Produits en ciment renforcé par des fibres — Plaques ondulées ou nervurées courtes et leurs accessoires pour couvertures

Reference number
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Contents

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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 9383 was prepared by Technical Committee ISO/TC 77, *Products in fibre reinforced cement.*

Annexes A and B form an integral part of this International Standard. Annex C is for information only.

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Products in fibre-reinforced cement — Short corrugated or asymmetrical section sheets and fittings for roofing

1 Scope

This International Standard specifies the technical characteristics of fibre-cement profiled sheets, described as short sheets — the length of which is normally less than or equal to 0,7 m [1] — the corrugation height of which is between 15 mm and 110 mm and also of fibre-cement fittings, used as roofing materials.

It specifies tests to check them, conditions of acceptance and marking.

It does not apply to short asbestos-cement corrugated and asymmetrical section sheets which are covered by ISO 393-5, nor to long fibre-cement sheets which are covered by ISO 9933, nor to their fittings.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was 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 edition of the standard 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.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 acceptance test: Test 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.

3.2 type test: Test concerned with the approval of a new product and/or a fundamental change in formulation and/or method of manufacture from which the effects cannot be predicted on the basis of previous experience.

The test is performed on the as-delivered product. The test is required to demonstrate conformity of a generic product to a specification.

3.3 acceptable quality level (AQL): When a continuous series of lots is considered, the quality level which for the purposes of sampling inspection is the limit of a satisfactory process average.[2]

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

1) In limited circumstances (e.g. at eaves), sheets up to a maximum length of 0,9 m may be used.

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

3.5 fibres

(1) Discrete elements randomly dispersed.

(2) Continuous strands and tapes.

(3) Nets or webs.

4 Symbols, abbreviations and units

For the purposes of this International Standard, the following symbols and abbreviations are used.

a	Pitch of the corrugation, in millimetres
b	Length of the specimen in the breaking bending moment test, in millimetres
e, e_1, e_2	Thicknesses of the sheet, in millimetres
h	Height of the corrugation, in millimetres
h_{od}	Height of the edge of the descending corrugation at edge, in millimetres
h_{om}	Height of the edge of the ascending corrugation at edge, in millimetres
L	Ratio of the estimation L_I to L_S
L_I	Upper estimation at 95 % confidence level of the result M_1 in the warm water test
L_S	Lower estimation at 95 % confidence level of the result M_2 in the warm water test
L_1, L_2, L_3	Lengths of the sheet, in millimetres
l	Clear span, in millimetres, between the supports in the breaking bending moment test
l_1, l_2	Widths of the sheet, in millimetres
M	Breaking bending moment at rupture, in newton metres per metre length
M_1	Average value of the test result of the control specimen of the first lot for the warm water test
M_2	Average value of the test result of the specimens after the warm water test
m	Mass of the specimen, in grams, after drying when determining the apparent density
P	Breaking load, in newtons, for the bending moment test
s_1	Standard deviation of the specimens with average M_1
s_2	Standard deviation of the specimens with average M_2
V	Apparent volume, in cubic centimetres, of the specimen for the apparent density test
ϱ	Apparent density of specimen, in grams per cubic centimetre

5 Sheets

5.1 General composition

Sheets and fittings covered by this International Standard consist essentially of an inorganic hydraulic binder[3] or 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-reinforced cement may be added.

5.2 General appearance and finish

The sheets may be left with their natural colour, or colouring matter may be added in the composition: they may also receive adherent coloured or uncoloured coatings on their surfaces.

Short profiled sheets are components, examples of which are given in figure 1. The corrugations are defined by their pitch, a, and their height, h.

The surface intended to be exposed to the weather shall have a generally smooth finish. Variations of the surface appearance which do not impair the characteristics of the sheets as defined in this International Standard are permitted.

Edges shall be straight and clean and the sheets shall be square. Sheets may have one or two corners premitred or prepared for mitring and may be predrilled for fixing.

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

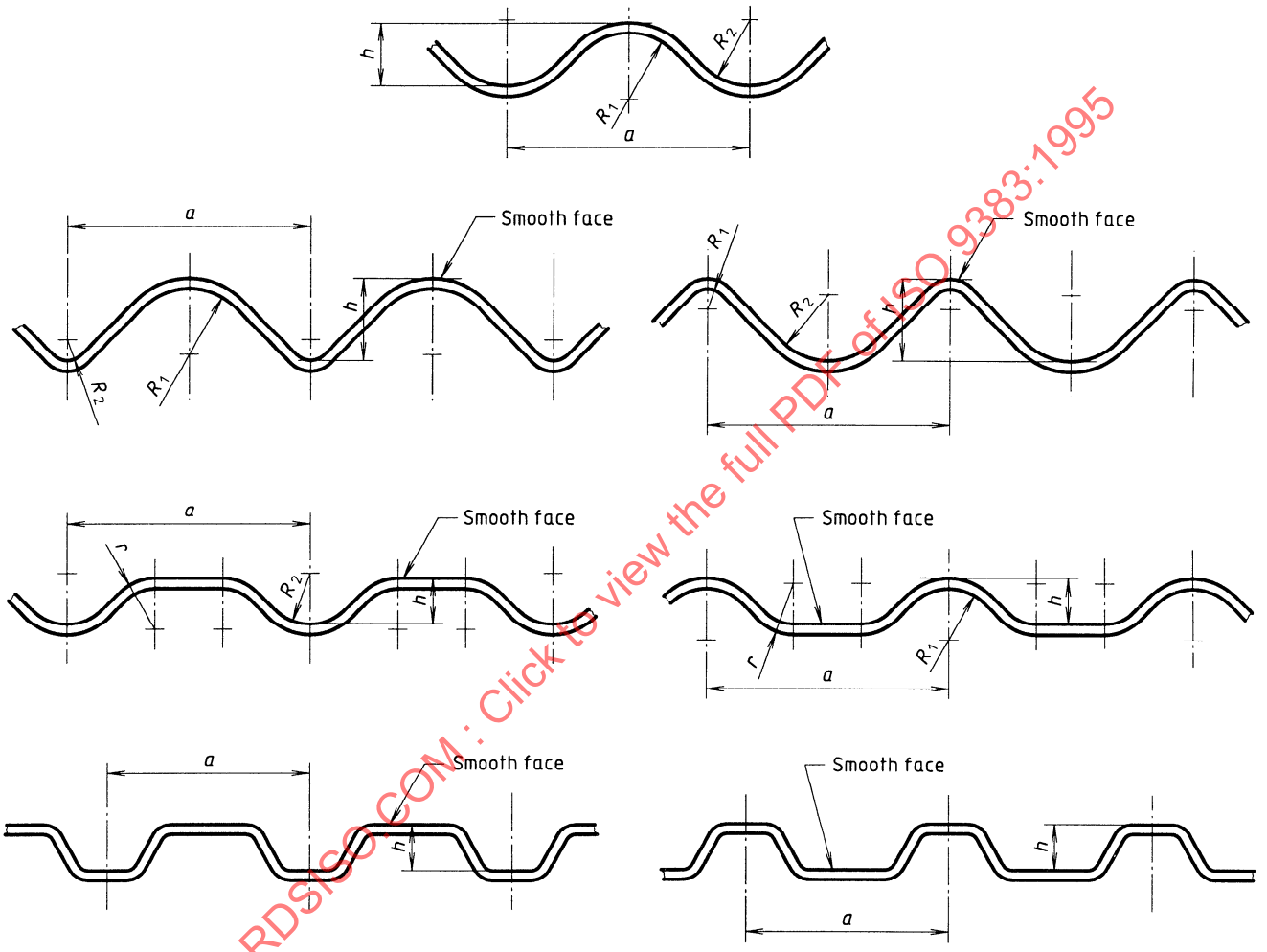


Figure 1

5.3 Categorization and classification

5.3.1 According to thickness

The thickness of the sheets may (see figure 2):

— either be approximately constant throughout the width of the profile (type A sheets);

— or vary regularly between the valley and the crown for corrugated sheets or between the lower part and the upper part of ribs for asymmetrical section sheets, in the same cross-section (type B sheets).

