BRITISH STANDARD

BS EN
494:2004
+A3:2007

Fibre-cement profiled sheets and fittings — Product specification and test methods

The European Standard EN 494:2004, incorporating amendments A1:2005, A2:2006 and A3:2007, has the status of a British Standard

ICS 91.100.40

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 494:2004+A3:2007, incorporating amendments A1:2005; A2:2006 and A3:2007. It supersedes BS EN 494:1994, which is withdrawn.

The start and finish of text introduced or altered by CEN amendment is indicated in the text by tags ⟨A1⟩ ⟨A1⟩. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by ⟨A1⟩ ⟨A1⟩.

The UK participation in its preparation was entrusted by Technical Committee B/542, Roofing and cladding products for discontinuous laying, to Subcommittee B/542/4, Fibre reinforced cement sheeting for roofing.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 9 December 2004

ISBN 978 0 580 59708 4

Amendments issued since publication

Amd. No.	Date	Comments
16051	14 February 2006	See national foreword
16726	31 October 2006	See national foreword
17300	31 August 2007	Implementation of CEN amendment A3:2007

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 494:2004+A3

March 2007

ICS 91.100.40

Supersedes EN 494:2004

English Version

Fibre-cement profiled sheets and fittings - Product specification and test methods

Plaques profilées en fibres-ciment et accessoires - Spécifications du produit et méthodes d'essai

Faserzement-Wellplatten und dazugehörige Formteile - Produktspezifikation und Prüfverfahren

This European Standard was approved by CEN on 3 March 2004 and includes Amendment 1 approved by CEN on 20 July 2005, Amendment 2 approved by CEN on 14 August 2006 and Amendment 3 approved by CEN on 8 February 2007.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 494:2004+A3:2007: E

Contents

Page

Foreword

This document (EN 494:2004+A3:2007) has been prepared by Technical Committee CEN/TC 128 "*Roof covering products for discontinuous laying and products for wall cladding*", the secretariat of which is held by IBN/BIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2007, and conflicting national standards shall be withdrawn at the latest by September 2007.

This document includes Amendment 1, approved by CEN on 2005-07-20, Amendment 2, approved by CEN on 2006-08-14 and Amendment 3, approved by CEN on 2007-02-08.

This document supersedes ⟩A3⟨ EN 494:2004 ⟨A3⟩.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ⟩A1⟨ ⟨A1⟩, ⟩A2⟨ ⟨A2⟩ and ⟩A3⟨ ⟨A3⟩.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA which is an integral part of this document.

A distinction has been made between product appraisal (type tests) and routine quality control requirements (acceptance tests).

The performance of a roof or another building part constructed with these products depends not only on the properties of the product as required by this document, but also on the design, construction and installation of the components as a whole in relation to the environment and conditions of use.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This document specifies the technical requirements and establishes methods of control and test as well as acceptance conditions for fibre-cement profiled sheets and their fibre-cement fittings for one or more of the following uses:

— roofing,

— internal wall finishes,

— external wall and ceiling finishes.

For the purpose of this document fibre-cement profiled sheets are classified according to their height of corrugation and their mechanical characteristics.

This document covers fibre-cement profiled sheets reinforced with fibres of different type as specified in 5.1.1, with and without factory applied coating.

This document does not include calculations with regard to works, design requirements, installation techniques, wind uplift or rain proofing of the installed sheets.

NOTE Some of these requirements can be applied to curved sheets, after agreement between manufacturer and purchaser.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

ENV 1187 [A3] *deleted text* [/A3], *Test methods for external fire exposure to roofs*

EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire test*

[A3] EN 13501-5, *Fire classification of construction products and building elements — Part 5: Classification using data from external fire exposure to roofs test* [/A3]

[A2] EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item* [/A2]

[A3] EN 15057, *Fibre cement profiled sheets — Impact resistance test method* [/A3]

[A2] EN ISO 1716, *Reaction to fire tests for building products — Determination of the heat of combustion (ISO 1716:2002)* [/A2]

ISO 390, *Products in fibre-reinforced cement — Sampling and inspection*

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

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3951, *Sampling procedures and charts for inspection by variables for percent non-conforming*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
profiled sheet
component the cross section of which consists of corrugations as in the examples shown in Figures A.1 to A.7. The corrugations are defined by their pitch *a* and their height *h*

3.2
acceptance test
test to establish whether a batch of products conforms to a specification. The test is performed on samples drawn either from continuous production or from a consignment

NOTE Test methods and specification limit values are specified in this document. Sampling levels and acceptance criteria are given in 6.3.2.

3.3
type test
test carried out to demonstrate conformity with the requirements of this document or for the approval of a new product and/or when a fundamental change is made in formulation and/or method of manufacture, the effects of which cannot be predicted on the basis of previous experience. The test is performed on the as delivered product, but is not required for each production batch

3.4
acceptable quality level *(AQL)*
quality level which in a sampling plan corresponds to a specified, relatively high probability of acceptance. It is the maximum percent defective (or maximum number of defects per 100 units) that for purposes of sampling inspection can be considered satisfactory as a process average

NOTE 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
as delivered
the same condition as the producer intends to supply the product after completing all aspects of the process including maturing and, when appropriate, painting

3.6
short sheet
sheet having a length less than or equal to 0,9 m

3.7
long sheet
sheet having a length greater than 0,9 m

3.8
upper face
face normally exposed to the weather

3.9
under face
the reverse of the upper face

4 Symbols and abbreviations

a 1. Pitch of the corrugations in millimetres

2. One of the coefficients of the regression line (Annex C)

b 1. Dimension of the specimen parallel to the supports in either the breaking load test or the bending moment test in millimetres

2. One of the coefficients of the regression line (Annex C)

d Apparent density of the sheet in grams per cubic centimetres

e Thickness of the sheet in millimetres

f Increase in deflection between applying 20% and 70% of the specified load in the breaking load test in millimetres

F Load at rupture from either the breaking load test or the bending moment test in newtons

F_S Load at rupture per metre width from the breaking load test in newtons

h Height of the corrugations in millimetres

h_{od} Height of the edge of the descending corrugation in millimetres

h_{om} Height of the edge of the ascending corrugation in millimetres

l Length of the sheet in millimetres

l_s Clear span between the supports in the breaking load test or span between the centre of the supports in the bending moment test in millimetres

L_1 Upper estimate of the mean breaking load or bending moment at 95% confidence level

L_2 Lower estimate of the mean breaking load or bending moment at 95% confidence level

m Mass of the specimen after drying in grams

M Bending moment at rupture per metre length from the bending moment test in newton metres per metre

R_L Ratio of estimate L_2 to estimate L_1

s_1 Standard deviation of the specimens with mean X_1

s_2 Standard deviation of the specimens with mean X_2

V Volume of the test specimen in cubic centimetres

x_o Actual result obtained when dry testing

w Width of the sheet in millimetres

X_1 Mean value of the test results (bending strength or bending moment) of the control specimens (first lot) for a type test

X_2 Mean value of the test results (bending strength or bending moment) of the specimens after a type test

x_{std} Minimum value to be used as the specification for the dry method of test. This value is calculated at the 97,5% lower confidence level from the value y_{std} specified for the wet method of test in this document

y_o Value calculated from the value obtained from a specimen tested dry, which is the estimate at the 97,5% lower confidence level of the value expected from a specimen tested wet

y_{std} Minimum value specified in the standard for wet testing.

5 Product requirements

5.1 General

5.1.1 Composition

Fibre-cement profiled sheets and fittings shall consist essentially of cement or a calcium silicate formed by chemical reaction of a siliceous and a calcareous material, reinforced by fibres. The cement shall comply with EN 197-1 or with technical specifications relevant in the country of use.

〚A1〉 This European Standard covers fibre-reinforced cement profiled sheets and fittings of type NT (Non-asbestos Technology). 〈A1〛

The reinforcing fibres shall be one or more of the following forms:

— discrete elements randomly dispersed;

— continuous strands or tapes;

— nets or webs.

Process aids, fillers and pigments which are compatible with the composite may be added.

5.1.2 Appearance and finish

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

Variations of the surface appearance which do not impair the characteristics of the sheets as defined in this document are permitted.

On exposure, the surface and/or its coating will be affected by weathering which may vary with site, location, aspect, pitch of roof and duration of exposure. Any deterioration in this respect shall not detract from the minimum mechanical and physical characteristics as specified in this document or from the function of the sheet as a durable element.

Edges shall be straight and clean.

Sheets may have mitred or pre-mitred corner(s) and/or may be predrilled for fixing.

The fittings shall have a general appearance and finish compatible with the sheets with which they are to be used. They may be supplied with holes for fixing.

5.2 Dimensions and tolerance

5.2.1 General

The manufacturer shall specify the nominal dimensions.

NOTE See 5.7 for designation and information.

Fittings shall have nominal dimensions and shapes determined by the manufacturer and appropriate to the corresponding corrugated section sheets.

5.2.2 Categorization by height of profile

The sheets are divided into five categories, depending on the nominal height of the corrugations, according to Table 1 (examples of profiles are shown in Figures A.1 to A.7).

Table 1 – Categorization by height of profile

Category	*h* (mm)
A	15 to 30
B	25 to 45
C	40 to 80
D	60 to 120
E	90 to 150

5.2.3 Thickness

The thickness of the sheets shall either:

— be approximately constant across the width of the profile, as shown in Figure A.8a or

— vary regularly from the crowns and valleys to the flanks of the corrugations, as shown in Figure A.8b.

When measured in accordance with 7.2.1.3 the minimum individual thickness for each category shall be as specified in Table 2.

Table 2 – Minimum individual thickness

Category	*h* (mm)	Minimum individual thickness (mm)	
		Length > 0,9 m	Length ≤ 0,9 m
A	15 to 30	4,0	3,5
B	25 to 45	5,0	4,0
C	40 to 80	5,2	4,0
D	60 to 120	5,5	5,0
E	90 to 150	6,0	-
NOTE A special Class Z is allowed in Category A with a minimum individual thickness of 3,5 mm.			

5.2.4 Tolerances on nominal dimensions

5.2.4.1 Profiled sheets

When measured in accordance with 7.2 the allowable dimensional variations shall be as follows:

a) on the pitch *a*:

a	Tolerances
$a \leq 75$ mm	± 1,5 mm
75 mm $< a \leq$ 180 mm	± 2,0 mm
180 mm $< a \leq$ 260 mm	± 2,5 mm
260 mm $< a$	± 3,0 mm

b) on the height *h*:

h	Tolerances
15 mm $\leq h \leq$ 45 mm	± 2,0 mm
45 mm $\leq h \leq$ 150 mm	± 3,0 mm

c) on the length *l* : ± 10 mm

d) on the width *w* : $^{+10}_{-5}$ mm

e) on nominal thickness *e*:

The average thickness measured in accordance with 7.2.1.3 shall be within ± 10% and not more than ± 0,6 mm of the nominal thickness.

f) on the squareness of the sheet:

Out of squareness ≤ 6,0 mm.

g) on the height of edges:

This tolerance applies only for sheets having a rising edge on one side and a descending edge on the other side, and where it is required by the installation technique in order to ensure weather tightness and/or geometrical fit.

The producer shall use the tolerances specified in installation standards or regulations or if none are given, he shall specify them in his literature.

5.2.4.2 Fittings

When measured in accordance with 7.2, the tolerances on nominal dimensions shall be as follows:

a) on length and width ± 10 mm

b) on the average thickness ± 1 mm

NOTE Installation standards or regulations can specify tolerances on other dimensions.

5.3 Physical requirements and characteristics for fibre-cement profiled sheets

5.3.1 General

Mechanical and material properties are determined for products as delivered, whenever practical. The results shall be identified as applying to coated or uncoated products.

NOTE See 6.3 for statistical interpretation.

5.3.2 Apparent density

The manufacturer's literature shall specify the minimum apparent density of the sheets. The sheet shall have an apparent density equal to or greater than that specified by the manufacturer when tested in accordance with 7.3.1.

5.3.3 Mechanical characteristics

5.3.3.1 Breaking load

There are two classes for sheets of length greater than 0,9 m depending on the minimum breaking load for each category. For sheets in Category C of length greater than 0,9 m and less than 1,25 m, there is a third class.

When tested in accordance with 7.3.2.1, the sheets shall have a breaking load, for a span of 1,1 m, at least equal to the values specified in Table 3.

Table 3 – Minimum breaking load

Category	*h* (mm)	Minimum breaking loads per metre width for a span of 1,1 m for sheets length > 0,9 m	
		Class 1 (N/m)	Class 2 (N/m)
A	15 to 30	1400	1250
B	25 to 45	2 500	2 000
C	40 to 80	4 250	3 500
D	60 to 120	7 000	5 500
E	90 to 150	12 500	8 500
NOTE 1 A special Class 3 is allowed in Category A with a minimum breaking load of 750 N/m. NOTE 2 A special Class 3 with a minimum breaking load per metre with of 2 200 N/m is allowed in Category C for sheets of length greater than 0,9 m and less than 1,25 m.			

5.3.3.2 Deflection

When tested in accordance with 7.3.2.1, the increase in deflection of sheets of length greater than 0,90 m measured between applying 20% and 70% of the minimum load specified for their class (see Figure A.24) shall not exceed:

$$f \leq 0{,}7 \times 10^{-3} \times l_s^2/h$$

where:

f is the increase in deflection, in millimetres;

*l*s is the clear span, in millimetres;

h is the nominal height of corrugation, in millimetres.

5.3.3.3 Bending moment

When tested in accordance with 7.3.2.2, the minimum bending moment per metre length at rupture of the sheets shall be as specified in Table 4.

5.3.3.4 [A3] Impact resistance

Where required, impact resistance shall be determined in accordance with EN 15057. [A3]

Table 4 – Minimum bending moment

Category	*h* (mm)	Minimum bending moment per metre length at rupture		
		Length > 0,9 m		Length ≤ 0,9 m (Nm/m)
		Class X (Nm/m)	Class Y (Nm/m)	
A	15 to 30	40	30	25
B	25 to 45	55	40	30
C	40 to 80	55	40	30
D	60 to 120	55	45	40
E	90 to 150	55	45	-
NOTE A special Class Z is allowed in Category A with a minimum bending moment of 20 Nm/m.				

