
Fibre-cement flat sheets — Product specification and test methods

*Plaques planes en fibres-ciment — Spécification des produits et
méthodes d'essai*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see the following URL: www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 8336:2009), which has been technically revised.

Introduction

The purpose of this document is to provide manufacturers and purchasers with uniform requirements for fibre-cement flat sheet products. These requirements are performance-based and have been specified with the objective of ensuring product quality, industry efficiency and the performance of the product in service.

ISO/TC 77 aims to harmonize this document, where possible, with other national fibre-cement standards (CEN, ASTM and JIS) to facilitate and promote uniform performance benchmarks for the global use of fibre-cement products.

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Fibre-cement flat sheets — Product specification and test methods

1 Scope

This document specifies methods for the inspection and testing of fibre-cement flat sheets and provides the acceptance conditions for their use in one or more of the following applications:

- external wall and ceiling finishes;
- internal wall and ceiling finishes;
- internal and external backing sheets.

Products covered by this document can be used for other purposes, provided they comply with the appropriate national or international application code or standard.

NOTE 1 This document does not apply to sheets for fire protection purposes.

NOTE 2 This document does not include calculations for installation design requirements, wind uplift or water proofing of the installed sheets.

NOTE 3 This document does not apply to the following products:

- boards of Portland or equivalent cement reinforced with fibrous wood particles;
- fibre-reinforced boards of calcium silicate or cement for thermal insulation or fire protection;
- sheets containing asbestos fibre reinforcement;
- sheets containing steel fibre reinforcement;
- fibre-cement roofing slates.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

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

ISO 12572, *Hygrothermal performance of building materials and products — Determination of water vapour transmission properties — Cup method*

ISO 13787, *Thermal insulation products for building equipment and industrial installations — Determination of declared thermal conductivity*

ANSI A118.1, *Specification for Dry-Set Portland Cement Mortar*

ANSI A118.4, *Specification for Latex-Portland Cement Mortar*

ANSI A136.1, *Organic Adhesives for Installation of Ceramic Tile*

ASTM G21:2015, *Standard Practice for determining Resistance of Synthetic Polymeric Materials to Fungi*

ASTM D1037, *Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials*

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 acceptance test

test to establish whether a batch of sheets conforms to a specification

Note 1 to entry: The test is performed on samples drawn from continuous production or from a consignment (see ISO 390).

Note 2 to entry: Test methods, specifications and limit values are specified in this document. Sampling levels and acceptance criteria are specified in [Clause 6](#).

3.2 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

Note 1 to entry: The test is performed on the as-delivered product, but is not required for each production batch.

3.3 acceptable quality level AQL

maximum percent defective (or maximum number of defects per 100 units) which can be considered satisfactory as a long-term average quality level in a sampling plan

Note 1 to entry: When a manufacturer's process satisfies a sampling scheme with an AQL of 4 %, this indicates that 96 % of the inspected product exceeds the specification. This type of specification provides the consumer with a clearly defined lower quality boundary; this does not occur if acceptance is based solely on the average value of the measured property. Examples of sampling schemes can be found in ISO 390, ISO 2859-1, or ISO 3951 (all parts).

3.4 apparent density

dry weight/unit volume based upon the volume of the sample determined by water displacement or equivalent

Note 1 to entry: This is an average density of the material as-delivered coated or uncoated.

3.5 as delivered

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 upper face

face normally exposed

3.7 under face

reverse of the *upper face* ([3.6](#))

3.8**textured sheet**

sheet that has a relief pattern which is either embossed on or applied to the *upper face* (3.6) as a coating

3.9**reinforcement fibre**

discrete randomly dispersed elements or continuous strands of cellulose fibre, synthetic organic, inorganic fibre or glass fibre, used in the manufacture of fibre-cement sheets

3.10**small-sized sheet**

sheet for which the method of installation includes horizontal overlap

Note 1 to entry: Their dimensions are generally such that they have an area of $<0,4 \text{ m}^2$ and a length/width ratio of ≤ 3 .