5.3.2 According to minimum bending moment at rupture

Each category of sheet is subdivided into two classes according to the value of the minimum bending moment at rupture in accordance with table 2.

NOTE 1 National standards may choose to retain only one or two classes, depending on the local conditions of the area in use.

5.4 Characteristics

5.4.1 Dimensions

The nominal dimensions shall be defined by national standards or by the manufacturer.

5.4.1.1 Width

The width is the arithmetic average of l_1 and l_2 as shown in figure 3.

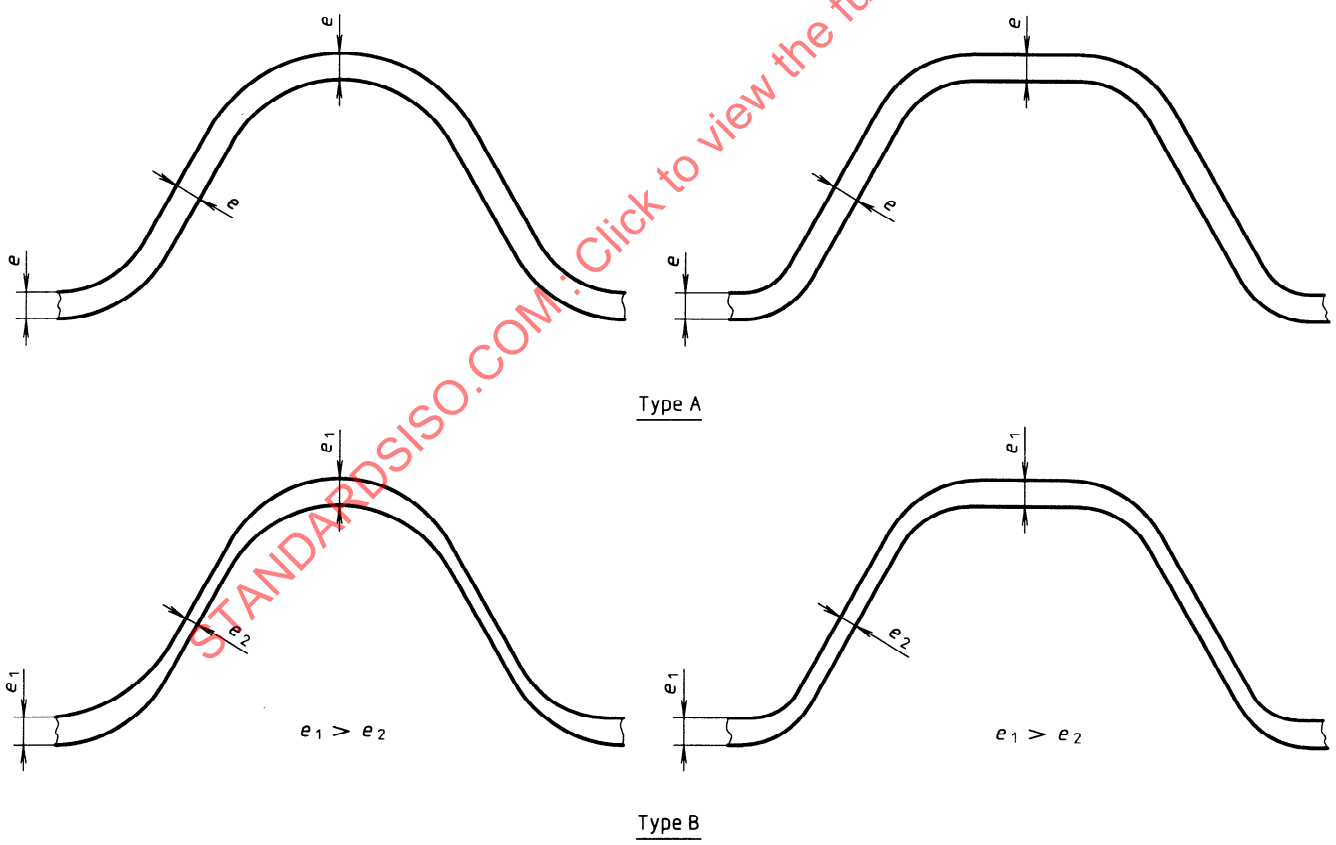


Figure 2

Dimensions in millimetres

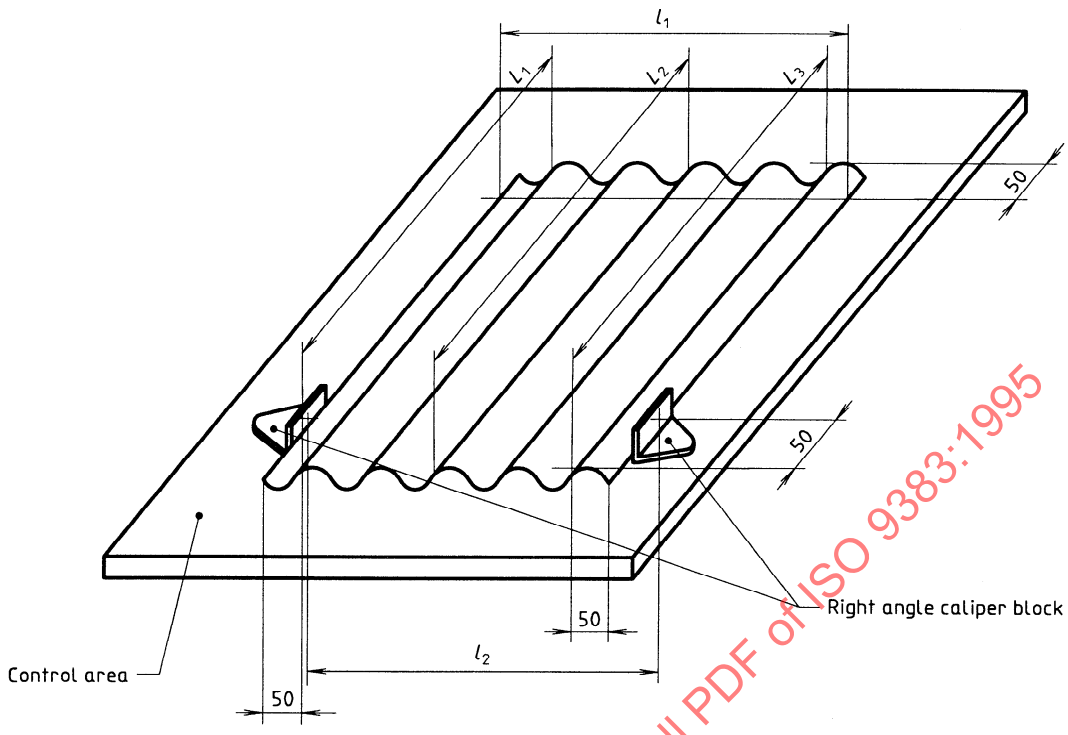


Figure 3

5.4.1.2 Thickness

Each individual thickness measured according to 5.5.5 shall not be less than the values in table 1.