5.3.4 Water impermeability

When tested in accordance with 7.3.3, traces of moisture may appear on the under surface of the sheets, but in no instance shall there be any formation of drops of water.

5.4 Durability requirements

5.4.1 General

Mechanical and material properties are normally determined for as delivered products. The results shall be identified as applying to coated or uncoated material. The performance of the coating in the tests specified in 5.4.2 and 5.4.3 shall not be considered in the assessment of the product.

5.4.2 Freeze-thaw

5.4.2.1 Freeze-thaw - Fibre cement profiled sheets

When tested in accordance with 7.4.1, after 100 freeze-thaw cycles, the ratio R_L as defined in 7.4.1.4 shall be not less than 0,70.

5.4.2.2 Freeze-thaw - Fibre cement fittings

When tested as specified in 7.4.3, any visible alteration shall not be of such a degree as to affect the performance in use.

5.4.3 Heat-rain

When tested in accordance with 7.4.2, after 50 heat-rain cycles any visible cracks, delamination or other defects in the fibre-cement sheets shall not be of such degree as to affect their performance in use.

(a) Water tightness is assessed according to 5.3.4.

(b) Warping and bowing are visually assessed.

5.4.4 Warm water

When tested in accordance with 7.3.4, after 56 days immersion at 60°C, the ratio R_L of the sheet as defined in 7.3.4.4 shall not be less than 0,70.

5.4.5 Soak-dry

When tested in accordance with 7.3.5, after 50 soak-dry cycles, the ratio R_L of the sheet as defined in 7.3.5.4 shall be not less than 0,70.

5.5 Summary of characteristics and classification

5.5.1 Summary of characteristics

Table 5 gives the differences between acceptance characteristics for long sheets and short sheets.

Table 5 – Acceptance characteristics

Category	Height corrugations (mm)	Long sheets					Short sheets	
		Minimum thickness (mm)	Breaking load		Bending moment at rupture		Minimum thickness (mm)	Bending moment at rupture (Nm/m)
			Class 1 (N/m)	Class 2 (N/m)	Class X (Nm/m)	Class Y (Nm/m)		
A	15 to 30	4,0	1 400	1 250	40	30	3,5	25
B	25 to 45	5,0	2 500	2 000	55	40	4,0	30
C	40 to 80	5,2	4 250	3 500	55	40	4,0	30
D	60 to 120	5,5	7 000	5 500	55	45	5,0	40
E	90 to 150	6,0	12 500	8 500	55	45	-	-

NOTE 1 A special Class 3Z is allowed in Category A with a minimum individual thickness of 3,5 mm, a minimum breaking load of 750 N/m and a minimum bending moment of 20 Nm/m.

NOTE 2 A special Class 3 with a minimum breaking load per metre width of 2 200 N/m in Category C for sheets of length greater than 0,90 m and less than 1,25 m is allowed.

5.5.2 Classification

5.5.2.1 Long sheets (length > 0,9 m)

The two types of long sheets are classified according to the following criteria:

— nominal height of corrugations: A, B, C, D, E

— class: Breaking loads 1, 2, 3

Bending moments X, Y, Z

Examples: B 2Y means height of corrugations between 25 mm and 45 mm, minimum breaking load 2 000 N/m, minimum bending moment 40 Nm/m.

C 1X means height of corrugations between 40 mm and 80 mm, minimum breaking load 4 250 N/m, minimum bending moment 55 Nm/m.

5.5.2.2 Short sheets (length ≤ 0,9 m)

Short sheets are classified according to the nominal height of corrugations in Categories A, B, C and D.

5.6 Fire and safety

5.6.1 External fire performance

When subject to regulatory requirements, the external fire performance of the sheets shall be declared in accordance with 7.5.1.

5.6.2 Reaction to fire

When subject to regulatory requirements, the reaction to fire of the sheets or fittings shall be declared in accordance with 7.5.2.

5.6.3 Release of dangerous substances

〚A1〉 *deleted text* 〈A1〛

For products containing substance(s) defined in Council Directive 76/769/EEC, the content shall be declared by the manufacturer. This applies to substances contained in the original formulation or created during the manufacturing process. In addition see Annex ZA.

5.7 Product information

The designation of the sheet shall include at least the following:

— type of product 〚A1〉 : NT 〈A1〛 (see 5.1.1);

— name of the profile;

— class;

— category;

— size.

The manufacturer shall include the following in his literature:

a) designation of the sheet as above;

b) shape of the profile;

c) number of complete corrugations;

d) nominal values for

- pitch,
- height of corrugations,
- thickness,
- height of edges, where applicable,
- length,
- width;

e) minimum apparent density;

f) information relevant to the handling and installation.

6 Evaluation of conformity

6.1 General

The conformity of products with the requirements of this document shall be demonstrated by:

- initial type testing; and
- factory production control by the manufacturer.

6.2 Type testing

6.2.1 General

Type tests shall be carried out on products as delivered. If several formats or sizes of the same nominal thickness are being produced from the same composition and by the same production method, type tests only need to be carried out on one size of each nominal thickness.

All characteristics listed in Table 6 shall be subject to initial type testing, except reaction to fire Class A1 without testing and external fire performance “deemed to satisfy” products.

Testing of mechanical characteristics is normally carried out with the upper face in compression. If required to establish a relationship between upper and under face testing, where significant differences are expected or if required for design purposes, the load shall be applied on the under face. Results obtained for under face testing are not relevant for classification.

6.2.2 Initial type testing

Initial type testing shall be performed to demonstrate conformity to this document. Tests previously performed in accordance with the provisions of this document (same product, same characteristic(s), test method, sampling procedure, same attestation of conformity, etc.) may be taken into account. In addition initial type testing shall be performed for the approval of a new product, or a fundamental change in formulation or method of manufacture, the effects of which cannot be predicted on the basis of previous experience.

The results of all type tests shall be recorded and held by the manufacturer for at least 5 years.

6.2.3 Further type testing

Whenever a change occurs in the fibre-cement sheet design, the raw material or supplier of components, or the production process, which would change significantly one or more of the characteristics, the type test shall be performed for the appropriate characteristic(s).

Table 6 — Number of sheets and fittings and compliance criteria

Characteristic	Requirement	Assessment method	Number of samples	Compliance criteria
Mechanical resistance (sheets)	5.3.3 [A3] (excluding 5.3.3.4) [A3]	7.3.2	Inspection S3 as per ISO 390	5.3.3 Tables 3 and 4 apply 4% AQL
[A3] Impact resistance [A3]	[A3] 5.3.3.4 [A3]	[A3] EN 15057 [A3]	[A3] See EN 15057 [A3]	[A3] See EN 15057 [A3]
Density (sheets)	5.3.2	7.3.1	7.3.1	5.3.2 and 7.3.1
External fire performance (sheets)	5.6.1	7.5.1	7.5.1	7.5.1
Reaction to fire (sheets and fittings)	5.6.2	7.5.2	7.5.2	7.5.2
Water impermeability (sheets)	5.3.4	7.3.3	3 test sheets	5.3.4
Dimensional variations (sheets and fittings	5.2	7.2	Inspection S3 as per ISO 390	5.2.3 and 5.2.4
Release of dangerous substances (sheets and fittings)	5.6.3	5.6.3		5.6.3
Warm water (sheets)	5.4.4	7.3.4	20 samples	5.4.4 and 7.3.4.4
Soak/dry (sheets)	5.4.5	7.3.5	20 samples	5.4.5 and 7.3.5.4
Freeze-thaw (sheets)	5.4.2	7.4.1	20 samples	5.4.2 and 7.4.1.4
Freeze-thaw (fittings)	5.4.2	7.4.3	5 samples	5.4.2
Heat-rain (sheets)	5.4.3	7.4.2	12 or 9 samples	5.4.3 and 7.4.2.4

6.3 Factory Production Control (FPC)

6.3.1 General

The manufacturer shall establish, document and maintain a FPC system to ensure that the products placed on the market conform with the stated performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.

A manufacturer who has established a Quality Management System according to EN ISO 9001, is considered to satisfy the above requirements.

The results of inspections, tests or assessments requiring action shall be recorded, as shall the action(s) taken.

6.3.2 Acceptance tests

The specifications of acceptance tests apply to the product as delivered, but may be carried out at an earlier stage of maturity.

Sampling from continuous production testing

— on the base sheet prior to coating,

— in conditions other than in Table 8,

is acceptable provided that it has been statistically established (see Annex C) that compliance with the requirements given in Table 3 is ensured.

Acceptance tests can also be used to confirm that a batch of sheets or fittings conforms with the standard, e.g. in conjunction with type tests or for receiving inspection.

The tests include the:

— measurement of dimensions - length, width and thickness (methods specified in 7.2.1);

— measurement of apparent density (method specified in 7.3.1, for sheets only);

— measurement of mechanical characteristics - bending strength (method specified in 7.3.2, for sheets only).

Each limit of specification, for the characteristics in Table 7, shall be subject to an AQL of 4%. The sampling schemes provided in ISO 390, with an AQL of 4% and an inspection level S_3, ensure that for large batches approximately 95% of the items fulfil the requirements.

Table 7 – Minimum sampling schemes

Profiled sheets Pitch Height of corrugations Thickness Height of edge (where applicable) Length Width Apparent density Breaking load Bending moment	ISO 2859-1 Inspection by attribute Double sampling AQL 4% Level S_1 ISO 3951 Inspection by variable; method s or σ AQL 4% Level S_3
Fittings Length Width Thickness	The same as for the dimensional characteristics of fibre-cement sheets

6.3.3 Equipment

All weighing, measuring and testing equipment shall be calibrated and regularly inspected according to documented procedures, frequencies and criteria.

6.3.4 Raw materials and components

The specification of all incoming raw materials and components shall be documented, as shall the inspection scheme for ensuring conformity.

6.3.5 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of all of the characteristics are maintained.

6.3.6 Non-conforming products

Non-conforming product shall be separated and handled according to documented procedures.

6.4 Inspection of a consignment of finished products

Inspection of a consignment of finished products is not a requirement of this document but if, in special cases, it is demanded by the customer, it may be carried out in accordance with Annex B and ISO 390.

7 Test methods

7.1 General

This part of the standard details both acceptance and type testing.

7.2 Dimensional tests

7.2.1 Dimensional tests for sheets

7.2.1.1 Measurement of pitch and height of corrugation

7.2.1.1.1 Preparation of specimen

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

7.2.1.1.2 Apparatus

7.2.1.1.2.1 A flat surface with dimensions appropriate to the dimensions of the sheets.

7.2.1.1.2.2 Steel cylindrical bars of 200 mm length with conical points fitted at the axis on one end and of large enough diameter to touch the flanks of the corrugations of the sheet.

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

7.2.1.1.2.4 A metal ruler accurate to 0,5 mm.

7.2.1.1.3 Procedure

7.2.1.1.3.1 Measurement of the pitch *a*

Lay the sheets flat and square on the surface (see Figure A.14) ensuring that the valley of every corrugation is in contact with it.

At one end of the sheet, lay the cylindrical bars in each valley of the corrugations with the conical point slightly out from the end of the sheet (see Figures A.9 to A.12).

Measure to the nearest 0,5 mm with the ruler the distance between consecutive conical points.

Any other method of measurement with the same accuracy may be used.

7.2.1.1.3.2 Measurement of the height of corrugation *h*

Lay the sheets flat and square on the surface (see Figure A.14) ensuring that the valley of every corrugation is in contact with it.

Select three complete corrugations or all complete corrugations if less than three, and on each selected corrugation take three regularly spaced measurements to the nearest 0,1 mm with the micrometer (see Figure A.13).

Any other method of measurement with the same accuracy may be used.

7.2.1.1.4 Expression and interpretation of results

7.2.1.1.4.1 Pitch *a*

Each measurement of the pitch shall conform to the specification of 5.2.4.1 a).

7.2.1.1.4.2 Height of corrugation *h*

Each result which is the average of three measurements on each corrugation shall conform to the specification of 5.2.4.1 b).

7.2.1.2 Measurement of the length and the width

7.2.1.2.1 Preparation of specimen

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

7.2.1.2.2 Apparatus

7.2.1.2.2.1 A flat surface with dimensions appropriate to the dimensions of the sheets.

7.2.1.2.2.2 A ruler graduated in millimetres.

7.2.1.2.2.3 Two rectangular caliper blocks.

7.2.1.2.3 Procedure

Lay the sheets flat and square on the surface (see Figure A.14) 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 of the sheet.

To measure the width of sheets longer than 0,9 m, take three measurements, one in the middle and one approximately 50 mm from each end or further in, if necessary, to avoid mitred corners. For sheets of nominal length equal to or shorter than 0,9 m take two measurements approximately 50 mm from each end.

7.2.1.2.4 Expression and interpretation of results

Read each measurement to the nearest millimetre. Calculate the arithmetic average of the length and width which shall conform to 5.2.4.1 c) and 5.2.4.1 d).

7.2.1.3 Measurement of the thickness

7.2.1.3.1 Preparation of specimen

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

7.2.1.3.2 Apparatus

The apparatus shall consist of a micrometer with hemi-cylindrical plates (see Figure A.15) of radius 2 mm and length 10 mm, accurate to 0,05 mm.

7.2.1.3.3 Procedure

Take six measurements to the nearest 0,1 mm approximately 15 mm in from the end of each sheet as follows:

— for sheets of the type shown in Figure A.8a take the measurements in three valleys and three crowns of the corrugation as shown in Figure A.13a;

— for sheets of the type shown in Figure A.8b take the measurements on three crowns and the corresponding three sides of the corrugations as shown in Figure A.13b.

7.2.1.3.4 Expression and interpretation of results

Each individual measurement shall conform to the appropriate minimum thickness specified in Table 2 (see 5.2.3) and the arithmetic average of the six measurements made on one sheet shall conform to 5.2.4 e).

