

INTERNATIONAL STANDARD

ISO 9933

First edition
1995-03-01

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

iTeh STANDARD PREVIEW

*(Produits en ciment renforcé par des fibres — Plaques ondulées ou
nervurées longues et leurs accessoires pour couvertures et revêtements*

[ISO 9933:1995](https://standards.iteh.ai/catalog/standards/sist/3d680498-d8aa-4b10-ad4d-6cd167855293/iso-9933-1995)

<https://standards.iteh.ai/catalog/standards/sist/3d680498-d8aa-4b10-ad4d-6cd167855293/iso-9933-1995>

INTERNATIONAL

ISO



Reference number
ISO 9933:1995(E)

Contents

	Page
1 Scope	1
2 Normative reference	1
3 Definitions	1
4 Symbols, abbreviations and units	2
5 Sheets	2
5.1 General composition	2
5.2 General appearance and finish	2
5.3 Categorization and classification	4
5.4 Characteristics	5
5.5 Tests	7
5.6 Marking	17
6 Fittings	17
6.1 Composition	17
6.2 General appearance and finish	17
6.3 Characteristics	17
6.4 Marking	18
7 Conformity with this International Standard	18
7.1 Conformity with requirements	18
7.2 Evidence of conformity of consignment of finished products	18

iTeh STANDARD PREVIEW
(standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/3d680498-d8aa-4b10-ad4d-6cd167855293/iso-9933-1995>

Annexes

A Receiving inspection for products which are not subject to third-party certification	19
B Dry bending moment test	20
C Bibliography	23

© ISO 1995

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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 9933 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.

<https://standards.iteh.ai/catalog/standards/iso-9933-1995>

iTeh STANDARD PREVIEW
This page intentionally left blank
(standards.iteh.ai)

[ISO 9933:1995](#)

<https://standards.iteh.ai/catalog/standards/sist/3d680498-d8aa-4b10-ad4d-6cd167855293/iso-9933-1995>

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

1 Scope

This International Standard specifies the technical characteristics of straight fibre-cement profiled sheets, of more than 0,9 m length, and their fibre-cement fittings used as roofing and cladding materials. It also specifies tests for checking these characteristics as well as marking and conditions of acceptance.

Some of these requirements may apply, after agreement between manufacturer and purchaser, to curved corrugated sheets.

It does not apply to asbestos-cement corrugated or profiled sheets which are covered by ISO 393-1 and ISO 393-3, nor to short fibre-cement sheets which are covered by ISO 9383, 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*.

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

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.¹⁾

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.

3.5 fibres

- (1) Discrete elements randomly dispersed.
- (2) Continuous strands and tapes.
- (3) Nets or webs.

3.6 breaking load: Maximum load achieved during the bending test and representing the load-bearing capacity of the sheets at the test span.

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
e, e_1, e_2	Thicknesses of the sheet, in millimetres
f	Deflection, in millimetres, in the breaking load test
$f_{0,2}$	Deflection, in millimetres, at 20 % of the specified load in the breaking load test
$f_{0,7}$	Deflection, in millimetres, at 70 % of the specified load in the breaking load test
f_t	$f_{0,7} - f_{0,2}$, 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_1 to L_3
L_1	Upper estimation at 95 % confidence level of the result M_1 in the warm water test
L_3	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
i	Clear span, in millimetres, between the supports in the breaking bending moment test
l_1, l_2, l_3	Widths of the sheet, in millimetres
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
P_c	Breaking load per metre width, in newtons per metre
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 specimens for the apparent density test
w	Width of the sheet for the breaking load test, in metres
ρ	Apparent density of specimen, in grams per cubic centimetre

STANDARD PREVIEW
5 Sheets
(standards.iteh.ai)

5.1 General composition

Sheets and fittings covered by this International Standard consist essentially of an inorganic hydraulic binder²⁾ 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.

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

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

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 pre-mitred or prepared for mitring and may be predrilled for fixing.