Table 1 — Thickness

Dimensions in millimetres

Height of corrugation, h	Thickness, e min.
$15 \leqslant h \leqslant 30$	3
$30 < h \leqslant 110$	4

5.4.1.3 Number of corrugations or ribs

The number of corrugations or ribs to be considered for designation is the number of complete corrugations or ribs of the sheet.

5.4.1.4 Height of edges

The nominal height of edges of both the ascending and descending edges (see figure 8) shall be specified in national standards. This requirement applies only for sheets having an ascending corrugation on one side and a descending corrugation on the other side.

5.4.1.5 Tolerances on dimensions

The following tolerances apply to nominal dimensions given by the manufacturer:

a) Tolerance on pitch, a:

$a \leqslant 75$ mm	$\pm$ 1,5 mm
75 mm $< a \leqslant$ 180 mm	$\pm$ 2 mm
180 mm $< a \leqslant$ 260 mm	$\pm$ 2,5 mm
260 mm $< a$	$\pm$ 3 mm

b) Tolerance on height, h:

15 mm $\leqslant h \leqslant$ 45 mm	$\pm$ 2 mm
45 mm $< h \leqslant$ 110 mm	$\pm$ 3 mm

c) Tolerance on length: $\pm$ 10 mm

d) Tolerance on width: $^{+10}_{-5}$ mm

e) Tolerance on nominal thickness, e: The average thickness measured according to 5.5.5 shall be within $\pm$ 10 %, but no more than $\pm$ 0,6 mm, of the nominal thickness.

f) Out-of-squareness of sheet: $\leqslant$ 6 mm

g) Tolerance on height of edges: The producers shall specify this tolerance in their literature when it is necessary to ensure the weathertightness of the roof, only for sheets having an ascending edge on one side and a descending edge on the other side.

5.4.2 Mechanical characteristics

When tested in accordance with 5.5.8, sheets shall have a bending moment per metre width at rupture at least equal to the value indicated in table 2.

Table 2 — Bending moment at rupture

Class	M, min. N·m/m	
	15 mm $\leqslant h \leqslant$ 30 mm	30 mm $< h \leqslant$ 110 mm
1	12	20
2	20	30

5.4.3 Physical characteristics

With the exception of 5.4.3.3, these characteristics shall be determined on products as-delivered wherever practical. The results are identified as applying to coated or uncoated materials. Failure of the coating does not constitute failure of the product.

5.4.3.1 Impermeability

When tested as specified in 5.5.9.1, traces of moisture may appear on the underface of the sheet but in no instance shall there be any formation of water drops.

5.4.3.2 Frost resistance

This test shall be carried out if local climatic conditions justify it or national standards specify it.

When tested as specified in 5.5.9.2, any visible cracks, delamination or other defects in the sheets shall not be of a degree as to affect their performance in use.

5.4.3.3 Apparent density

The manufacturer shall indicate the nominal value of the apparent density of the sheets.

When measured in accordance with the provisions of 5.5.9.3, the sheets shall have an apparent density equal to this value with a tolerance of $\pm$ 10 %.

5.4.3.4 Warm water

When tested as specified in 5.5.9.4, any visible cracks, delamination or other defects in the sheets shall not be of a degree as to affect their performance in use.

The finished product shall exhibit a ratio L as defined in 5.5.9.4 not less than 0,70. This is equivalent to a decrease in load of no more than 15 % when the coefficient of variation is 15 %.

5.4.3.5 Heat-rain

When tested as specified in 5.5.9.5, any visible cracks, delamination or other defects in the sheets shall not be of a degree as to affect their performance in use.

5.5 Tests

5.5.1 Acceptance tests

The following acceptance tests shall be carried out at the manufacturer's works on sheets as delivered, the maturity of which is guaranteed by the manufacturer. Sampling levels and acceptance criteria shall be as defined in ISO 390, and the minimum value of any parameter is subject to an AQL of 4 %.

5.5.1.1 Compulsory tests (see annex A)

— geometrical characteristics (5.5.3 to 5.5.7);

— mechanical characteristics (5.5.8).

5.5.1.2 Optional tests (at purchaser's request — see annex A)

— apparent density (5.5.9.3).

5.5.2 Type tests

These type tests should be repeated every five years but are not necessarily required for each production batch.

These tests are

— impermeability (5.5.9.1);

— frost resistance (5.5.9.2) if local conditions justify it or if national standards specify it;

— warm water (5.5.9.4) (optional for national standards);

— heat-rain (5.5.9.5).

5.5.3 Checking profile

5.5.3.1 Preparation of specimen

The specimen shall be a complete sheet as-delivered without conditioning.

5.5.3.2 Apparatus

5.5.3.2.1 A smooth flat surface with dimensions appropriate to the dimensions of the sheets.

5.5.3.2.2 Steel cylindrical bars, length 200 mm and diameter large enough to touch the sides of the valleys, with conical points, shall be fitted at the axis on one end.

5.5.3.2.3 A micrometer with hemispherical head accurate to 0,1 mm.

5.5.3.2.4 A graduated metal ruler reading to 0,5 mm.

5.5.3.3 Procedure

Lay the sheet flat and square on the flat surface in accordance with figure 3, ensuring that the valley of every corrugation is in contact with it.

5.5.3.3.1 Measurement of pitch, *a*

At one end of the sheet, lay the cylindrical bars in each valley of the corrugations with the conical point of each cylindrical bar slightly outside the sheet (see figure 4). With the graduated ruler, measure to the nearest 0,5 mm the distance between consecutive conical points.

Any other measurement method with an accuracy equal or higher may be used.

5.5.3.3.2 Measurement of corrugation height, *h*

Choose three complete corrugations on a sheet. On each of them, with the micrometer, take three measurements regularly spaced down the length of the sheet in accordance with figure 5.

Any other measurement method with an accuracy equal or higher may be used.

5.5.3.4 Expression and interpretation of results

5.5.3.4.1 Pitch

Each measurement of the pitch, expressed in millimetres, shall be compared with the specification in 5.4.1.5 a).

5.5.3.4.2 Corrugation height

Each result is the arithmetical average of the three measurements on each corrugation, expressed in millimetres, to the nearest 0,1 mm. The three results shall all comply with the specification in 5.4.1.5 b).

5.5.4 Measurement of length and width

5.5.4.1 Preparation of specimen

The specimen shall be a complete sheet as-delivered without conditioning.

5.5.4.2 Apparatus

5.5.4.2.1 A smooth flat surface with dimensions appropriate to the dimensions of the sheets.

5.5.4.2.2 A ruler graduated in millimetres.

5.5.4.2.3 Two rectangular caliper blocks.

5.5.4.3 Procedure

Lay the sheet flat on the surface in accordance with figure 3, ensuring that the valley of every corrugation is in contact with it.

To measure the length, take three measurements: one in the middle and one approximately 50 mm from each side or further to avoid mitred corners (see figure 3).

To measure the width, take two measurements, approximately 50 mm from each end or further to avoid mitred corners (see figure 3).

5.5.4.4 Expression and interpretation of results

Read each measurement to the nearest 1 mm. Calculate the arithmetic average of the length and width which shall comply with the specifications in 5.4.1.5 c) and 5.4.1.5 d), respectively.

The results are considered to be satisfactory if they conform with the requirements.