7.2.1.4 Measurement of out of squareness

7.2.1.4.1 Preparation of specimen

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

7.2.1.4.2 Apparatus

7.2.1.4.2.1 A flat surface with dimensions appropriate to the dimensions of a sheet.

7.2.1.4.2.2 A metal ruler accurate to 0,5 mm.

7.2.1.4.2.3 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.

7.2.1.4.3 Procedure

The out of squareness shall be measured as indicated in Figure A.16.

7.2.1.4.4 Expression and interpretation of results

The out of squareness shall conform to of 5.2.4 f).

7.2.1.5 Measurement of height of edges

7.2.1.5.1 Preparation of specimen

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

7.2.1.5.2 Apparatus

7.2.1.5.2.1 A flat surface with dimensions appropriate to the dimension of the sheet.

7.2.1.5.2.2 A device for measuring the height of the ascending corrugation *(h_{om})*.

7.2.1.5.2.3 A device for measuring the height of the descending corrugation *(h_{od})*.

7.2.1.5.3 Procedure

Measure the height of both edges (see Figure A.17) with the device to an accuracy of 1 mm.

7.2.1.5.4 Expression and interpretation of results

At any point on the edge of the sheet (except at mitred corners), the result shall conform to 5.2.4 g).

7.2.2 Dimensional tests for fittings

The test specimen is a complete fitting. The apparatus is the same as for sheets.

7.2.2.1 Measurements of length and width

For each dimension, take two measurements (one at each end). Read each measurement to the nearest millimetre.

Calculate the arithmetic average for each dimension which shall conform to 5.2.4.2 a).

7.2.2.2 Measurement of the thickness

The measurements shall be made:

— on three crowns and three valleys on the corrugated parts, at approximately 15 mm from the edge;

— on two distinct points on the flat part, at approximately 15 mm from the edge.

Calculate the average of the six measurements made on the corrugated part, and the average of the two measurements made on the flat part. These two averages shall conform to 5.2.4.2 b).

7.3 Tests for physical performance and characteristics

7.3.1 Apparent density

7.3.1.1 Preparation of specimen

The test specimen of size of at least 40 mm long and the width of one full corrugation shall be cut from a sheet.

7.3.1.2 Apparatus

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

7.3.1.2.2 A balance accurate to within 0,1 % of the specimen mass and equipped to determine both the immersed mass and the non-immersed mass of the specimen.

7.3.1.3 Procedure

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

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

7.3.1.4 Expression and interpretation of results

The apparent density *d* is given by the formula:

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

where:

d is the apparent density of the sheet in grams per cubic centimetres;

m is the mass of the specimen after drying in grams;

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

The result shall conform to 5.3.2.

7.3.2 Mechanical characteristics

7.3.2.1 Breaking load and deflection

7.3.2.1.1 Preparation of specimen

The test specimen shall be either a complete sheet or a transversely cut sheet with a minimum length of 1,20 m.

Testing shall be carried out after wet conditioning except that for quality control purposes dry testing can be carried out providing it is statistically established (see Annex C) that compliance with the requirements for wet testing given in Table 3 is ensured.

Specimens shall be conditioned in accordance with Table 8.

Table 8 – 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

7.3.2.1.2 Apparatus

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) and with an error of accuracy and an error of repeatability less than or equal to 3%, comprising (see Figure A.18).

Two parallel supports (one fixed) set in the same horizontal plane and longer than the sample width. The upper face of each support shall be flat and 50 mm in width. The distance between the supports shall be set to give a clear span of 1,10 m.

A rigid flat loading beam of width 230 mm of the same length as the supports and parallel and equidistant from them. It shall be attached to the mechanism by means of a flexible joint.

Three strips of felt or soft material approximately 10 mm thick.

7.3.2.1.3 Procedure

For sheets having a height of corrugation greater than 80 mm the clear span shall be increased to at least 15 times the height of corrugation.

For sheets shorter than 1,20 m the clear span shall be reduced to a minimum of 700 mm or 12 times the height of corrugations, whichever is greater, and the width of the loading beam reduced by the ratio of this clear span to 1,10 m.

Place the specimen on the supports (the upper face in compression) which are at right angles to the corrugations and after interposition of strips of felt or soft material loaded at midspan by the flat beam distributing evenly the load applied on its centre.

Measure the difference in deflection, expressed in mm, at midspan while applying a load between 20 % and 70 % of the load specifying the class.

The rate of loading shall be such that the rupture occurs between 10 s and 45 s after start of its application.

Record the breaking load at rupture *F*.

7.3.2.1.4 Expression and interpretation of results

The breaking load referred to the width *b* is given by the formula:

$$F_s = \frac{F}{b} \times 10^3$$

When a span l_S other than 1100 mm is used, the breaking load for comparison with Table 3 in 5.3.3.1 is given as:

$$F_s = \frac{F}{b} \times \frac{l_s}{1100} \times 10^3$$

where:

F_S is the load at rupture per metre width from the breaking load test in newtons per metre;

F is the load at rupture from the breaking load test in newtons;

b is the dimension of the specimen parallel to the supports in the breaking load test in millimetres;

l_S is the clear span between the supports in millimetres.

For specimens tested wet the results of the test shall conform to the appropriate specification in Table 3 (see 5.3.3.1) for breaking load and 5.3.3.2 for the deflection.

For specimens tested dry, either:

— calculate the corresponding wet values $y_{O,}$ using the method in Annex C, in which case y_O shall conform to Table 3 (see 5.3.3.1), or

— calculate the appropriate revised value for the specifications $x_{std,}$ using the method in Annex C, in which case the dry results shall conform to the revised value.

7.3.2.2 Bending moment

7.3.2.2.1 Preparation of specimen

The test specimen of length at least 0,3 m shall be cut from a whole sheet avoiding the edge corrugations if possible.

Specimens of sheets of constant thickness as shown in Figure A.8a should have a crown at the centre point and one full pitch either side plus an overlap on the support bearers to a maximum of half a pitch each side (see Figure A.19). If the sheet width will not allow this, then reduce the sheet width to half one pitch each side of the central crown plus an overlap as defined (see Figure A.20).

It is recommended that sheets of variable thickness as shown in Figure A.8b have a valley at the centre point and one and a half pitches either side plus an overlap on the support bearers to a maximum of half a pitch (see Figure A.21).

Testing shall be carried out after wet conditioning, except that for quality control purposes dry testing can be carried out providing it is statistically established (see Annex C) that compliance with the requirements for wet testing given in Table 4 is ensured.

Specimens shall be conditioned in accordance with Table 8.

7.3.2.2.2 Apparatus

A bending test machine which achieves a constant rate of deflection of the specimen (or where this facility is not available a constant rate of loading is acceptable) and with an error of accuracy and an error of repeatability less than or equal to 3 % comprising the following:

- two parallel supports (one fixed) set in the same horizontal plane and longer than the sample width. The face of each support shall be rounded (radius 3 mm to 25 mm),

- either a loading bar for sheets as shown in Figures A.19a, A.19b and A.20, or a rigid beam of suitable width for sheets as shown in Figures A.21a and A.21b, longer than the sample length, parallel to the supports and located at the same distance of each of them,

- a strip of felt or soft material approximately 10 mm thick, longer than the sample length and wider than the loading bar or the rigid beam.

7.3.2.2.3 Procedure

Place the specimens on the supports (the upper face in compression) and after interposition of strips of felt or soft material (see Figures A.19 to A.21) load in the middle at the top of a corrugation using the loading bar or using the rigid beam, depending on the type.

The rate of loading shall be such that the rupture occurs between 10 s and 30 s after the start of its application.

Record the load at rupture *F*.

7.3.2.2.4 Expression and interpretation of results

The bending moment at rupture is given by the appropriate formula:

— for sheets of constant thickness (see Figure A.8a)

$$M = \frac{F \times l_s}{4 \times b}$$

— for sheets of variable thickness (see Figure A.8b)

$$M = \frac{F \times l_s}{6 \times b}$$

where:

M is the bending moment at rupture per metre length from the bending moment test in newton metres per metre;

F is the load at rupture in newtons;

l_S is the span between supports in millimetres;

b is the length of the test specimen in millimetres.

For specimens tested wet, the results of the test shall conform to 5.3.3.3.

For specimens tested dry, either

— calculate the corresponding wet values y_O, using the method in Annex C in which case y_O shall conform to Table 4 (see 5.3.3.3), or

— calculate the appropriate revised value for the specifications x_{std}, using the method in Annex C in which case the dry results shall conform to the revised value.

7.3.3 Water impermeability

7.3.3.1 Preparation of specimens

The test shall be made on three whole sheets as delivered or cut sheets with a minimum length of 1,20 m.

The sheets shall be kept for 7 days in a laboratory atmosphere at ambient temperature (exceeding 5 °C).

7.3.3.2 Apparatus

A frame constructed as shown in Figure A.22. The width of the frame depends on the profile of the sheets and shall be wherever possible more than 0,5 m. The length of the frame shall be between 0,5 m and 1,0 m.

7.3.3.3 Procedure

Seal the frame on the upper face of the sheet.

Fill the frame with water until the level is approximately 60 mm above the top of corrugations.

Examine the lower face after 24 h.

7.3.3.4 Expression and interpretation of results

The result of the visual assessment shall conform to 5.3.4.

7.3.4 Warm water

7.3.4.1 Preparation of specimens

7.3.4.1.1 Long sheets

20 specimens are required. The specimens shall be longitudinally cut from the middle of a complete sheet, with two complete corrugations or if the sheet is not wide enough, one complete corrugation.

Specimens shall be transversely cut to a length allowing a clear span of 12 times the height of corrugation.

The specimens shall be longitudinally cut in the valley a little beyond the axis, as indicated in Figure A.23.

7.3.4.1.2 Short sheets

20 specimens are required and prepared as for the bending moment test described in 7.3.2.2.1.

7.3.4.2 Apparatus

7.3.4.2.1 A water bath with a temperature control at (60 ± 2) °C.

7.3.4.2.2 A bending test machine either as described in 7.3.2.1.2 for long sheets or 7.3.2.2.2 for short sheets.

7.3.4.3 Procedure

Divide the specimens at random into two lots of 10.

Submit the first lot of 10 specimens to the breaking load test described in 7.3.2.1 for long sheets (taking for *w* the average of two measurements of the width of the specimen) or to the bending moment test described in 7.3.2.2 for short sheets, including the conditioning procedure (see Table 8).

At the same time immerse the second lot of 10 specimens in water at 60 °C saturated with product of the same composition and maintain the temperature at (60 ± 2) °C for (56 ± 2) days. The pieces of product used for saturation shall be broken down to a size and be of sufficient quantity to ensure saturation is complete.

After (56 ± 2) days carry out the breaking load test described in 7.3.2.1 for long sheets (taking for *w* the average of two measurements of the width of the specimen) or the bending moment test described in 7.3.2.2 for short sheets, including the conditioning procedure (see Table 8).

7.3.4.4 Expression and interpretation of results

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

Let X_1 and s_1 be the mean and the standard deviation of the results obtained on the first lot, and X_2 and s_2 be the mean and the standard deviation of the results obtained on the second lot tested after the period of immersion in warm water.

Calculate (ISO 2602):

$L_2 = X_2 - (0{,}58 \times s_2)$ which is the lower estimation of the mean breaking load or bending moment after immersion in warm water at 95% confidence level (second lot).

$L_1 = X_1 + (0{,}58 \times s_1)$ which is the upper estimation of the mean breaking load or bending moment at 95% confidence level of the reference lot (first lot).

Calculate the ratio, $R_{L,}$ as follows:

$$R_{L} = \frac{L_2}{L_1}$$

The result shall conform to 5.4.4.

7.3.5 Soak-dry

7.3.5.1 Preparation of specimens

7.3.5.1.1 Long sheets

20 specimens are required. The specimens shall be longitudinally cut from the middle of a complete sheet, with two complete corrugations or, if the sheet is not wide enough, one complete corrugation.

Specimens shall be transversely cut to a length allowing a clear span of 12 times the height of corrugation.

The specimens shall be longitudinally cut in the valley a little beyond the axis, as indicated in Figure A.23.

7.3.5.1.2 Short sheets

20 specimens are required and prepared as for the bending moment test described in 7.3.2.2.1.

7.3.5.2 Apparatus

7.3.5.2.1 A ventilated oven capable of achieving a temperature of (60 ± 5) °C and a relative humidity of < 20% with a full load of specimens.

7.3.5.2.2 A bath filled with water at ambient temperature (> 5°C).

7.3.5.2.3 A bending test machine as specified in either 7.3.2.1.1 (long sheets) or 7.3.2.2.2 (short sheets).

7.3.5.3 Procedure

Divide the specimens at random into two lots of 10.

Submit the first lot of 10 specimens to the breaking load test, in 7.3.2.1 for long sheets (taking for *w* the average of two measurements of the width of the specimen), and to the bending moment test, in 7.3.2.2 for short sheets including the conditioning procedure (see Table 8).

At the same time begin to submit the second lot to 50 soak-dry cycles consisting of

— immersion in water at ambient temperature for 18 h and

— drying in a ventilated oven at (60 ± 5) °C and relative humidity of less than 20% for 6 h. The 20% humidity shall be achieved at least 3 h prior to the conclusion of the 6 hours drying.

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

After 50 cycles, carry out the breaking load test in 7.3.2.1 for long sheets (taking for *w* the average of two measurements of the width of the specimen), and the bending moment test described in 7.3.2.2 for short sheets, including the conditioning procedure (see Table 8).

7.3.5.4 Expression and interpretation of results

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

Let X_1 and s_1 be the mean and standard deviation of the results obtained on the first lot and X_2 and s_2 be the mean and the standard deviation of the results obtained on the second lot tested after the soak-dry cycles.

Calculate (ISO 2602):

$L_2 = X_2 - (0{,}58 \times s_2)$ which is the lower estimation of the mean breaking load or bending moment after soak-dry cycles at 95% confidence level (second lot).

$L_1 = X_1 + (0{,}58 \times s_1)$ which is the upper estimation of the mean breaking load or bending moment at 95% confidence level of the reference lot (first lot).

Calculate the ratio, R_L, as follows:

$$R_L = \frac{L_2}{L_1}$$

The result shall conform to 5.4.5.

