
Vlaknatocementne valovite strešne plošče in fazonski kosi - Specifikacije in preskusne metode

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

Faserzement-Wellplatten und dazugehörige Formteile für Dächer - Produktspezifikationen und Prüfmethoden

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

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EUROPEAN STANDARD

EN 494

NORME EUROPÉENNE

EUROPÄISCHE NORM

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English version

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roofing - Product specification and test methods**

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Foreword

This European Standard has been prepared by CEN/TC 128 "Roof covering products for discontinuous laying", the secretariat of which is held by ON.

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

Attention is drawn to the need for observance of EC and/or EFTA Directives transposed into national legal requirements restricting the use of certain materials and to the related marking and labelling requirements.

The performance of a roof constructed with these products depends not only on the properties of the product as required by this standard, but also on the design, construction and performance of the roof as a whole in relation to the environmental and conditions of use.

Annex C is an informative Annex and contains an A-Deviation.

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 August 1994, and conflicting national standards shall be withdrawn at the latest by August 1994.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, Switzerland, United Kingdom.

1 SCOPE

This standard specifies the technical requirements and establishes methods of control and tests as well as acceptance conditions for fibre-cement profiled sheets and their fibre-cement fittings for roofing.

For the purpose of this standard fibre-cement profiled sheets are classified according to their height of corrugation and their mechanical characteristics. Examples of profiles are shown in figures 1 to 7.

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

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2 NORMATIVE REFERENCES

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This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 29001 : 1987 Quality systems - Model for quality assurance in design, development, production, installation and servicing

EN 29002 : 1987 Quality systems - Model for quality assurance in production and installation

ENV 197-1 : 1992 Cement - Composition, specifications and conformity criteria - Part 1: Common cements

ISO 390 : 1993 Fibre-cement products - Sampling and inspection.

ISO 2859-1 : 1989 Sampling procedures for inspection by attributes - Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.

ISO 3951 : 1989 Sampling procedures and charts for inspection by variables for percent nonconforming

3 DEFINITIONS

For the purposes of this standard the following definitions apply:

3.1 profiled sheet:

Component the cross section of which consists of corrugations as in the examples shown in figures 1 to 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, specification and limit values are specified in this standard. Sampling levels and acceptance criteria are given in 6.1.2.

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3.3 type test:

Test carried out 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 and is required to demonstrate conformity of a generic product to a specification; it is not required for each production batch.

3.4 acceptance quality level (AQL):

In a sampling plan, the quality level which 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.

4 SYMBOLS AND ABBREVIATIONS

- a*
 - 1. Pitch of the corrugations in millimetres
 - 2. One of the coefficients of the regression line (annex B)
- 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 B)
- 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
- L₁* Upper estimate of the mean breaking load or bending moment at 95% confidence level
- L₂* 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 newtons metres per metre
- R_L* Ratio of estimate *L₂* to estimate *L₁*
- s₁* Standard deviation of the specimens with mean *X₁*
- s₂* Standard deviation of the specimens with mean *X₂*
- V* Volume of the test specimen in cubic centimetres
- x₀* Actual result obtained when dry testing
- w* Width of the sheet in millimetres
- X₁* Mean value of the test results (bending strength or bending moment) of the control specimens (first lot) for a type test
- X₂* 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 standard
- 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 REQUIREMENTS FOR SHEETS

5.1 General requirements

5.1.1 Composition

Fibre-cement profiled sheets 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 relevant national standards of CEN members and/or ENV 197-1.

Two types of fibre-reinforced cement profiled sheets are included in this standard:

Type AT (Asbestos Technology) for products the formulation of which contains chrysotile asbestos.

Type NT (Non-asbestos Technology) for products reinforced by other fibres and not containing asbestos.

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 can be left with their natural colour, or colouring matters can be added in the composition; they can 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 standard 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 standard or from the function of the sheet as a durable element.

Edges shall be straight and clean.

Sheets can have mitred or premitred corner(s) and/or can be predrilled for fixing.

5.2 Dimensions and tolerances

NOTE: See 6.1 for statistical interpretation.

5.2.1 General

The manufacturer shall specify the nominal dimensions.

NOTE: See 5.6 for designation and information.

5.2.2 Categorization by height of profile

The sheets are divided into five categories, depending on the nominal height of the corrugations (see figures 1 to 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 8a) or
- vary regularly from the crowns and valleys to the flanks of the corrugations, as shown in figure 8b).

When measured in accordance with 7.2.3 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	-

5.2.4 Tolerances on nominal dimensions

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

a) on the pitch a :

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

b) on the height h :

15 mm ≤	$h \leq 45$ mm	$\pm 2,0$ mm
45 mm <	$h \leq 150$ mm	$\pm 3,0$ mm

c) on the length l : ± 10 mm

d) on the width w :
+ 10 mm
- 5

e) on nominal thickness e :

The average thickness measured in accordance with 7.2.3 shall be within $\pm 10\%$ and not more than $\pm 0,6$ mm of the nominal thickness.

f) on the squareness of the sheet:

Out of squareness $\leq 6,0$ 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 method of laying in order to ensure weathertightness 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.

5.3 Physical requirements and characteristics

5.3.1 General

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

NOTE: See 6.1 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	1 400	1 250
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: A special class 3 with a minimum breaking load per metre width 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 24) shall not exceed:

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

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.

Table 4: Minimum bending moment

Category	h mm	Minimum bending moment per metre length at rupture		
		Length > 0,9 m		Length ≤ 0,9 m N m/m
		Class X N m/m	Class Y N m/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	-

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.

5.3.5 Warm water

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

5.3.6 Soak-dry

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