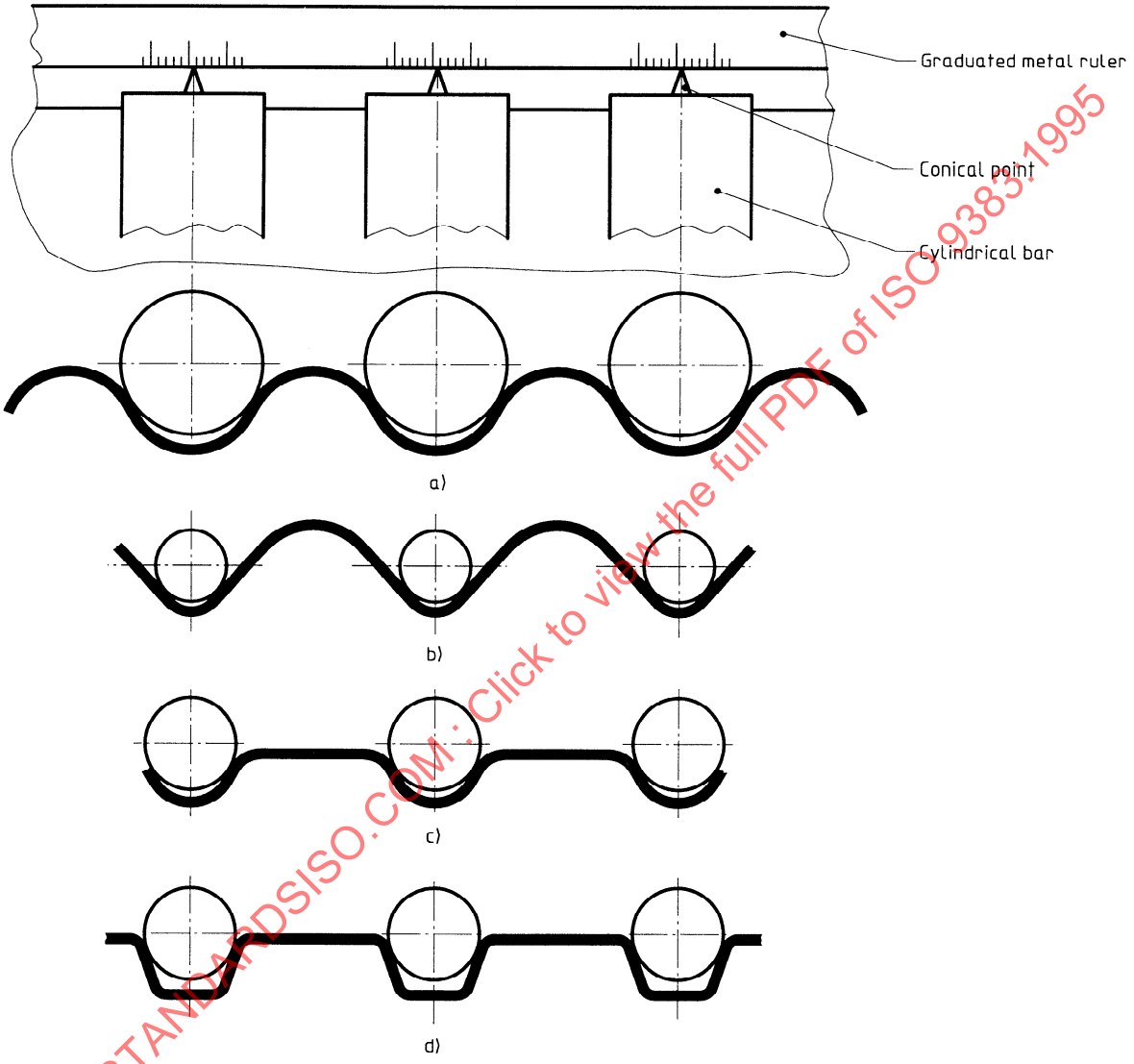
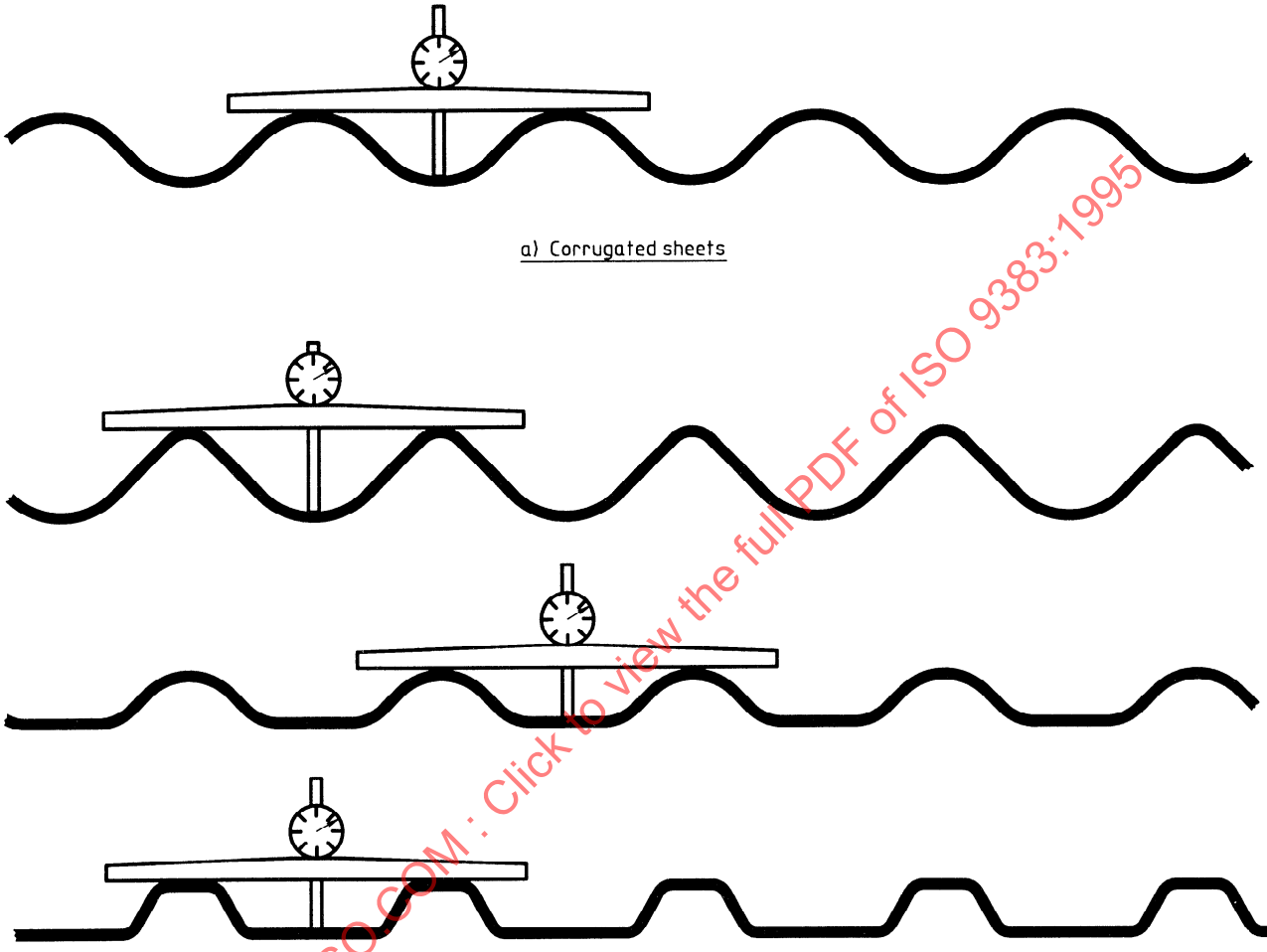


Figure 4



a) Corrugated sheets

b) Asymmetrical sheets

Figure 5

5.5.5 Thickness check

5.5.5.1 Preparation of specimen

The specimen shall be a complete sheet as-delivered without conditioning.