7.4 Tests for climatic performance

7.4.1 Freeze-thaw

7.4.1.1 Preparation of specimens

7.4.1.1.1 Long sheets

20 specimens are required. The specimens shall be longitudinally cut from the middle of a complete sheet, with two complete corrugations or, if the sheet is not wide enough, one complete corrugation.

Specimens may be transversely cut to a length allowing a clear span of 12 times the height of corrugation.

The specimens shall be longitudinally cut in the valley a little beyond the axis, as indicated in Figure A.23.

7.4.1.1.2 Short sheets

20 specimens are required and prepared as for the bending moment test described in 7.3.2.2.1.

7.4.1.2 Apparatus

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

7.4.1.2.2 A bending test machine as specified in either 7.3.2.1.2 for long sheets or 7.3.2.2.2 for short sheets.

7.4.1.2.3 A water bath filled with water and maintained at (20 ± 4) °C.

7.4.1.3 Procedure

Divide the specimens at random into two lots of 10.

Submit the first lot of 10 specimens to the breaking load test, in 7.3.2.1 for long sheets (taking for *w* the average of two measurements of the width of the specimen), or to the bending moment test, in 7.3.2.2 for short sheets, including the conditioning procedure (see Table 8).

At the same time immerse the second lot of specimens in water at ambient temperature (> 5 °C) for 48 h.

Then subject the second lot of specimens to 100 of the following freeze-thaw cycles:

— cool (freeze) in the freezer which shall reach a temperature of (-20 ± 4) °C within 1 h to 2 h and hold this temperature for a further 1 h,

— heat (thaw) in the water bath which shall reach a temperature of (20 ± 4) °C within 1 h to 2 h and hold at this temperature for a further 1 h.

During both the cooling and heating (freezing and thawing) cycles position the specimens to enable free circulation of the conducting medium (air in the freezer or water in the bath) around them.

Each freeze-thaw cycle shall take between 4 h and 6 h but an interval of 72 h maximum may be taken between cycles during which the specimens shall be stored in water at 20 °C.

Control of the freeze-thaw cycles can be automatic or manual. Continuous automatic cycling is preferable. For manual control record the completion of each cycle.

Carry out the breaking load test, in 7.3.2.1 for long sheets (taking for *w* the average of two measurements of the width of the specimen) and the bending moment test, in 7.3.2.2 for short sheets, including the conditioning procedure (see Table 8).

7.4.1.4 Expression and interpretation of results

For each of the two lots, calculate the mean breaking load or bending moment and the standard deviation at the value obtained.

Let X_1 and s_1 be the mean and the standard deviation of the results obtained on the first lot, and X_2 and s_2 be the mean and the standard deviation of the results obtained on the second lot tested after freeze-thaw cycles.

Calculate (ISO 2602):

$L_2 = X_2 - (0{,}58 \times s_2)$ which is the lower estimation of the mean breaking load or bending moment after freeze-thaw cycles at 95% confidence level (second lot).

$L_1 = X_1 + (0{,}58 \times s_1)$ which is the upper estimation of the mean breaking load or bending moment at 95% confidence level of the reference lot (first lot).

Calculate the ratio, R_L, as follows:

$$R_L = \frac{L_2}{L_1}$$

The result shall conform to 5.4.2.

7.4.2 Heat-rain

7.4.2.1 Preparation of specimens

The specimens shall be full size sheets. 12 specimens are required for sheets of length equal to or less than 0,9 m or nine specimens for longer sheets.

7.4.2.2 Apparatus

7.4.2.2.1 A frame with dimensions capable of taking at least one full size sheet and the overlapping strips, inclined at (25 ± 5)° placed in a ventilated area.

7.4.2.2.2 A heating device capable of maintaining the specified uniform temperature on the surface of the tested elements, at the crowns of the corrugations.

The heating device shall have a power output regulated by means of a black body temperature sensor located at the central area of the test rig where the maximum temperature is expected, i.e. at the closest distance underneath a heating unit.

The temperature at this location shall be regulated at (70 ± 5) °C and shall be reached after 15 min of heating.

At any time the difference between black body temperature in the centre and black body temperature near the corners of the test rig, also measured underneath heating units and at the crowns of the corrugations, shall not exceed 15 °C.

7.4.2.2.3 A water sprinkling device with an output of approximately 2,5 l/(m^2.min), delivering water of ambient temperature (> 5 °C).

NOTE For this test an aluminium plate of 1 mm thickness painted with a matt black paint is used as a black body, the measurement device being a thermocouple or a similar device fixed on the surface of the aluminium plate.

7.4.2.3 Procedure

Condition the specimens by storing them to allow them to reach equilibrium for 7 days in a laboratory atmosphere.

The number of full size sheets will depend on the size of the frame but shall be at least one.

Lay each sheet with overlaps at the four edges. At the edges of the frame overlaps can be provided by strips of sheets.

Fix the specimens on the frame according to regulations or, if no regulations exist, to manufacturer's instructions.

Submit the upper face of the sheets to 50 cycles without interruption in accordance with Table 9.

Table 9 – Heat-rain cycle

Cycles	Duration
Wetting 2,5 l/(m^2.min)	2 h 50 min
Pause	10 min
Heating (70 ± 5) °C	2 h 50 min
Pause	10 min
Total cycle	6 h

After 50 cycles inspect the sheets for the following:

— cracking (longitudinal, transverse and at the fixing points);

— delamination;

— other visible defects.

7.4.2.4 Expression and interpretation of results

The results of the visual assessment shall conform to 5.4.3.

7.4.3 Freeze-thaw test for fittings

The specimens shall be cut from complete fittings and shall be at least 200 mm x 200 mm.

The apparatus is the same as for sheets.

Five specimens cut from different fittings are submitted to the same freeze-thaw cycle as sheets.

After the 100 cycles are completed, examine them with the naked eye for cracks, delamination or other defects and record any observations. These observations shall conform to 5.4.2.

7.5 Test for fire performance

7.5.1 Test for external fire performance

7.5.1.1 Sheets satisfying the requirements for the external fire performance, due to the deemed to satisfy list

Sheets covered by this EN are considered “deemed to satisfy without the need ▌A3⟩ for ⟨A3▐ testing” in relation to the requirements for external fire performance, provided that they meet the definitions given in Commission Decision 2000/553/EC.

NOTE Member States may have national “deemed to satisfy” lists going further than that given Decision 2000/553/EC.

7.5.1.2 Other sheets

Sheets not meeting the definition as given in the list of products considered “Deemed to satisfy without the need for testing” shall be tested and classified in accordance with ▌A3⟩ EN 13501-5 ⟨A3▐. The sheets to be tested

shall be installed, in addition to the general provision given in ENV 1187, in a manner representative of their intended use in accordance with the manufacturer's specifications.

7.5.2 Test for reaction to fire

7.5.2.1 Sheets and fittings satisfying the requirements for the fire reaction Class A1 without the need for testing

Sheets and fittings containing 1% or less organic substances by mass or volume, whichever is the most onerous, are considered to satisfy the requirements for performance Class A1 of the characteristics reaction to fire, in accordance with the provisions of EC Decision 96/603/EC, as amended, without the need for testing.

7.5.2.2 Other sheets and fittings

7.5.2.2.1 〚A2〛 General 〚A2〛

Sheets and fittings not covered by 7.5.2.1 shall be tested and classified in accordance with EN 13501-1. The sheets to be tested shall, where the test method requires, be installed, in addition to the general provisions given in the test method, in a manner representative of their intended use in accordance with the manufacturer's specifications.

7.5.2.2.2 〚A2〛 Mounting and fixing provisions for EN 13823

7.5.2.2.2.1 End use applications

The end uses covered by the standardised mounting and fixing are fibre cement profiled sheets and fittings used as the external layer for discontinuously laid roof coverings, used as internal and external wall finishes and used as external ceiling finishes. In these end uses, the side of the product directed away from the fire is normally in contact with air and the cavity behind may or may not be filled with thermal insulation.

7.5.2.2.2.2 Test specimen

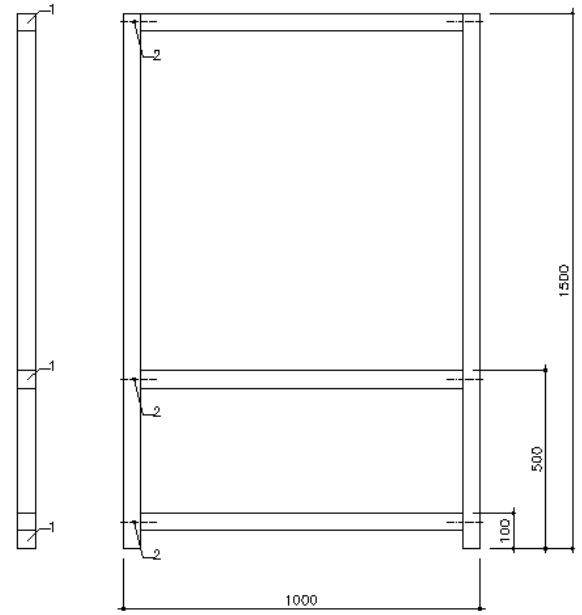
Products used for the construction of the test assembly are fibre cement profiled sheets with standard dimensions of length, width and thickness. They are cut to size to accommodate the dimensions of the test assembly. They include all facings and/or coatings that are normally applied to the product as it is placed on the market.

7.5.2.2.2.3 Test assembly

7.5.2.2.2.3.1 Dimensions

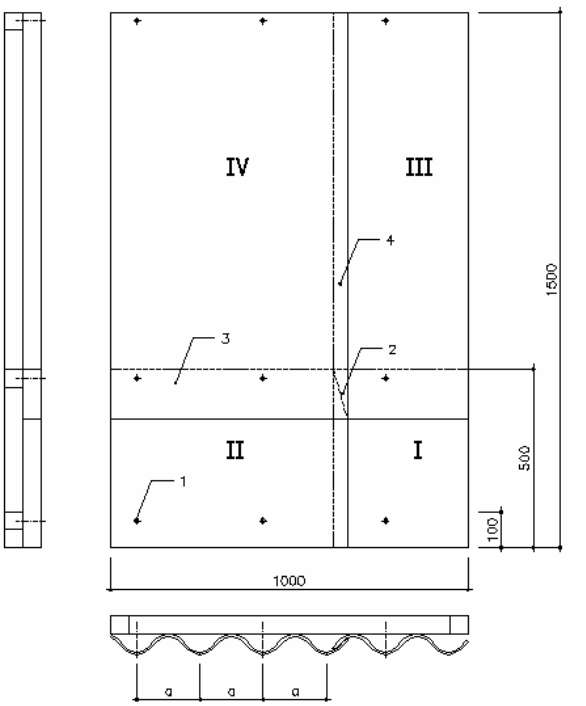
The test assembly is a corner set up made of two timber frame supporting constructions each with a height of 1,5 m to which the fibre cement profiled sheets are fixed. One frame forms a long wing (1,0 m) the other frame forms a short wing (0,5 m). Further information is given in Figures 1, 2, 3, 4 and 5.

Dimensions in millimetres; tolerances: 2 %, unless otherwise specified in text



Key
1 timber member (50 ± 1) mm × (50 ± 1) mm
2 screw or nail

Figure 1 — Timber frame long wing

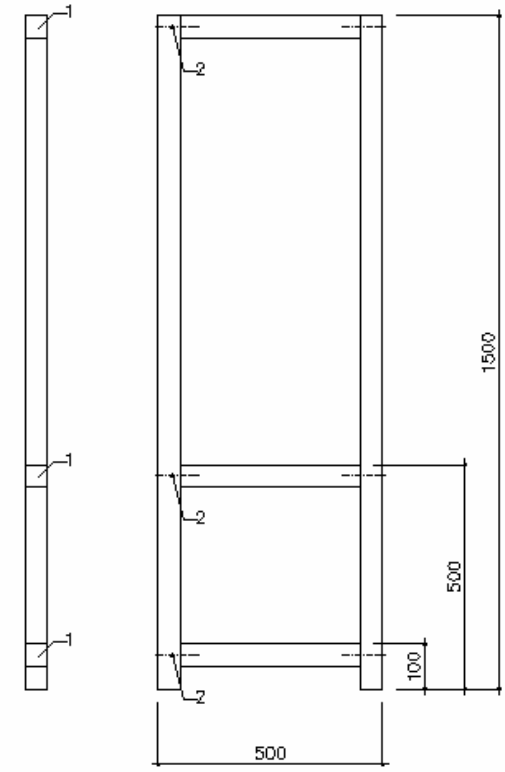


Key

I, II, III, IV	order of fixing
a	pitch of the profile
1	screw fix into crown
2	mitring of sheets
3	end lap (horizontal)
4	side lap (vertical)