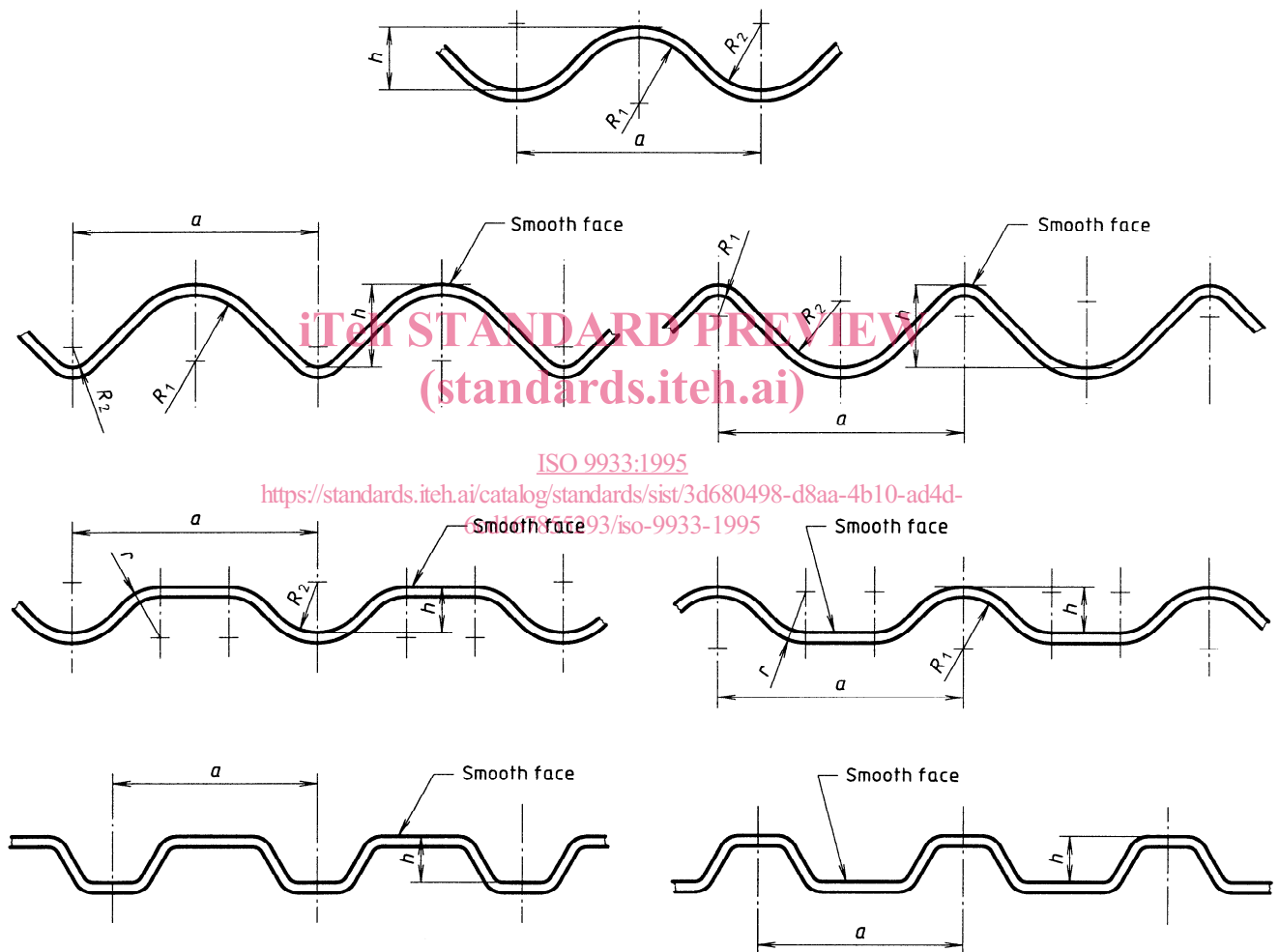


Figure 1

5.3 Categorization and classification

5.3.1 According to nominal height of corrugations

The sheets are categorized according to the height of their corrugations, h , in accordance with table 1.

Table 1 — Categories

Category	Description	h mm
A	Shallow corrugations	$15 \leq h \leq 30$
B	Medium corrugations	$25 \leq h \leq 55$
C	Deep corrugations	$40 \leq h \leq 80$
D	Very deep corrugations	$60 \leq h \leq 150$

5.3.2 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).

5.3.3 According to minimum breaking load in bending

Each category of sheet is subdivided into classes according to the value of the minimum breaking load (see table 3).