5.5.5.2 Apparatus

5.5.5.2.1 Micrometer with hemicylindrical plates as in figure 6, accurate to 0,05 mm.

Dimensions in millimetres

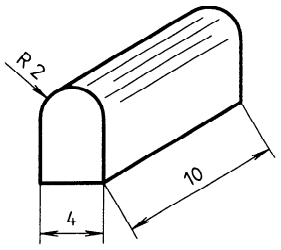


Figure 6

5.5.5.3 Procedure

Make the measurement approximately 15 mm in from the end:

— in the valley and at the crown of the corrugation for sheets of type A;

— on the crown and on the flank of the corrugation for sheets of type B.

Measure the thickness at six points (three crowns and three valleys for type A, three crowns and three flanks for type B), including necessarily those corresponding to side corrugations or ribs. For sheets with less than six crowns and valleys, measure the thickness on each corrugation or rib.

5.5.5.4 Expression and interpretation of results

The results are the individual measurements and the average of all measurements, expressed in millimetres, which shall be compared with the specifications in 5.4.1.2 and 5.4.1.5 e). For sheets with less than six crowns and valleys, individual results shall be compared with the specification in 5.4.1.5 e).

The results are considered to be satisfactory if they conform with the requirements.

5.5.6 Squareness check

5.5.6.1 Preparation of specimen

The specimen shall be a complete sheet as-delivered without conditioning.

5.5.6.2 Apparatus

5.5.6.2.1 A smooth flat surface with dimensions appropriate to the dimensions of the sheet.

5.5.6.2.2 A rectangular frame with two corrugated ends and two straight sides or any other appropriate device to check the squareness of ends with respect to corrugations with an accuracy of 1 mm.

5.5.6.2.3 A graduated metal ruler reading to 0,5 mm.

5.5.6.3 Procedure

Lay the sheet flat on the surface ensuring that the valley of every corrugation is in contact with it.

Measure the out-of-squareness at each end as indicated in figure 7 as an example.

5.5.6.4 Expression and interpretation of results

The results in millimetres shall comply with the specification in 5.4.1.5 f).

The results are considered to be satisfactory if they conform with the requirements.

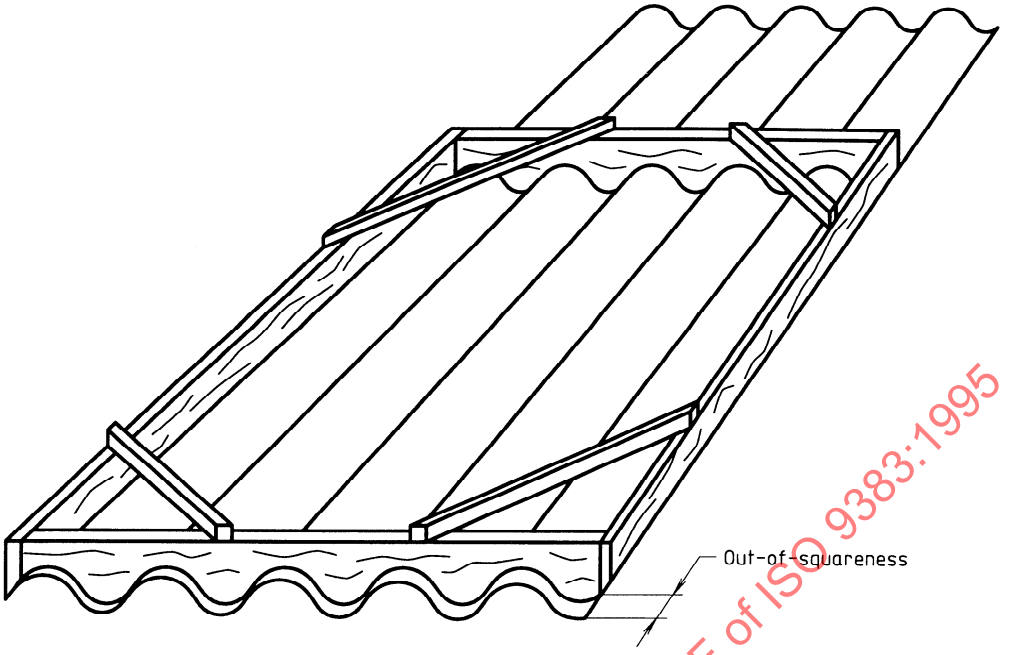


Figure 7

5.5.7 Height of edges

5.5.7.1 Preparation of specimen

The specimen shall be a complete sheet as-delivered without conditioning.

5.5.7.2 Apparatus

5.5.7.2.1 A smooth flat surface with dimensions appropriate to the dimensions of the sheet.

5.5.7.2.2 Two appropriate measurement devices: one device for the ascending corrugation (h_{om}), and one device for the descending corrugation (h_{od}).

5.5.7.3 Procedure

Lay the sheet flat on the surface ensuring that the valley of every corrugation is in contact with it.

Measure the height of both edges as in figure 8 with the devices, with an accuracy of 1 mm.

5.5.7.4 Expression and interpretation of results

The results at any point on the edge of the sheets, expressed in millimetres, shall be compared with the specification in 5.4.1.5 g).

The results are considered to be satisfactory if they conform with the requirements.

5.5.8 Bending moment

5.5.8.1 Preparation of specimen

A test specimen of length 0,3 m shall be cut from a whole sheet excluding the edge corrugations. The manufacturer shall guarantee its maturity.

Sheets of type A should have a crown at the centrepoint and one full pitch either side plus an overlap on the support bearers to a maximum of half a pitch each side (see figure 9). If the sheet width will not allow this, then reduce to half one pitch each side of the central crown plus an overlap as defined above (see figure 10).

Sheets of type B should have a valley at the centre point and one and a half full pitches either side plus an overlap on the support bearers to a maximum of half a pitch (see figure 11).