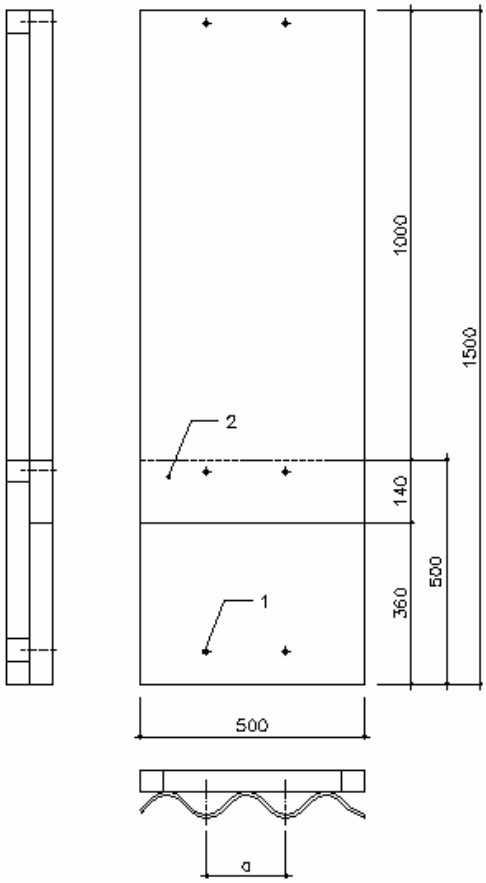
Figure 2 — Product fixing long wing

Dimensions in millimetres; tolerances: 2 %, unless otherwise specified in text



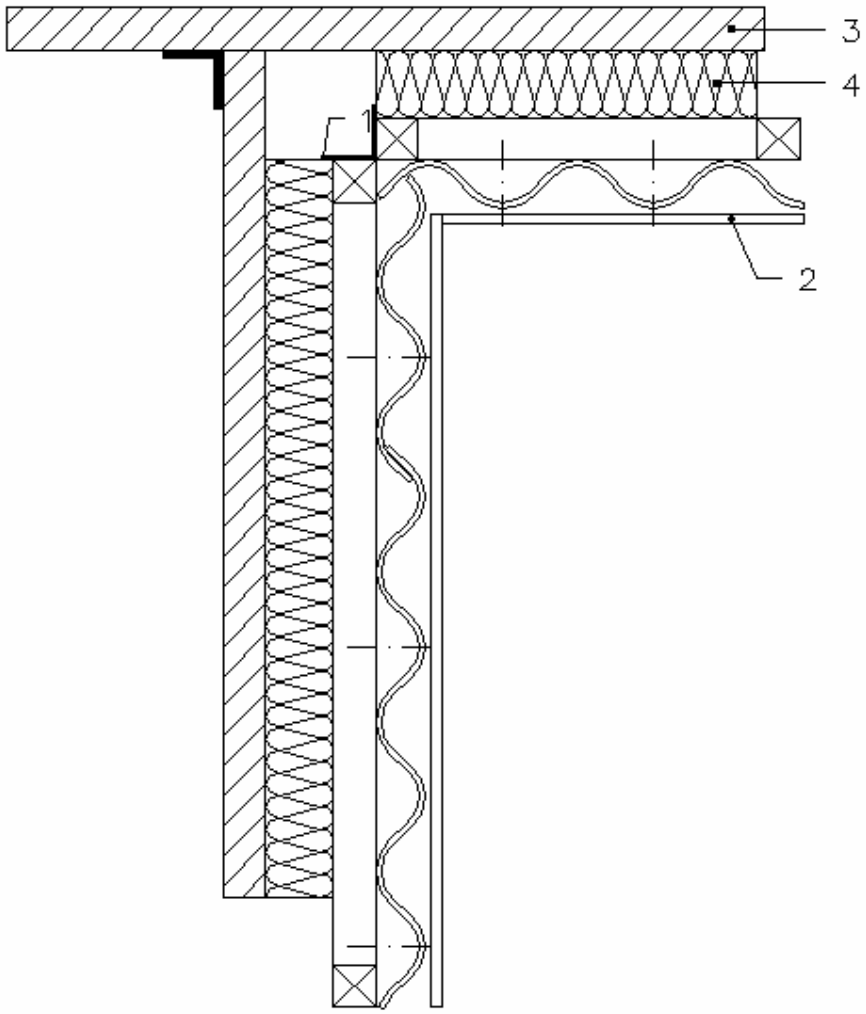
Key
1 timber member (50 ± 1) mm × (50 ± 1) mm
2 screw or nail

Figure 3 — Timber frame-short wing



Key
a pitch of the profile
1 screw fix into crown
2 end lap (horizontal)

Figure 4 — Product fixing short wing



Key
1 metal bracket or profile for connecting both frames
2 U-channel
3 backing board
4 insulation – mineral wool

Figure 5 — Corner set-up

7.5.2.2.2.3.2 Supporting construction and thermal insulation

Both long and short wing frames are made out of wood, (50 ± 1) mm × (50 ± 1) mm or larger available standard sizes for vertical and horizontal members provided sufficient stability for the frames is obtained. They are nailed or screwed together. When mounted into the test rig they are positioned such as to leave a space of at least 80 mm between the test rig backing board and the frame. The frames with the fibre cement profiled sheets fixed to it shall be free standing. The space of at least 80 mm between test rig backing board and backside of the supporting frame shall be filled with mineral wool insulation with a nominal density of (70 ± 20) kg/m³ and class A2-s1,d0 according to EN 13501-1. This configuration is representative for the end use as described in 7.5.2.2.2.1.

7.5.2.2.2.3.3 Fixings

The fibre cement profiled sheets are screwed onto the supporting frame using the normal self drilling and tapping metal screws as in practice. Washers and EPDM rubber or bituminous sealants as used in practice shall be used.

The screws are positioned in the top (crown) of the corrugation as in practice and at locations as indicated on the respective figures for product fixing short and long wing (see Figures 1 to 5).

7.5.2.2.2.3.4 Product orientation

For all end use applications, the testing is performed in vertical position. Products with identical surface finishes on both sides have to be tested at one side only. Products with different surface finishes or coatings on different sides shall be tested on both sides or with the side representative for the worst performance directed to the fire. The worst performance is normally obtained with the side having the finish with the highest organic content per m² surface or with the side with the darkest colour. The side with the highest organic content shall be derived from the composition of the different finishing layers or by determining their PCS value according to EN ISO 1716, taking account of the respective applied dry weights of the finishing layers.

In case both sides are tested, the classification of the side with the worst performance can be used for the classification of the product, or the classification of each of the sides can be declared separately. In case only one side is tested, the classification of that side can be used for the classification of the product.

7.5.2.2.2.3.5 Profile direction

The product shall be mounted onto the supporting frame such that its longitudinal direction of manufacturing is in vertical position.

7.5.2.2.2.3.6 Joints / overlaps

The side overlap shall be as in practice for the type of profile and the dimensions of the end waves of the specific profile that is to be tested. The end lap shall be 140 mm. The test shall be performed without additional sealant devices in both end and side lap.

The top edge of the bottom sheets shall be at a height of (500 ± 10) mm from the bottom of the assembly. The central axis of the horizontal end lap of (140 ± 10) mm is therefore at (430 ± 15) mm from the bottom of the assembly. An end lap shall be constructed in both the short and long wing.

A side overlap shall be constructed in the long wing. The side overlap is at a distance from the corner of the assembly depending on the type of profile and the specific design of the side lap for the product tested. In any case the sheet closest to the corner shall have a width of at least one and a half corrugation and not more than two corrugations.

The order of fixing the sheets on both wings is:

— bottom row starting from bottom corner with the face of the sheets as tight as possible to the rear of the U-channel;

— overlapping row starting from corner.

At the intersection of horizontal end lap and vertical side lap sheets shall be mitred as in practice.

When the profile of the sheet does not allow a tight corner joint the sheet shall be trimmed to ensure tight joint is produced.

7.5.2.2.2.4 Number of tests

Three valid tests are required for classification. The products used for the construction of the three test assemblies are taken from standard production lots. The normal manufacturing tolerances apply.

NOTE This is for example the case for the overall thickness and thickness of finishes or coating layers.

7.5.2.2.2.5 Field of application for the obtained classification

The classification is obtained based on the results of testing of three assemblies of the same product subject to the normal manufacturing tolerances. The classification therefore applies to fibre cement profiled sheets of the same mix formulation[1)] for the base sheet, the same type of profile, the same thickness, the same density and with the same facing or coating thickness as used for the test and within a range determined by the normal manufacturing tolerances.

The classification also applies to fibre cement profiled sheets:

— with different types of profiles, having a similar or greater height, with different sheet length and with different sheet width as long as the mix formulation for the base sheet is the same;

— with different shapes of end waves and different side lap arrangements as long as the side lap covering length (measured horizontally) is not smaller than the one used for the test;

— with a different end lap;

— with a thickness equal to or greater than that used for the test;

— with a density, determined in accordance with 5.3.2, within a range of ± 0,15 g/cm³ of the density used in the test;

— in vertical wall finishes, in ceiling finishes and in pitched roofs with pitches ranging from 5° up to 65°;

— without finishes or with different finishes or coatings (e.g. different colours) as long as the test was performed considering the worst case as explained in 7.5.2.2.2.3.4 and 7.5.2.2.2.4;

— fixed to timber or structures classified A1 according to EN 13501-1, e.g. metal;

— without thermal insulation behind the sheets or with other types of class A2-s1,d0 according to EN 13501-1 insulation materials;

— fixed with all other types of mechanical devices such as metal (excluding aluminium) screws and metal hooks, in the top or bottom of the corrugation and at different location;

— with all kinds of sealant in the side and end overlap.

Fibre cement fittings are generally not flat and cannot be tested in the Single Burning Item test following the prescriptions of EN 13823. However as these elements are made of the same composition and with the same finishes as the profiled sheets they are used with, they shall be given the same classification as the one obtained for the profiled sheets. 〈A2〉

1) Mix formulation is the type formula and does not include differences such as raw material variations.

8 Marking, labelling and packaging

The packaging of fibre-cement sheets and fittings shall be marked with at least the following:

a) manufacturer's identification;

b) number of this document;

c) size and/or name (for fibre-cement sheets only);

d) class (for fibre-cement sheets only);

e) date of manufacture;

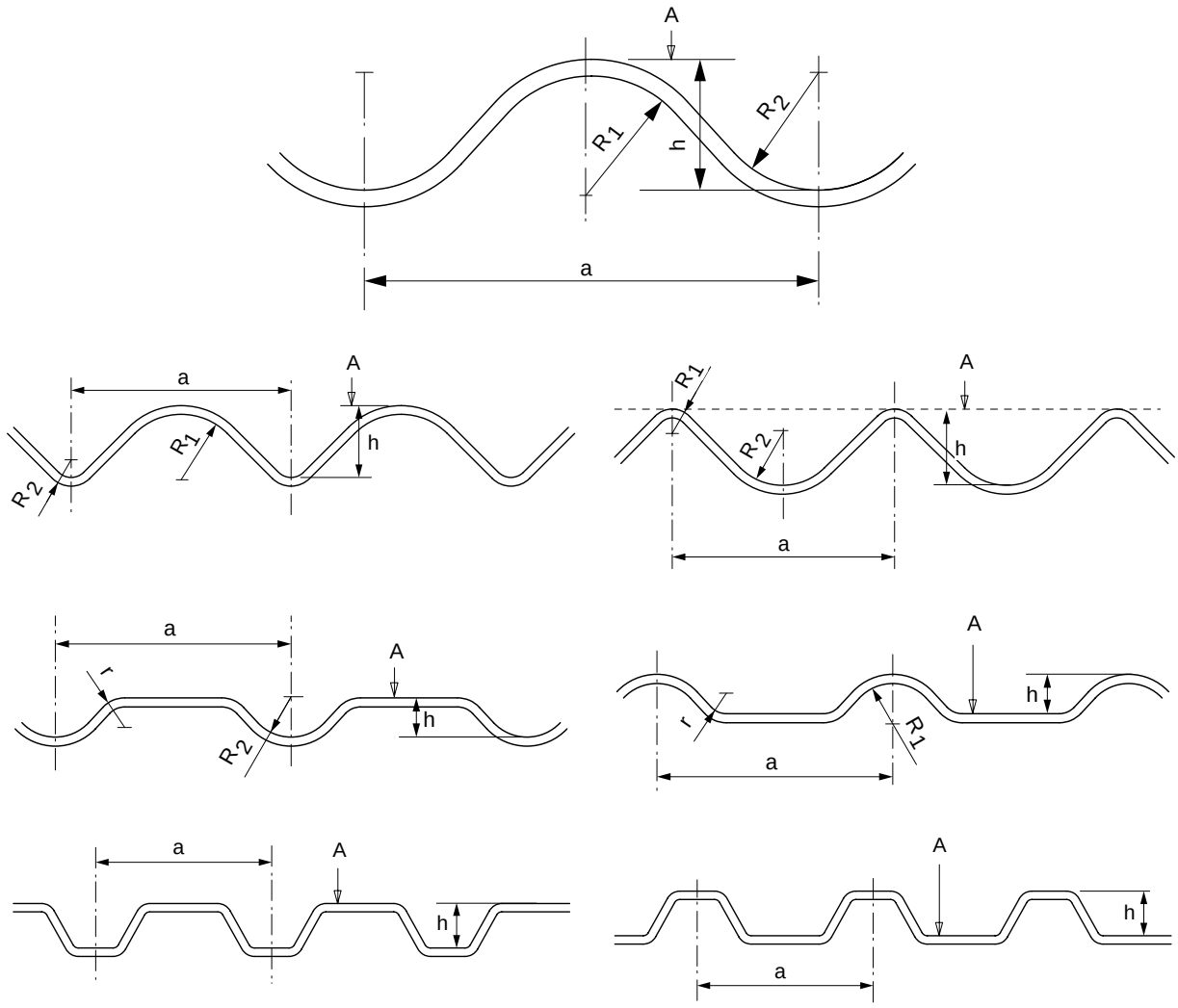
f) ▌A1⟩ NT (see 5.1.1) ⟨A1▐.

A minimum of 15% of the fibre-cement sheets in each delivered unit shall be durably marked with at least items a), d), e) and f) from the above list, and a minimum of 50% of fittings with a), e) and f).

Where ZA.3 covers the same requirements as this clause, the requirements of this clause are met.