NOTES

- 1 National standards may choose one or more classes depending on the local conditions in the area in use.
- 2 National standards may specify, in addition of the minimum breaking load, the unit flexural strength for categories B and C provided that the manufacturer defines the profile, including the side corrugations, and consequently indicates how to calculate the moment of inertia.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 9933:1995

<https://standards.iteh.ai/catalog/standards/sist/3d680498-d8aa-4b10-4d4d-6cd167855293/iso-9933-1995>

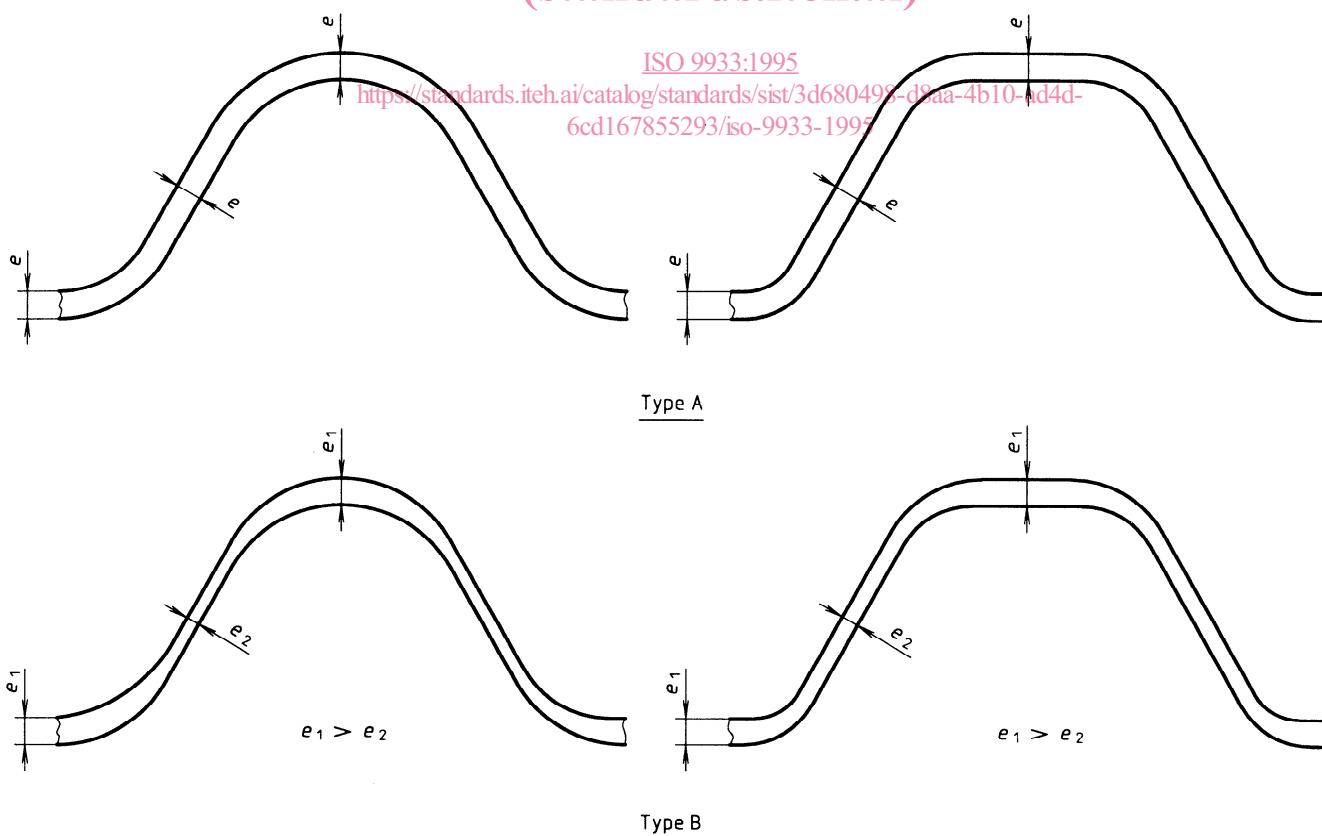


Figure 2

5.4 Characteristics

Table 2 — Thickness

Dimensions in millimetres

Categories	Thickness, <i>e</i> min.
A	3
B	4
C	4,5
D	5,5

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 , l_2 and l_3 as shown in 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 2.

5.4.1.3 Number of corrugations

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

ITIH STANDARD PREVIEW
(standards.iteh.ai)

ISO 9933:1995

<https://standards.iteh.ai/catalog/standards/sist/3d680498-d8aa-4b10-ad4d-6cd167855293/iso-9933-1995>