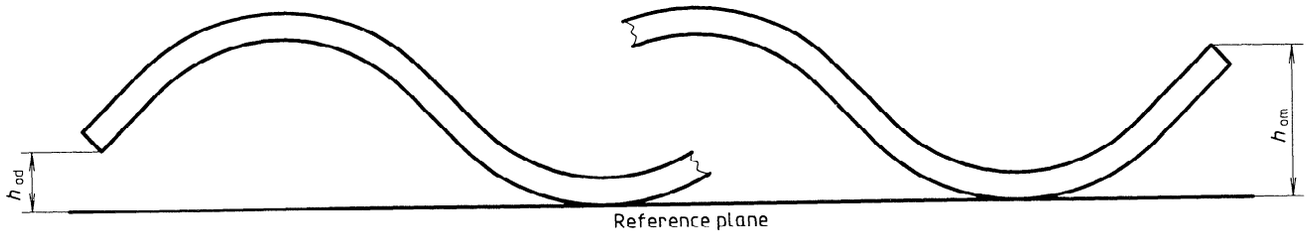


Figure 8

Dimensions in metres

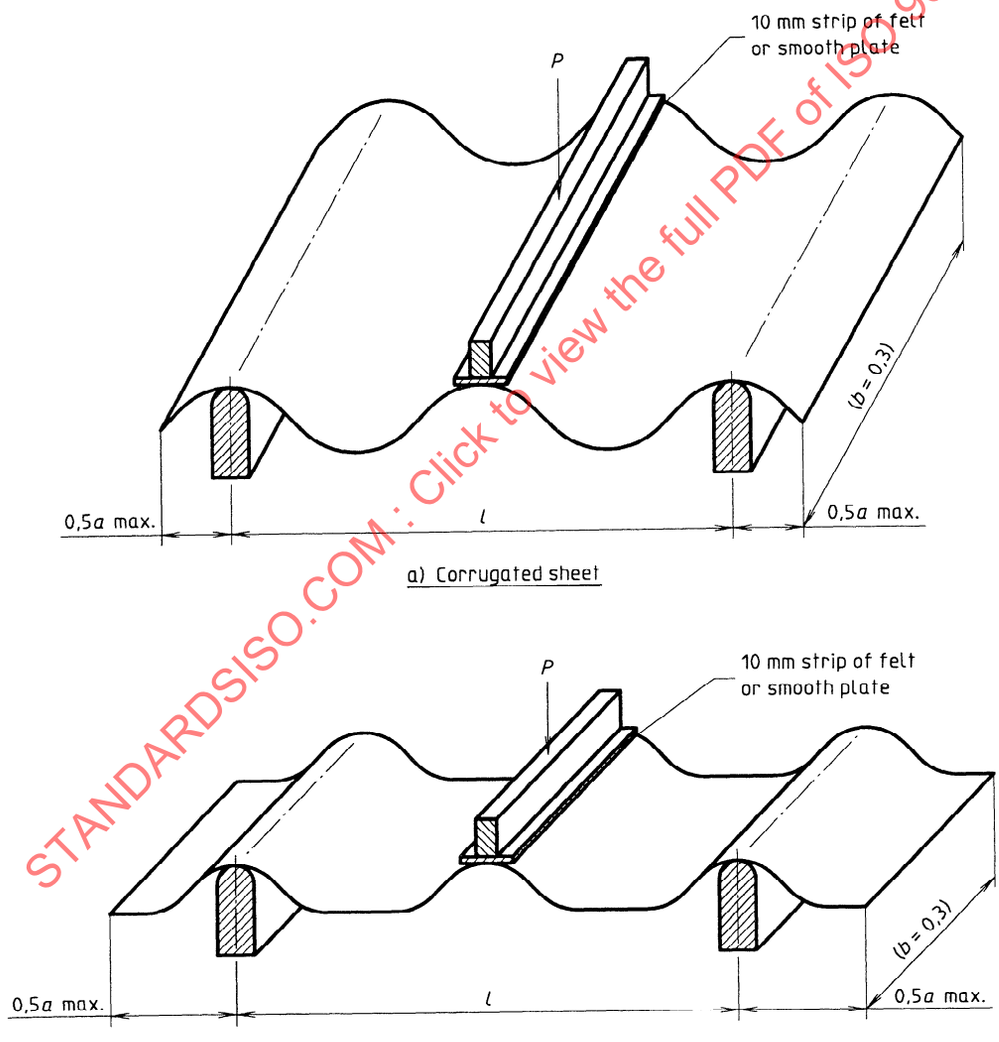


Figure 9

Dimensions in metres

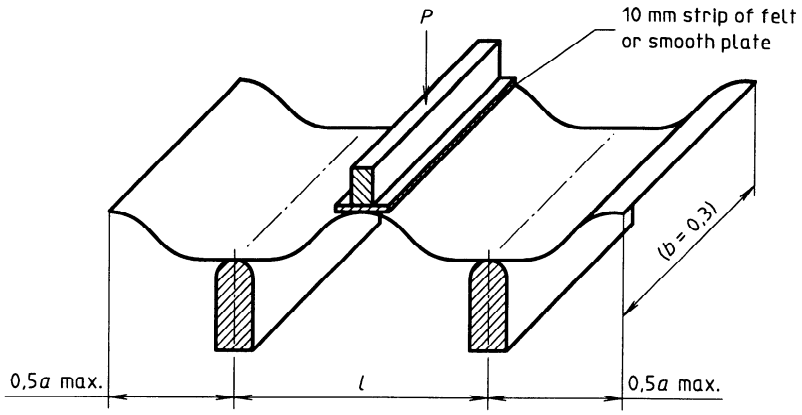
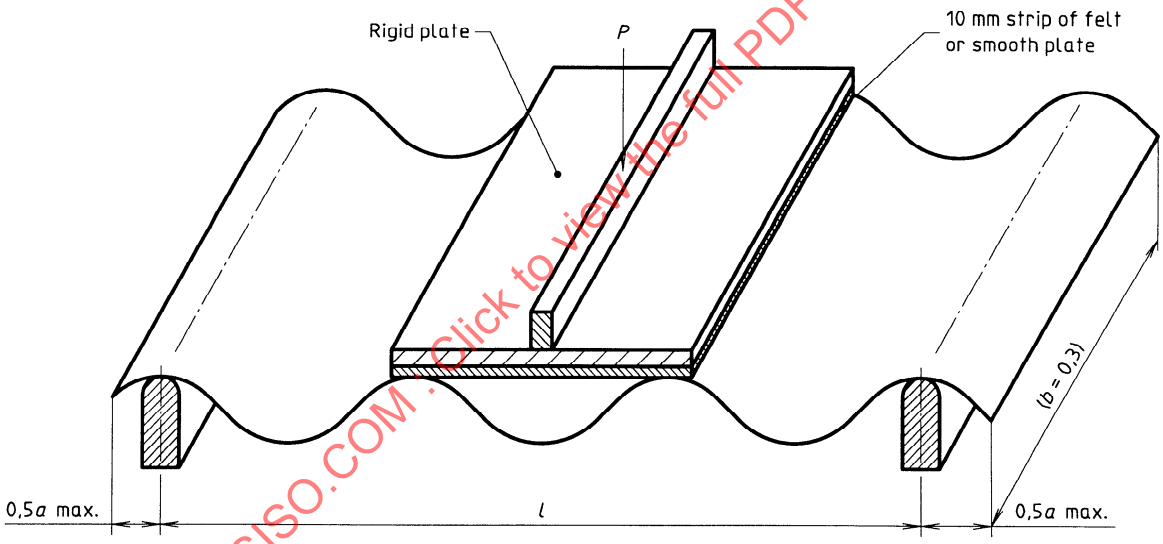
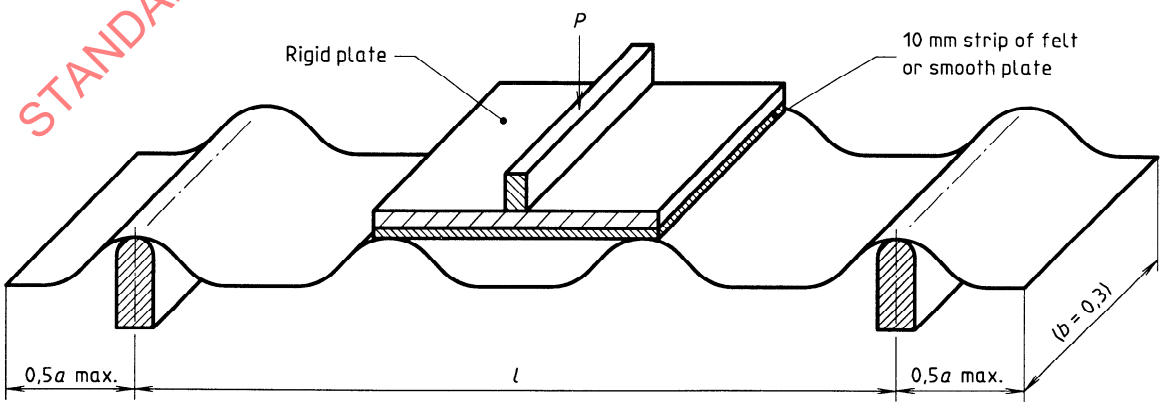


Figure 10

Dimensions in metres



a) Corrugated sheet, type B



b) Asymmetrical section sheet, type B

Figure 11

5.5.8.2 Apparatus

5.5.8.2.1 Bending test machine with a constant rate of deflection when applying the load, and with an error of exactitude and an error of reproducibility less than or equal to 3 %. Where this facility is not available, a constant rate of loading is acceptable.