Annex A
(normative)

Figures



Key

(A) Upper face

Figures A.1 to A.7 – Examples of categorization by height of profile

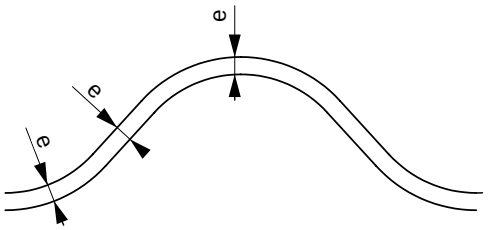


Figure A.8a – Profiled sheet with constant thickness

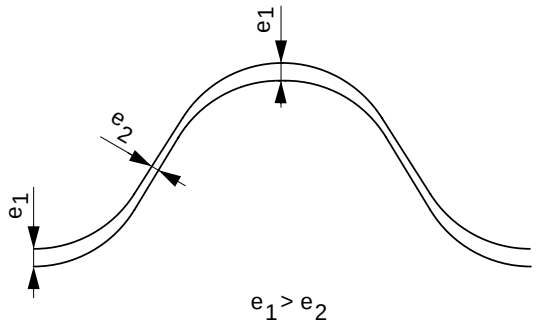
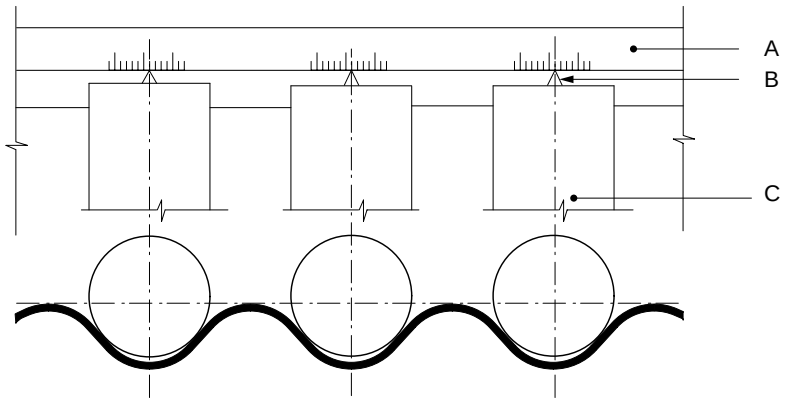


Figure A.8b – Profiled sheet with variable thickness



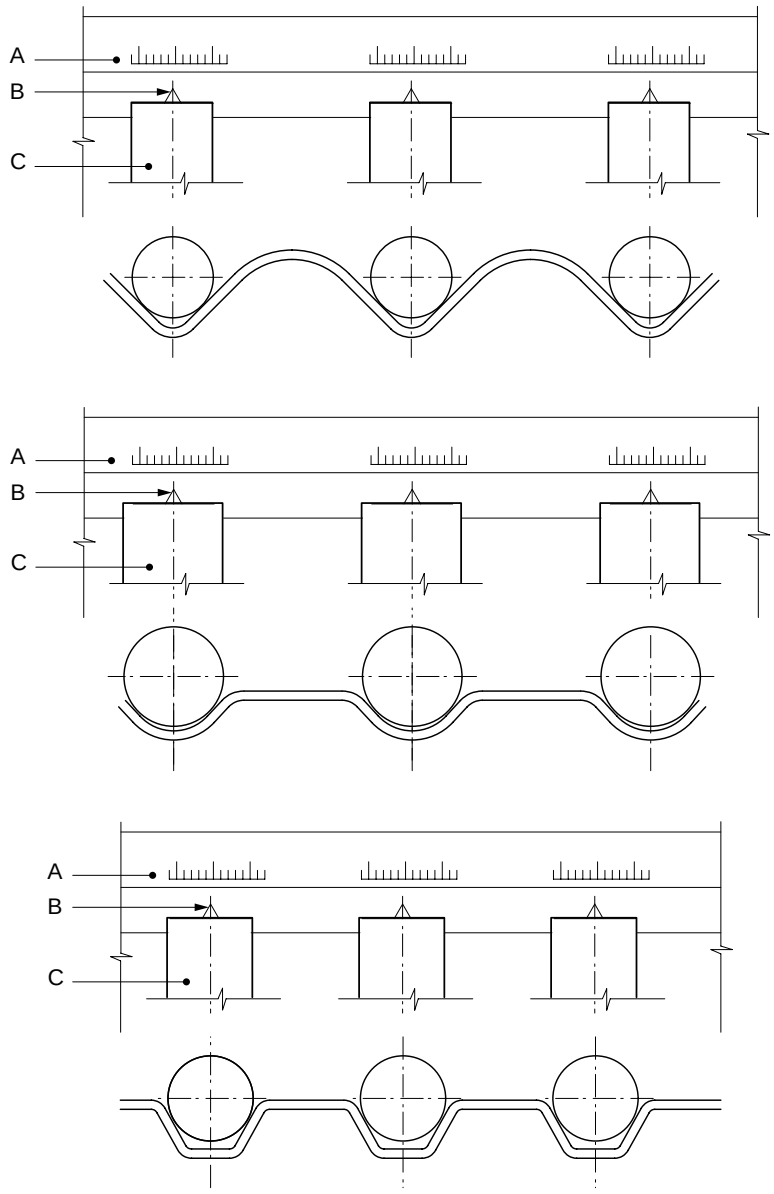
Key

(A) Graduated metal rule

(B) Conical point

(C) Cylindrical bar

Figure A.9 - Measurement of the pitch



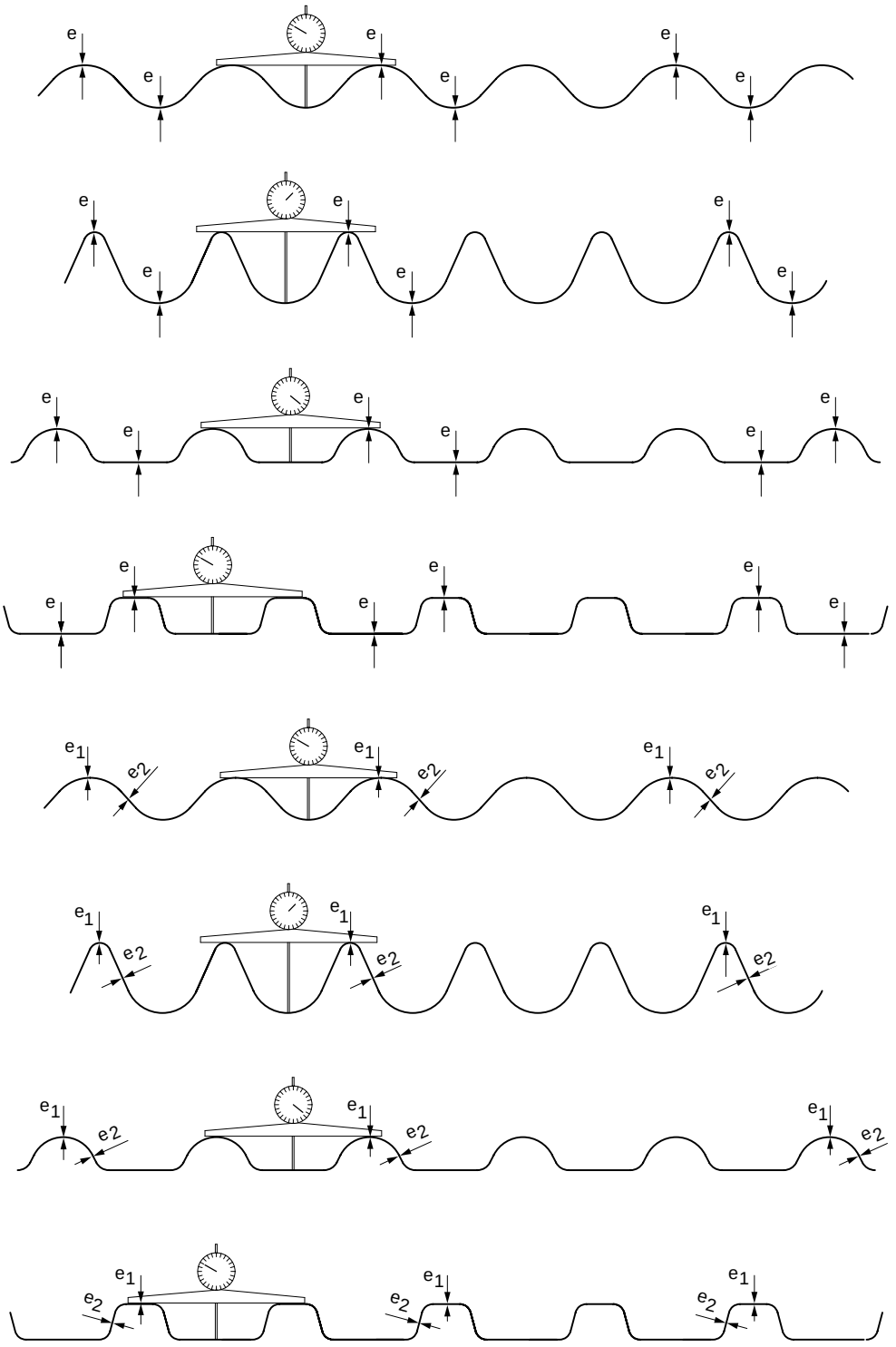
Key

(A) Metal rule

(B) Conical point

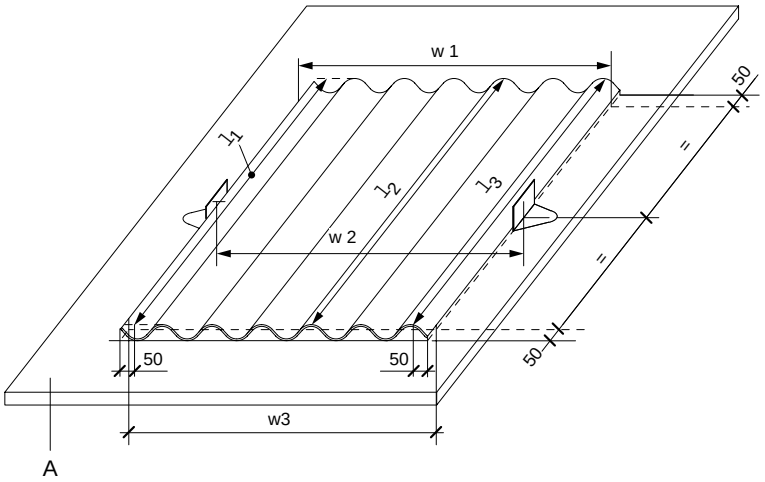
(C) Cylindrical bar

Figures A.10, A.11 and A.12 - Measurement of the pitch



Figures A.13a and A.13b – Measurement of height of corrugations and thickness

Dimensions in millimetres



Key

(A) Control area

Figure A.14 – Measurement of length and width

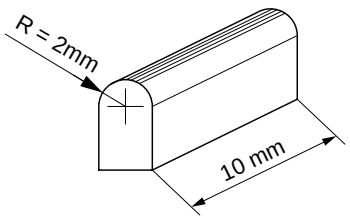
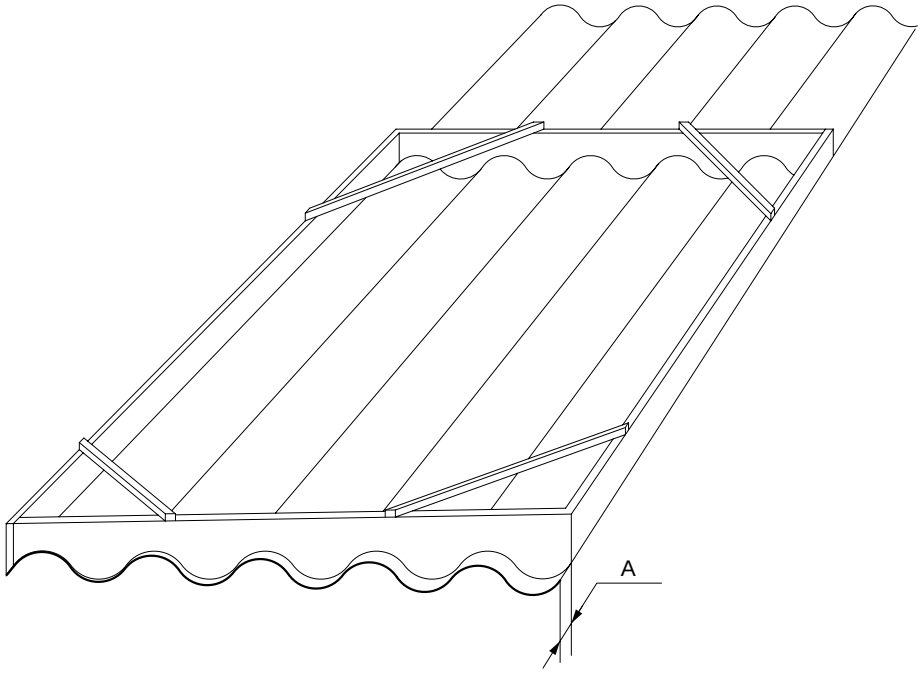


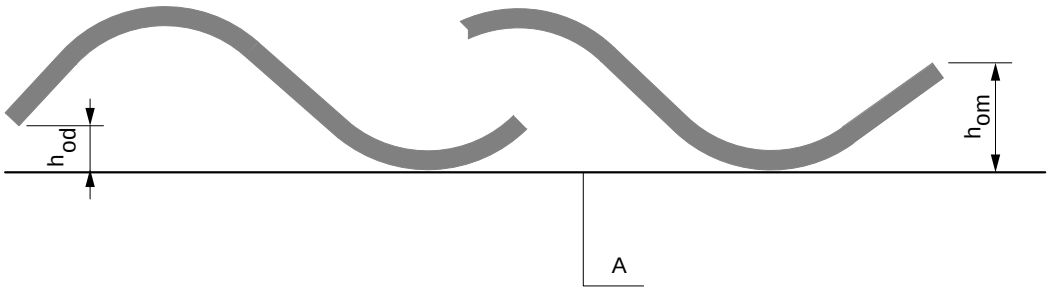
Figure A.15 – Hemi-cylindrical plate for measurement of thickness