3.11**large-sized sheet**

sheet that do not correspond to indicators for *small-sized sheets* (3.10)

Note 1 to entry: Large sheets can be declared as “small-sized sheets”, provided tolerances for small-sized sheets apply and are specified in the manufacturer’s literature.

3.12**planks**

category A sheet having an *aspect ratio* (3.13) of >7 normally used as horizontal overlapping wall covering

3.13**aspect ratio**

ratio of the sheet length to the sheet width

3.14**modulus of rupture****MOR**

maximum load/unit area of cross section at breaking, under flexural loading conditions

Note 1 to entry: The modulus of rupture is referred to as the bending strength or flexural strength in some countries.

3.15**quality control**

<factory> part of quality management to ensure the product being manufactured meets stated requirements

Note 1 to entry: This is referred to as factory production control (FPC) in some countries.

3.16**ambient laboratory condition**

laboratory condition where the temperature is at $(23 \pm 10) ^\circ\text{C}$ and $(50 \pm 20) \%$ relative humidity

4 Symbols and abbreviated terms

a	nominal length or width of sheet, in mm
b	a) dimension of the specimen (length or width) measured parallel to the test machine supports, in mm b) one of the coefficients of the regression line (see Annex B)
d	apparent density of the sheet, in g/cm ³
e	thickness of sheet, in mm
F	breaking load, modulus of rupture test, in N
l	length, in mm
L_m	length of moisture movement specimen, in mm
l_s	span between support centres in modulus of rupture test, in mm
m	mass of the specimen after drying, in g
MOR	modulus of rupture, in MPa
MOR_{fi}	modulus of rupture of i^{th} exposed specimen after the type test
MOR_{fci}	modulus of rupture of i^{th} unexposed reference specimen
MOR_i	individual ratio of the modulus of rupture of the i^{th} pair of exposed and unexposed specimens
n	number of paired specimens
R	average ratio of the modulus of rupture of exposed and unexposed specimens
R_L	lower estimate of the mean of the ratios at 95 % confidence level of the modulus of rupture of exposed and unexposed specimens
s	standard deviation of the values in the appropriate calculation
μ	water vapour transmission value
λ	thermal conductivity
V	volume of specimen, in cm ³
w	width, in mm
x_i	individual value of the i^{th} specimen tested dry
x_{std}	minimum value to be used as the specification for the dry test method of test. This value is calculated at the 97,5 % lower confidence level from the value specified for the wet method of test (see Annex B)
x_0	actual result obtained when dry testing (see Annex B)
$\bar{x}$	mean value of x_i for $i = 1$ to n
y_i	individual value of the i^{th} specimen tested wet

y_{std}	minimum value specified in the standard for wet testing (see Annex B)
y_0	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 (see Annex B)
$\bar{y}$	mean value of y_i for $i = 1$ to n
NT	new technology (European term for asbestos-free fibre-cement products)

5 Requirements

5.1 General

Sheets covered by this document are divided into three categories: A, B and C, according to their application. Within these categories, there are five classes based upon the minimum modulus of rupture performance (see [5.6.1](#)). The dimensional sizes are based upon the installation requirements (see [5.5.1](#) and [5.5.2](#)). They may be supplied coated or uncoated.

Dimensional tolerances are specified for two levels of product quality: Level I and Level II, which are selected according to the installation requirements of the product.

NOTE When selecting a sheet product for a particular building application, consideration is given to the sheet category.

[Table 1](#) provides information concerning the sheet category which should be selected for various typical building applications.

Table 1 — Sheet applications and categories

Application	Category
Façades	A
Lap siding (planks) or cladding	A
Backing for tile façade	A
Sub-flooring (external)	A
Soffits (eaves lining)	B
External backing for render or cladding	B
Rigid underlay for roofs or walls	B
Formwork or shuttering	B
Backing for internal wall or floor tiles	C
Ceiling linings	C
Interior substrate for walls for paint or wallpaper finish	C
Sub-flooring (internal)	C

NOTE [Table 1](#) provides examples of common building applications. Other applications can be agreed upon by the manufacturer and the purchaser.