Dimensions in millimetres

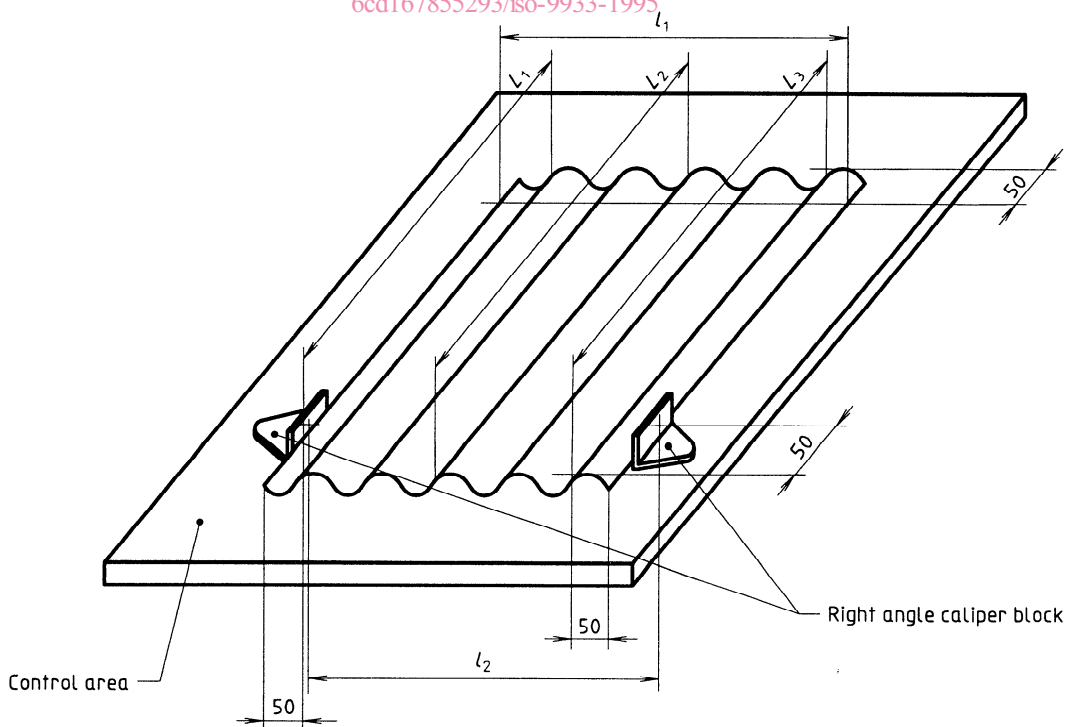


Figure 3

5.4.1.5 Tolerances on dimensions

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

a) Tolerance on pitch, a :

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

b) Tolerance on height, h :

15 mm $\leq h \leq 45$ mm	± 2 mm
45 mm $< h \leq 150$ mm	± 3 mm

c) Tolerance on length: ± 10 mm

d) Tolerance on width: $\begin{matrix} +10 \\ -5 \end{matrix}$ mm

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

f) Out-of-squareness of sheet: ≤ 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.

5.4.2.1 Breaking load

When tested as specified in 5.5.8, sheets shall have a breaking load at least equal to the specified values indicated in table 3.

5.4.2.2 Deflection

When tested as specified in 5.5.8, the increase in deflection f_t between applying 20 % ($f_{0,2}$) and 70 % ($f_{0,7}$) of the load specifying the class shall not exceed the conventional value f given by the following equation:

$$f = 0,7 \times 10^{-3} \times \frac{l_2}{h}$$

$$f_t = f_{0,7} - f_{0,2}$$

where $f_{0,7}$ and $f_{0,2}$ are as specified in table 3 for the category and class of sheets under test.

However, this specification does not apply to the two lower classes of categories A, B and C, and to the lower class of category D.

5.4.3 Physical characteristics

NOTE 4 For non-roofing and cladding applications, alternative physical characteristics may be agreed between the manufacturer and purchaser.

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.

5.4.2 Mechanical characteristics

NOTE 3 For non-roofing and cladding applications, alternative mechanical characteristics may be agreed between the manufacturer and purchaser.

Table 3 — Minimum breaking load per metre width according to category and class

Category	Minimum breaking load N/m									
	Class									
	1	2	3	4	5	6	7	8	9	10
A (15 mm $\leq h \leq 30$ mm)	600	800	1 000	1 400	—	—	—	—	—	—
B (25 mm $\leq h \leq 55$ mm)	—	—	1 000	1 400	2 000	2 500	3 300	—	—	—
C (40 mm $\leq h \leq 80$ mm)	—	—	—	1 400	2 000	2 500	3 300	4 250	—	—
D (60 mm $\leq h \leq 150$ mm)	—	—	—	—	—	—	3 300	4 250	5 600	7 400

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 specimens 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

- dimensions (5.5.3 to 5.5.7);
- mechanical characteristics: breaking load (5.5.8).

5.5.1.2 Optional tests (at purchaser's request)

- 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

- mechanical characteristics: deflection (5.5.8);
- 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