Key

(A) Out of squareness

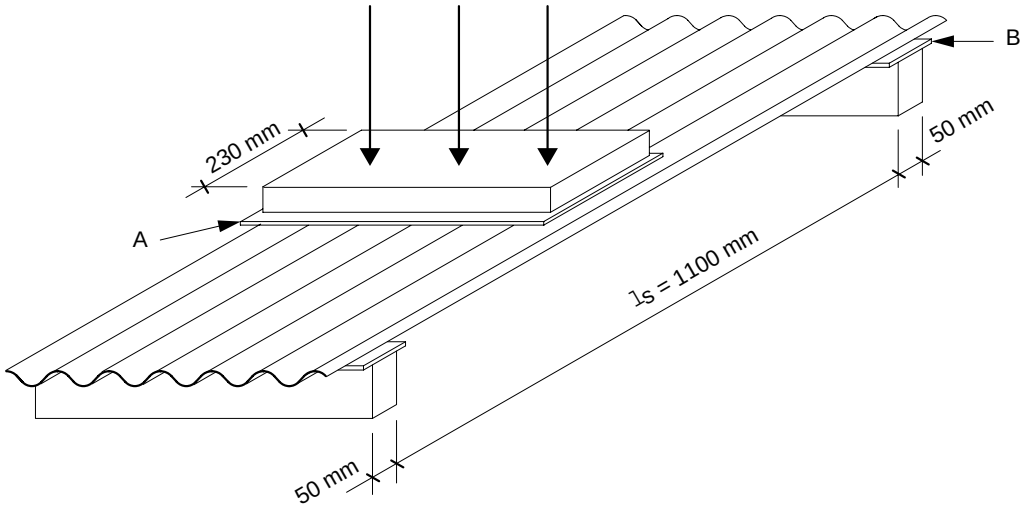
Figure A.16 – Measurement of out of squareness



Key

(A) Reference plane (control surface)

Figure A.17 – Measurement of the height of edges

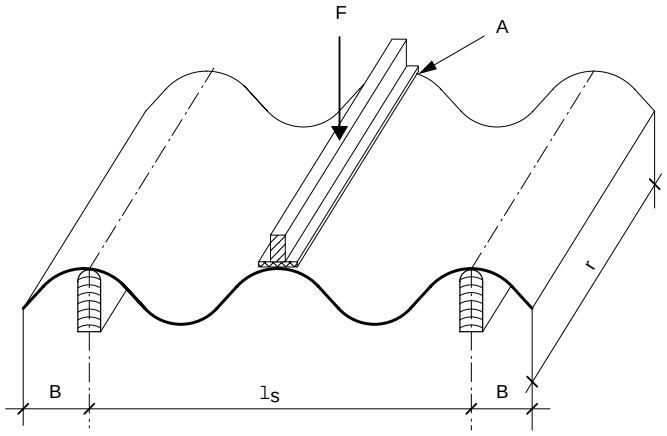


Key

(A) Strips of felt of soft material

(B) Strips of felt of soft material

Figure A.18 – Breaking load test

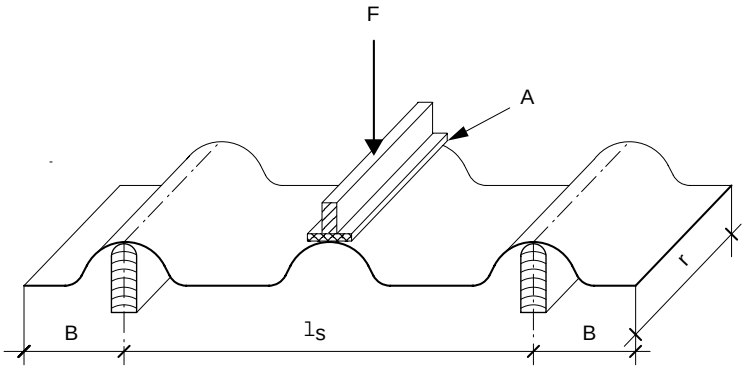


Key

(A) 10 mm felt strip or smooth plate

(B) ½ pitch max.

Figure A.19a – Apparatus for the bending moment test

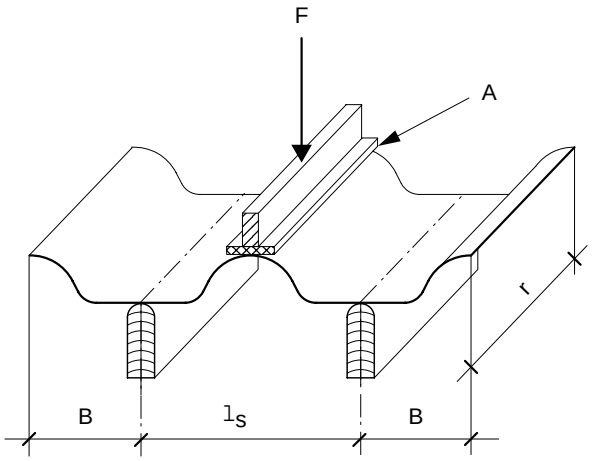


Key

(A) 10 mm felt strip or smooth plate

(B) ½ pitch max.

Figure A.19b – Apparatus for the bending moment test

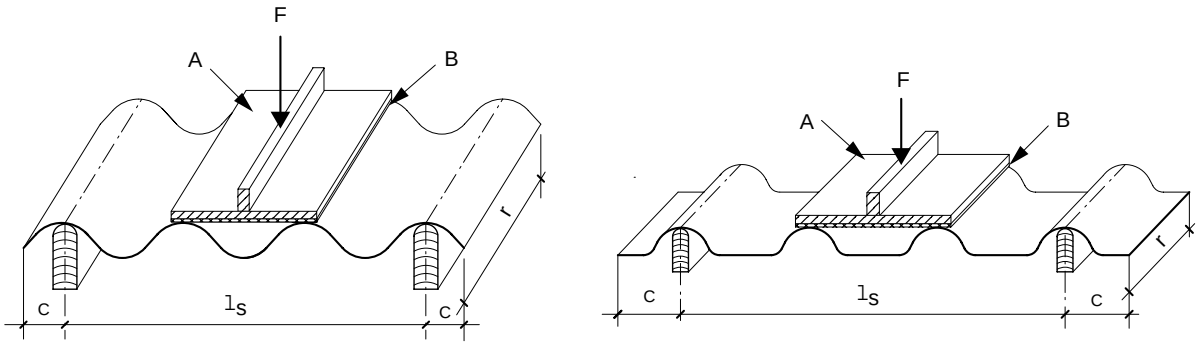


Key

(A) 10 mm felt strip or smooth plate

(B) ½ pitch max.

Figure A.20 – Apparatus for the bending moment test



Key

(A) Rigid plate

(B) 10 mm felt strip or smooth plate

(C) ½ pitch max.

Figure A.21 – Apparatus for the bending moment test

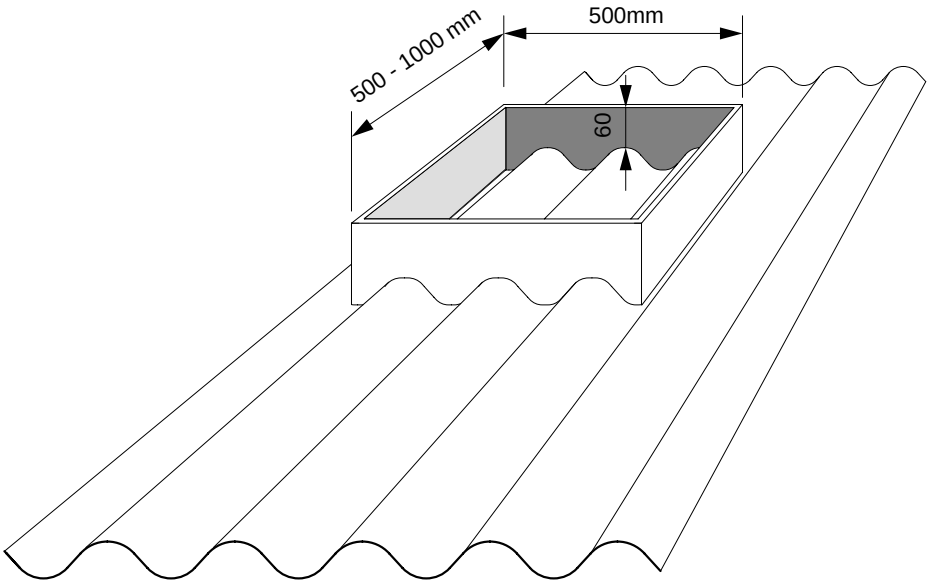
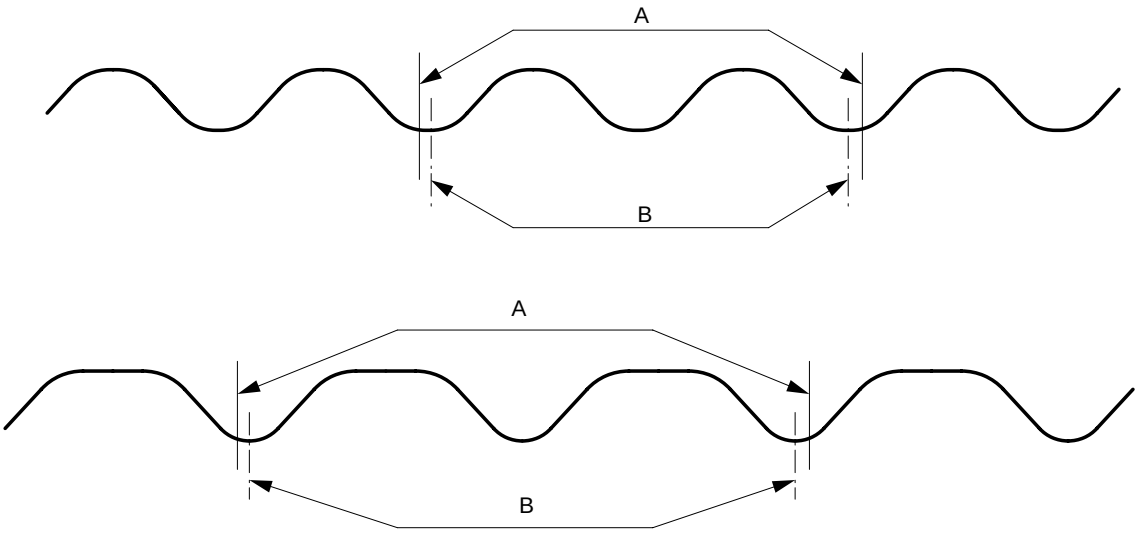


Figure A.22 – Arrangement for water impermeability test

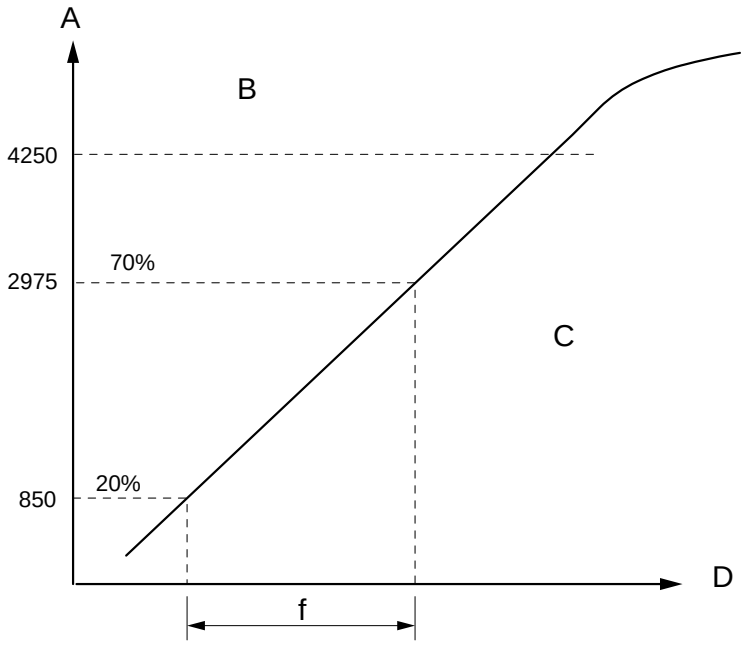


Key

(A) Trace of cutting

(B) Corrugation valley axis

Figure A.23 – Longitudinal cutting of specimens for warm water test, soak-dry and freeze-thaw test



Key

(A) Load in newtons per metre

(B) Specified load Cat. C, Class 1

(C) Example for sheets of Cat. C, Class 1

(D) Deflection in millimetres

Figure A.24 – Measurement of the deflection during breaking load test

Annex B
(normative)

Consignment inspection sampling

B.1 When tenders, and/or orders specify it, the acceptance sampling shall be carried out in lot(s) of the consignment in accordance with the test programme of this product standard, unless there is a special agreement. Therefore, the test programme necessarily covers the characteristics as specified in Table 6.

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

B.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. Unless otherwise agreed between the manufacturer and purchaser, the maximum and minimum inspection lots shall be as follows:

Sheets of length < 1,5 m:	8 000 and 400	sheets
Sheets of length > 1,5 m:	3 000 and 200	sheets
Fittings:	400 and 200	fittings

B.3 The tests shall be carried out by the laboratory of the manufacturer or by an independent laboratory selected by mutual agreement between the manufacturer and the purchaser. In case of dispute, the tests shall be carried out in the presence of both parties.

B.4 When non-destructive tests are carried out and the result of the sampling inspection does not meet the acceptance tests requirements of this document, the tests shall 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 the manufacturer and purchaser.

Annex C
(normative)

Statistical method for determining the corresponding wet values or revised dry specifications for the breaking load and/or bending moment when carrying out the dry method of test for quality control purposes

C.1 Procedure

Sample at least 20 sheets. Cut them into paired specimens for either the breaking load test described in 7.3.2.1 or the bending moment test described in 7.3.2.2.

Both specimens of a pair shall be cut from the same sheet and each given the same number.

Test one set of specimens wet and one set of specimens dry for breaking load in accordance with 7.3.2.1 or bending moment in accordance with 7.3.2.2

From the paired results determine whether there is a correlation between them at the 97,5% confidence level using the method in C.2.

If there is no significant correlation then dry testing cannot be used. If the correlation is positive then continue as follows:

a) determine the regression line using the method described in C.3;

b) determine either of the following:

- a wet value for each specimen from the obtained dry value, using the method described in C.4;
- a revised minimum value to be used as the specification for dry testing corresponding to the appropriate minimum value for wet testing as specified in this document using the method described in C.5.