5.2 Sheet classifications

5.2.1 Category A

Sheets are intended for exterior applications where they may be subjected to the direct action of sun, rain, frost or snow. They may be supplied coated or uncoated.

5.2.2 Category B

Sheets are intended for applications where they may be subjected to heat, moisture and occasional frost, e.g. where they are either protected from or not subjected to severe weathering conditions.

5.2.3 Category C

Sheets are intended for internal applications, such as interior walls, floors, tile underlayment and backer board, where they may be subjected to heat and moisture, but not to frost.

5.3 Composition and manufacture

5.3.1 General

Fibre cement flat sheets shall consist essentially of cement or a calcium silicate formed by the chemical reaction of a siliceous and a calcareous material and shall contain reinforcement fibres (see 3.9). Process aids, fillers, aggregates and pigments which are compatible with fibre-reinforced cement may be added.

5.3.2 Reinforcement fibre

Reinforcement fibre shall be one or a combination of the following materials:

- a) cellulose fibre;
- b) synthetic organic or inorganic fibre;
- c) glass fibre.

These materials may have one or more of the following forms:

- discrete elements randomly dispersed;
- continuous strands.

5.3.3 Cement

The cement shall comply with the relevant national standards in the country of manufacture.

5.3.4 Manufacture

These products may be formed either with or without pressure and cured, under either natural or accelerated conditions, to meet the physical requirements specified in this document.

5.4 Appearance and finish

The upper face (3.6) of the sheet can be with or without texture. The sheets can be coloured or left in their natural colour. The sheets can also receive coatings such as sealers, primers, and/or finished top coats. Variations of the surface appearance which do not impair the fitness for purpose of the sheets are permitted.

5.5 Dimensions and tolerances

5.5.1 Nominal length and width

The manufacturer shall specify the nominal lengths and widths of the fibre-cement sheets.

5.5.2 Thickness

The manufacturer shall specify the nominal thicknesses of the sheets. For non-textured sheets, the nominal thickness refers to the average thickness. For textured sheets, the nominal thickness refers to the maximum thickness.

NOTE The nominal thickness of textured sheets cannot be used for the calculation of mechanical performance.

5.5.3 Tolerances on nominal dimensions and shape

5.5.3.1 General

When measured, sheet dimensions and shapes shall be within the tolerance ranges specified in this clause, except where alternative values have been agreed between the purchaser and manufacturer, or where national standards specify alternative values.

5.5.3.2 Tolerances on length and width

Tolerances on nominal length and width dimensions, a , when measured in accordance with the procedure in 7.2, shall be in accordance with the values given in Table 2, for the appropriate level nominated for the product.

Table 2 — Tolerances on nominal length and width dimensions for levels I and II

Nominal dimension (a) ^a mm	Tolerance	
	Level I	Level II
$a \leq 600$	± 3 mm	± 4 mm
$600 < a \leq 1\,000$	± 3 mm	± 5 mm
$1\,000 < a \leq 1\,600$	$\pm 0,3 \% a$	$\pm 0,5 \% a$
$1\,600 < a$	± 5 mm	± 8 mm
^a Nominal length or width.		

5.5.3.3 Tolerances on thickness

5.5.3.3.1 Non-textured sheets

For sheets without a textured surface, the tolerances on the nominal thickness, e , when measured in accordance with 7.2, shall comply with Table 3. The maximum difference between extreme values of the thickness measurements within one sheet shall not exceed 10 % of the maximum measured value.

Table 3 — Tolerances on nominal thickness for non-textured sheets

Thickness mm	Tolerance
$e \leq 6$	$\pm 0,6$ mm
$6 < e \leq 20$	$\pm 10 \% e$
$e > 20$	± 2 mm

5.5.3.3.2 Textured sheets

For sheets with a textured surface, the tolerances on the nominal thickness, e , when measured in accordance with 7.2, shall comply with Table 4. The maximum difference between extreme values of the eight thickness measurements within one sheet shall not exceed 15 % of the maximum measured value.