This machine comprises (see figures 9 to 11)

a) **Two parallel supports** (one rigid) in the same horizontal plane whose length is at least 0,3 m and whose upper face is rounded (radius 3 mm to 5 mm).

b) **A loading bar** for sheets of type A, **a plate** of suitable width for sheets of type B, with a minimum length of 0,3 m, parallel to and equidistant from the supports.

c) **Three strips of felt or soft material** approximately 10 mm thick, with length at least 0,3 m, and width equal to the supports and loading beam.

5.5.8.3 Procedure

Before testing, immerse the specimen in water at an ambient temperature greater than 5 °C for 24 h.

Testing is normally carried out after wet conditioning but for quality control purposes, dry testing may be carried out providing it is statistically established (see annex B) that compliance with the requirements for wet testing given in table 2 is ensured.

Condition specimens in accordance with table 3.

Table 3 — Conditioning

Test	Conditioning procedure
Acceptance test, wet	24 h immersion in water
Acceptance test, dry	7 days ± 1 day in ambient laboratory conditions
Type test	Prior to the bending test 7 days ± 1 day in ambient laboratory conditions followed by 24 h immersion in water

The specimen is placed on the supports (the smooth face in compression) and, after interposition of strips of felt or soft material as in figures 9 to 11, loaded in the middle at the top of corrugation by the loading bar or the rigid plate, depending on the type.

The rupture shall occur between 10 s and 30 s after the beginning of loading.

5.5.8.4 Expression and interpretation of results

The bending moment at rupture, expressed in newton metres per metre length, is given by the formula:

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

for sheets of constant thickness (type A), or

$$M = \frac{Pl}{6b}$$

for sheets of variable thickness (type B),

where the length of the test specimen, b, is 0,3 m.

The results of the test shall comply with the specified values in table 2.

5.5.9 Physical characteristics

5.5.9.1 Impermeability

5.5.9.1.1 Specimen preparation

The test shall be made on three whole sheets as-delivered.

The sheets shall be kept for 7 days in a laboratory atmosphere at an ambient temperature greater than 5 °C.

5.5.9.1.2 Apparatus

5.5.9.1.2.1 A frame whose width depends on the profile of the sheets, and the dimensions of which are as in figure 12.

Dimensions in millimetres

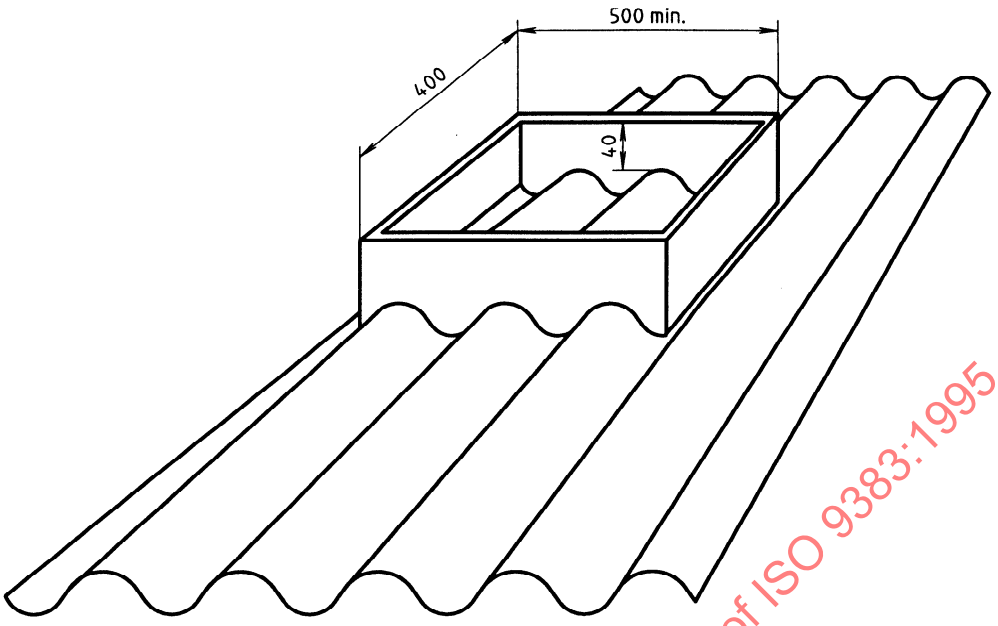


Figure 12

5.5.9.1.3 Procedure

Seal the frame on the sheet.

Then fill the frame with water until the level is approximately 20 mm above the top of the corrugations.

Examine the underface after 24 h.

5.5.9.1.4 Expression and interpretation of results

The result shall be assessed visually by comparison with the specification in 5.4.3.1.

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

5.5.9.2 Frost resistance

5.5.9.2.1 Preparation of specimens

This test shall be performed on five specimens cut one from each of five sheets.

These specimens shall have the following dimensions:

a) 300 mm in the direction of corrugation,

b) 200 mm perpendicular to the corrugations.

5.5.9.2.2 Apparatus

5.5.9.2.2.1 A freezer having a forced air circulation and capable of being regulated to the prescribed freezing conditions with a full load of test specimens.

5.5.9.2.2.2 A water bath filled with water and maintained at 20 °C ± 2 °C.

5.5.9.2.3 Procedure

Immerse the specimens in water at an ambient temperature greater than 5 °C for 24 h intervals until the difference between two consecutive weighings is less than 0,5 %.

Then subject the specimens to freeze/thaw cycles consisting of

a) cooling in the air to reach − 20 °C ± 2 °C within 1 h to 2 h, and holding at this temperature for 1 h;

b) thawing in water to reach + 20 °C ± 2 °C within 1 h to 2 h, and holding in this condition for 1 h. Then recommence freezing.

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

Freeze/thaw cycles may be controlled automatically or manually. Continuous automatic cycling is pre-

ferred. Manual supervision of freeze/thaw cycles shall record the completion of each cycle.

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

An interval between cycles (72 h maximum) is permissible. During this interval specimens shall be stored at 20 °C.

The total number of freeze/thaw cycles shall be defined by the national standard specifying the test. In default the total number of cycles shall be 50.

5.5.9.2.4 Expression and interpretation of results

The result shall be assessed visually by comparison with the specification in 5.4.3.2.

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

5.5.9.3 Apparent density

5.5.9.3.1 Preparation of specimen

A test specimen of size of approximately 40 mm × 60 mm shall be cut from the sheet.

5.5.9.3.2 Apparatus

5.5.9.3.2.1 A ventilated oven capable of achieving a temperature of 100 °C to 105 °C with full load of specimens.

5.5.9.3.2.2 A weighing scale accurate to within ± 0,1 % and equipped to determine the immersed and non-immersed masses of the specimens.