C.2 Determination of the correlation between the results of testing wet and dry specimens

Calculate the coefficient of correlation between wet and dry values from the following equation

$$r = \frac{\sum_{1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\left\{\sum_{1}^{n}(x_i - \bar{x})^2 \sum_{1}^{n}(y_i - \bar{y})^2\right\}^{1/2}} \qquad \text{(C.1)}$$

where

n is the number of paired specimens;

x_i is the individual value of the i^{th} specimen tested dry;

y_i is the individual value of the i^{th} specimen tested wet;

$\bar{x}$ is the mean of the values of x_i for i = 1 to *n;*

$\bar{y}$ is the mean of the values of y_i for i = 1 to *n.*

Calculate the value of *t* from the following equation

$$t = \left| \frac{r}{\sqrt{1 - r^2}} \right| \sqrt{n - 2} \qquad \text{(C.2)}$$

Compare *t* to the Student's coefficient $t_{0,025/n-2}$.

If $t > t_{0,025/n-2}$ then there is a significant relationship between the results of wet and dry testing and the regression line is straight. Dry testing can be carried out for quality control purposes

— when *n* = 20 then $t_{0,025/n-2} = 2{,}101$;

— for *n* > 20 refer to Student's *t* tables.

C.3 Determination of the regression line

The equation of the regression line is

$$y = a + bx$$

Calculate the values of *a* and *b* from the following equations:

$$b = \frac{\sum_1^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_1^n (x_i - \bar{x})^2} \qquad \text{(C.3)}$$

$$a = \bar{y} - b\bar{x} \qquad \text{(C.4)}$$

A plot of the regression line is shown in Figure C.1.

C.4 Determination of a value for wet testing from an obtained value for dry testing

Calculate the residual standard deviation (also called the standard error of the estimate) from the following equation:

$$s = \sqrt{\frac{\sum_1^n (y_i - a - bx_i)^2}{n - 2}} \qquad \text{(C.5)}$$

Calculate the value for wet testing from the following equation using the obtained dry value x_o

$$y_o = (a + bx_o) - s\,t_{0,025/n-2}\sqrt{\frac{n+1}{n} + \frac{\left(x_0 - \bar{x}\right)^2}{\sum_1^n \left(x_i - \bar{x}\right)^2}} \qquad \text{(C.6)}$$

where:

x_o is the actual result obtained when dry testing;

y_o is the value calculated from x_o which is the estimate at the lower 97,5% confidence level of the value expected from wet testing.

— when $n = 20$ then $t_{0,025/n-2} = 2,101$;

— for $n > 20$ refer to Student's t tables.

For routine quality control testing individual values of y_o can be calculated each time or alternatively by substituting a suitable range of values for x_o in equation C.6 a plot of x_o, y_o can be made (see Figure C.1) from which future values can be read.

C.5 Determination of the minimum value specified for dry testing x_{std} corresponding to the minimum value specified for wet testing in this document y_{std}

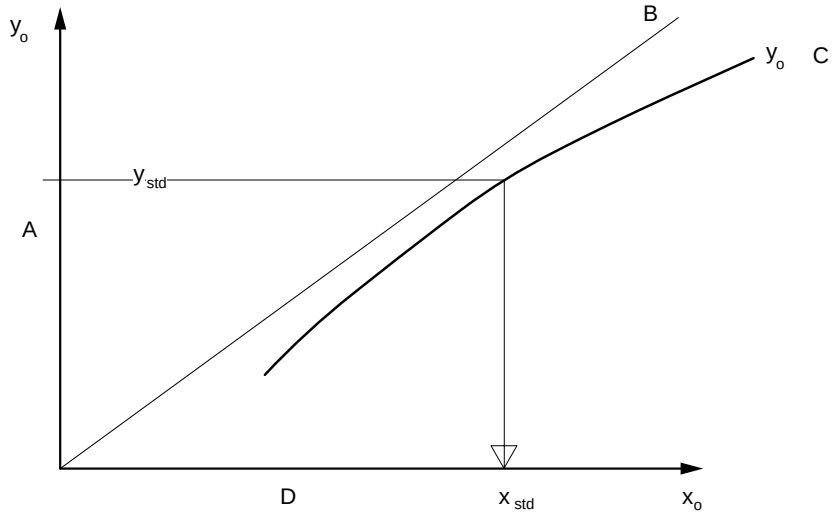
Plot the line for y_o, x_o by substituting a suitable range of values for x_o in equation C.6.

Read the value for x_{std} corresponding to the value for y_{std} from the graph (see Figure C.1)

where:

y_{std} is the minimum value specified in the standard for wet testing;

x_{std} is the minimum value to be specified for dry testing calculated from y_{std} at the 97,5% lower confidence level.



Key

A Wet values

B Regression line

C (from equation C.6)

D Dry values

Figure C.1 – Regression line for wet / dry values with lower confidence level

〖A3〉 *deleted text* 〈A3〗

Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under Mandates M/121 “Internal and external wall and ceiling finishes” and M/122 “Roof coverings, rooflights, roof windows and ancillary products” given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard shown in this annex meet the requirements of the mandates given under the EU Construction Products Directive (89/106).

Compliance with these clauses confers a presumption of fitness of the construction products covered by this European Standard for their intended use.

WARNING — Other requirements and other EU Directives, not affecting the fitness for intended use may be applicable to a construction product falling within the scope of this standard.

NOTE In addition to any specific clauses relating to dangerous substances contained in this standard, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply. An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (CREATE, accessed through http://europa.eu.int/comm/enterprise/construction/internal/dangsub/dangmain.htm).

This annex has the same scope as Clause 1 of this standard. It establishes the conditions for the CE marking of the fibre cement profiled sheets and fittings intended for the uses indicated in Tables ZA.1.1 to ZA.1.2 and shows the relevant clauses applicable.

Construction product: Fibre cement profiled sheets and fittings

Intended use (1): Discontinuously laid roof coverings for building

Table ZA.1.1 — Relevant clauses for roof coverings

Essential characteristics	Clauses in this European Standard	Mandated levels and/or classes	Notes
Mechanical resistance	5.3.3 [A3] (excluding 5.3.3.4) [A3]	-	Technical classes 1X, 2X, 3X or 1Y, 2Y, 3Y Does not apply to fittings
[A3] Impact resistance [A3]	[A3] 5.3.3.4 [A3]	[A3] - [A3]	[A3] Does not apply to fittings [A3]
External fire performance	5.6.1	See [A3] EN 13501-5 [A3]	Does not apply to fittings
Reaction to fire	5.6.2	A1 to F	
Water permeability	5.3.4	-	Does not apply to fittings
Dimensional variations	5.2.4	-	
Release of dangerous substance	5.6.3	-	
Durability against warm water	5.4.4	-	Technical classes 1X, 2X, 3X or 1Y, 2Y, 3Y Does not apply to fittings
Durability against soak/dry	5.4.5	-	Technical classes 1X, 2X, 3X or 1Y, 2Y, 3Y Does not apply to fittings
Durability against freeze-thaw	5.4.2	-	Technical classes 1X, 2X, 3X or 1Y, 2Y, 3Y Technical classes do not apply to fittings
Durability against heat-rain	5.4.3	-	Does not apply to fittings

Construction product: Fibre cement profiled sheets and fittings

Intended use (2): Internal wall and external wall and ceiling finishes

Table ZA.1.2 — Relevant clauses for internal and external wall and ceiling finishes

Essential characteristics	Clauses in this European Standard	Mandated levels and/or classes	Notes
Reaction to fire	5.6.2	A1 to F	
Water permeability	5.3.4	-	Does not apply to fittings
Release of dangerous substance	5.6.3	-	
Flexural tensile strength (only for sheets intended for use in suspended ceilings)	5.3.1/5.3.3 [A3] (excluding 5.3.3.4) [A3]		Technical classes 1X, 2X, 3X or 1Y, 2Y, 3Y
Durability against warm water	5.4.4	-	Technical classes 1X, 2X, 3X or 1Y, 2Y, 3Y Does not apply to fittings
Durability against soak/dry	5.4.5	-	Technical classes 1X, 2X, 3X or 1Y, 2Y 3Y Does not apply to fittings
Durability against freeze-thaw	5.4.2	-	Technical classes 1X, 2X, 3X or 1Y, 2Y, 3Y Technical classes do not apply to fittings. Does not apply to products for internal use
Durability against heat-rain	5.4.3	-	Does not apply to products for internal use Does do not apply to fittings

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these MSs are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option “No performance determined” (NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

ZA.2 Procedure for the attestation of conformity of fibre cement profiled sheets and fittings

ZA.2.1 Systems of attestation of conformity

The systems of attestation of conformity for fibre cement profiled sheets and fittings indicated in Tables ZA.1.1 and ZA.1.2, as given in Annex III of the Mandates M/121 and M/122, are shown in Table ZA.2 for the intended uses and relevant level(s) and classes.

Table ZA.2 — Attestation of conformity systems

Product	Intended use	Level(s) or class(es)	Attestation of conformity system
Fibre cement profiled sheets and fittings	All uses subject to reaction to fire regulations	A1**, A2**, B**, C**, D and E	3
		A1*** and F	4
	External roofs subject to regulations on external fire performance*	Products requiring testing	3
		Products deemed to satisfy without testing	4
	For uses subject to regulations on dangerous substances	-	3
* Does not apply to external walls coverings ** Products/materials for which there is no clearly identifiable stage in the production process which results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material) *** Products/materials that do not require to be tested for reaction to fire (e.g. products/materials of Class A1 according to Commission Decision 96/603/EC, as amended)			
System 3: See Directive 89/106/EEC (CPD) Annex III.2.(ii), Second possibility System 4: See Directive 89/106/EEC (CPD) Annex III.2.(ii), Third possibility			

The attestation of conformity of the fibre cement profiled sheets and fitting in Tables ZA.1.1 and ZA.1.2 shall be according to the evaluation of conformity procedures indicated in Table ZA.3.1 and ZA.3.2 resulting from the application of the clauses of this European Standard indicated therein.

Table ZA.3.1 – Assignment of evaluation of conformity tasks for system 3

Tasks		Content of the task	Evaluation of conformity clauses to apply
Tasks for the manufacturer	Factory production control (F.P.C)	Parameters related to all characteristics of Tables ZA.1.1 and/or ZA.1.2 relevant for the intended use	6.3
	Initial type testing by the manufacturer	All characteristics of Tables ZA.1.1 and/or ZA.1.2 relevant for the intended use, i.e. mechanical resistance, [A3⟩ impact resistance, ⟨A3] water permeability, dimensional variation and durability, other than those shown below	6.2
	Initial type testing by the notified lab	Reaction to fire (Classes A1**, A2**, B**, C**, D, E), external fire performance other than deemed to satisfy and dangerous substances	6.2

Table ZA.3.2 – Assignment of evaluation of conformity tasks for system 4

Tasks		Content of the task	Evaluation of conformity clauses to apply
Tasks for the manufacturer	Factory production control (F.P.C)	Parameters related to all characteristics of Tables ZA.1.1 and/or ZA.1.2 relevant for the intended use	6.3
	Initial type testing	All characteristics of Tables ZA.1.1 and/or ZA.1.2 relevant for the intended use, i.e. mechanical resistance, ⟨A3⟩ impact resistance, ⟨A3⟩ water permeability, dimensional variation and durability	6.2

ZA.2.2 EC Declaration of conformity

(In case of products under system 3): When compliance with the conditions of this annex is achieved, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity (EC Declaration of conformity), which entitles the manufacturer to affix the CE marking. This declaration shall include:

— name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

— description of the product (type, identification, use, ...) and a copy of the information accompanying the CE marking;

— provisions to which the product conforms (i.e. Annex ZA of this EN);

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions);

— ⟨A3⟩ span chosen for the test (in the case of impact resistance as a declared performance); ⟨A3⟩

— name and address of the notified laboratory(ies);

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorised representative.

(In case of products under system 4): When compliance with this annex is achieved, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity (EC Declaration of conformity), which entitles the manufacturer to affix the CE marking. This declaration shall include:

— name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

— description of the product (type, identification, use, ...) and a copy of the information accompanying the CE marking;

— provisions to which the product conforms (i.e. Annex ZA of this EN);

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions);

— ⟨A3⟩ span chosen for the test (in the case of impact resistance as a declared performance); ⟨A3⟩

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or of his authorised representative.

The above mentioned declaration shall be presented ▌A3⟩ in the language or languages in the Member State ⟨A3▌ in which the product is to be used.

ZA.3 CE marking

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EC and shall be shown on the accompanying commercial documents (e.g. a delivery note). The following information shall accompany the CE marking symbol:

— name or identifying mark and registered address of the producer;

— the last two digits of the year in which the marking is affixed;

— reference to this European Standard (EN 494);

— description of the product: generic name, material, and intended use;

— ▌A1⟩ NT (see 5.1.1) ⟨A1▌;

— size (e.g. corrugation height), technical class: category and classes for mechanical resistance, e.g. C1X;

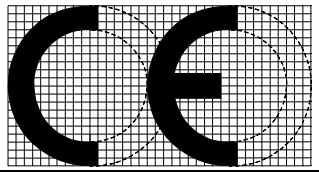
— ▌A3⟩ impact resistance (for intended use as roof covering only): pass or NPD;

— reaction to fire: class followed by "without testing" for products in accordance with 7.5.2.1, class(es) for tested products in accordance with 7.5.2.2, or NPD (class F);

— external fire performance: B_{ROOF} followed by "Deemed to satisfy" for products in accordance with 7.5.1.1, class(es) followed by a description of the test assembly(ies) for tested products, or NPD (class F_{roof}) ⟨A3▌.

The “No performance determined” (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination.

Figure ZA.1 gives an example of the information to be given on the commercial documents, for a sheet intended to be used as a roofing product and internal or externally as a wall covering.



Any Co Ltd, P.O. Box 21, B 1050
[A3] **07** [A3]

EN 494
Fibre cement profiled sheets for roofing and internal and external wall covering
NT
Corrugation height 40 to 80 mm Class C1X
[A3] Impact resistance Pass [A3]
Reaction to fire A1 [A3] (without testing) [A3]
External fire performance [A3] B_{ROOF} (Deemed to satisfy) [A3]

Figure ZA.1 — Example CE marking information

In addition to any specific information relating to dangerous substances shown above, the component should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation

NOTE European legislation without national derogations need not be mentioned.

〖A1〉 *deleted text* 〈A1〗

Bibliography

EN ISO 9001, *Quality management systems — Requirements (ISO 9001:2000).*

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