Table 4 — Tolerances on nominal thickness for textured sheets

Thickness mm	Tolerance
$e \leq 6$	-0,6 mm + 0,9 mm
$6 < e \leq 20$	-10 % e + 15 % e
$e > 20$	-2 mm + 3 mm

5.5.3.4 Tolerances on shape

5.5.3.4.1 General

When measured for straightness and squareness of edges, sheets shall comply with the requirements given in [5.5.3.4.2](#) and [5.5.3.4.3](#), respectively. Edge straightness tolerances are only applicable to large-sized sheets.

5.5.3.4.2 Straightness of edges

When measured in accordance with [7.2](#), the tolerances on the straightness of edges, defined as a percentage of the length of the edge of the relevant dimension (length or width), shall be in accordance with [Table 5](#) for the appropriate level, I or II.

Table 5 — Tolerances on straightness of edges

Level I	Level II
$\leq 0,1$ %	$\leq 0,3$ %

5.5.3.4.3 Squareness of edges

The tolerances on the squareness of edges of sheets measured in accordance with [7.2](#) shall be in accordance with [Table 6](#) for the appropriate level, I or II.

Table 6 — Tolerances on squareness of edges

Level I	Level II
$\leq 0,2$ %	$\leq 0,4$ %

5.6 Physical requirements and characteristics

5.6.1 General

Compliance with this document requires that the sheets satisfy the prescribed minimum physical or mechanical performance requirements, according to their category and class, as listed in [Table 7](#). These properties are determined on as-delivered sheets. Test results shall identify whether they apply to coated or uncoated sheets.

Table 7 — Minimum physical test requirements

Physical property	Minimum test performance requirement			Test requirements	Test method
	Category A (Saturated condition)	Category B (Saturated condition)	Category C (Ambient condition)		
Density	See 5.6.3	See 5.6.3	See 5.6.3	See 7.3.2	Annex E
Modulus of rupture				See 7.3.1	Annex C
Class 1	4 MPa	4 MPa	4 MPa		
Class 2	7 MPa	7 MPa	7 MPa		
Class 3	13 MPa	13 MPa	10 MPa		
Class 4	18 MPa	18 MPa	16 MPa		
Class 5	24 MPa	24 MPa	22 MPa		
NOTE 1 Values stated in this table are the minimum values at 4 % AQL. Minimum value (4 % AQL) for this property is to be declared by the manufacturer.					
NOTE 2 For acceptance testing, use 4 % AQL values.					
NOTE 3 For initial type testing, where production variance is not yet known, an estimate of the mean MOR at the 95 % confidence level is calculated to determine the class. See D.6 .					

5.6.2 Modulus of rupture

When tested as specified in [7.3.1](#) using the test method given in [Annex D](#), the minimum modulus of rupture (MOR) of the sheets expressed in MPa shall be as specified in [Table 7](#). The MOR shall be the average of the values obtained from testing the samples in both directions.

The MOR of the sheets in the weaker direction shall not be less than 70 % of the value specified in [Table 7](#) (this is not applicable for plank products).

NOTE For textured sheets, the MOR is not used for calculating mechanical performance.

5.6.3 Apparent density

The manufacturer's literature shall specify the minimum apparent density for each category of sheet manufactured. When tested in accordance with [7.3.2](#), using the test method given in [Annex E](#), the apparent density shall not be less than the specified value.

5.6.4 Moisture movement

The manufacturer's literature shall state the percentage value of lineal sheet moisture movement measured when the sheet is exposed to a relative humidity change from 30 % to 90 %. The stated value shall be determined in accordance with [7.3.3](#) using the test method given in [Annex F](#). For category C sheets, this shall be $\leq 0,07$ %.

NOTE Some national testing methods and performance requirements for moisture movement will differ from those given in this document.

5.6.5 Water permeability

Category A, B and C sheets, when tested for water permeability in accordance with [7.3.4](#), using the test method given in [Annex G](#), may exhibit traces of moisture on the underside of the sheet, but in no instance shall there be any formation of water drops.

NOTE Some national testing methods and performance requirements for water permeability will differ from those given in this document.