5.5.9.3.3 Procedure

Determine the volume, V, by immersion in water or another method having an accuracy equal or higher. In case of immersion, the test specimen shall be saturated in water beforehand.

Determine the mass, m, of the specimen after drying it in the ventilated oven maintained at 100 °C to 105 °C for 24 h ± 1 h.

5.5.9.3.4 Expression and interpretation of results

The apparent density is given by the formula:

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

It shall be compared with the specification of 5.4.3.3.

The result is considered to be satisfactory if it conforms with the specification.

5.5.9.4 Warm water

This test investigates the possible degradation of the products by keeping them in warm water for a protracted period.

5.5.9.4.1 Preparation of specimens

Cut 20 specimens, the dimensions of which shall be as given in 5.5.8.1 from at least five sampled sheets as-delivered by the producer.

5.5.9.4.2 Apparatus

5.5.9.4.2.1 A water bath capable of temperature control to 60 °C ± 2 °C.

5.5.9.4.2.2 A bending test machine as specified in 5.5.8.2.

5.5.9.4.3 Procedure

Divide the specimens at random into two lots of 10.

Submit one lot of 10 specimens to the bending moment test in accordance with 5.5.8 and, at the same time, immerse the 10 specimens of the second lot in water at 60 °C saturated with product of the same composition and maintain at 60 °C ± 2 °C for 56 days ± 2 days. The pieces of products used for saturation shall be broken down to a size and be of sufficient quantity to ensure saturation is complete.

At the end of this period, place the second lot of specimens in a laboratory atmosphere for 7 days. Examine the specimens with the naked eye in order to detect any cracks or obvious defect such as to affect their performance in use and record any observations. Then carry out the bending moment test as specified in 5.5.8, including preliminary conditioning.

5.5.9.4.4 Expression and interpretation of results

For each of the two lots, calculate the mean breaking bending moment and the standard deviation of the values obtained.

Let M_1 and s_1 be the mean and the standard deviation of the results obtained on the first lot, and M_2 and s_2 be the mean and the standard deviation of the results obtained on the second lot tested after immersion in water.

Calculate

the lower estimation of the mean breaking bending moment after immersion in warm water at 95 % confidence level:

$$L_S = M_2 - 0{,}58s_2$$

the upper estimation of the mean breaking bending moment at 95 % confidence level of the reference lot:

$$L_1 = M_1 + 0{,}58s_1$$

NOTE 2 The coefficient of 0,58 is related to a sampling size of 10 specimens as defined in ISO 2602:1980, table 1, for the unilateral level of confidence at 95 %.

Calculate the 95 % lower confidence limit as follows:

$$L = \frac{L_1}{L_S}$$

The visual observations and the result L shall be compared with the requirements of 5.4.3.4.

The results are considered to be satisfactory if they conform with the requirements.

5.5.9.5 Heat-rain

5.5.9.5.1 Preparation of specimens

The test shall be carried out on 12 full size sheets.

5.5.9.5.2 Apparatus

5.5.9.5.2.1 A suitable frame inclined at 25° ± 5° placed in a space without draught but conveniently ventilated.

5.5.9.5.2.2 A heating device calibrated in order to maintain a blackbody[4] surface temperature of 70 °C ± 5 °C on the surface at the crown of corrugations. It should provide an approximately uniform power output during the whole heating period.

5.5.9.5.2.3 A water-sprinkling device with an output of approximately 2,5 l/min per square metre of plate surface, delivering water at an ambient temperature higher than 5 °C.

5.5.9.5.3 Procedure

Submit the test specimens to preliminary conditioning by storage to equilibrate for 7 days in a laboratory atmosphere with suitable aeration, with the specimens fixed on the frame according to national standards or regulations or, if non-existent, to the manufacturer's laying instructions. Lay each sheet with actual or simulated overlaps at the four edges.

Submit the sheets to 25 cycles as described in table 4.

Table 4 — Heat-rain cycle

Operation	Duration
Wetting (2,5 l/min/m^2)	2 h 50 min
Interval	10 min
Heating 70 °C ± 5 °C	2 h 50 min
Interval	10 min
Total	6 h

After 25 cycles, inspect the sheets for cracking (longitudinal, transverse and at the fixing points), delamination, or other visual defects. Examination of the sheets may be delayed but the 25 cycles shall be consecutive.

5.5.9.5.4 Expression and interpretation of results

The result of the visual assessment shall comply with the specification in 5.4.3.5.

The result is considered to be satisfactory if it complies with the requirements.

5.6 Marking

A minimum of 15 % of the sheets shall be marked legibly and indelibly so as to identify

a) the manufacturer;

b) the date of manufacture;

c) the class.

6 Fittings

6.1 Composition

The fittings shall be of similar composition to the sheets.

4) For the definition of a blackbody, see paragraphe 4.4 in ASTM E 638-78 (1987). For this test an aluminium plate of 1 mm thickness painted with a matt black paint is used as a blackbody. The measurement device is a thermocouple or a similar device fixed behind the aluminium plate.

6.2 General appearance and finish

Fittings are components with particular shapes which are fitted to profiled sheets and complete the roofing at the verge, ridge and eaves or perform functions such as ventilation, daylight-admission, etc.

Fittings shall have straight and clean edges. They may have lapping joints. They may be left in their natural colour or colouring matter may be added in the composition. They may also receive adherent coloured or uncoloured coatings on their surface.

6.3 Characteristics

6.3.1 Dimensions

The fittings shall have dimensions and tolerances appropriate for use with their corresponding sheets.

6.3.2 Physical characteristics

6.3.2.1 Frost resistance (type characteristics)

This test shall be carried out if local climatic conditions justify it or if national standards specify it.

When tested as specified in 6.3.2.2 (optional test), any visible cracks, delamination or other defects in the fittings should not be of a degree as to affect their performance in use.

These characteristics shall be determined on products as-delivered wherever practical. The results are identified as applying to coated or uncoated materials. Failure of the coating does not constitute failure of the product.

6.3.2.2 Frost resistance test

The specimens shall be cut from complete fittings and shall be approximately 200 mm by 200 mm.

The apparatus is the same as for sheets.

Submit five specimens cut from different fittings to the same freeze/thaw cycle as for the sheets.

After the cycles are completed, examine them with the naked eye for cracks, delamination or other defects and record any observations. The result complies with this International Standard if the observations are in accordance with the specification of 6.3.2.1.

6.4 Marking

Marking of the fittings shall permit identification of the manufacturer.

7 Conformity with this International Standard

7.1 Conformity with requirements

For the acceptance tests, 95 % of the delivered products shall fulfill the requirements of 5.4.1.2, 5.4.1.5, 5.4.2 and 5.4.3.3.

The use of the sampling schemes provided in ISO 390 with an AQL of 4 % and an inspection level S3 ensures that for continuous series of large batches, approximately 95 % of the items fulfill these requirements. Other methods may be used provided they ensure at least the same level of quality.

For each type test, in the absence or a fundamental change to the formulation and/or method of manufacture, results from one test performed within the last five years shall be taken as conformity to the requirements of 5.4.3.1, 5.4.3.2, 5.4.3.4 and 5.4.3.5.

7.2 Evidence of conformity of consignment of finished products

When tenders and/or orders do not specify receiving inspection, the lots are presumed to be in conformity with this International Standard.

Inspection of a consignment of finished products should take place only where there is no third-party certification. In this case, it shall be conducted in accordance with ISO 390, which gives an AQL of 4 % with an inspection level S3 and according to annex A.