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International Standard



393/2

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**Asbestos-cement products —  
Part 2: Asbestos-cement-cellulose corrugated sheets and  
fittings for roofing and cladding**

*Produits en amiante-ciment — Partie 2: Plaques ondulées et leurs accessoires en amiante-ciment-cellulose pour couvertures et revêtements*

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**Descriptors** : asbestos cement products, asbestos cement roofing, corrugated sheets, fittings, classification, specifications, tests, acceptance testing, marking.

## 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 393/2 was prepared by Technical Committee ISO/TC 77, *Products in fibre reinforced cement*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

## Contents

	Page
1 Scope and field of application .....	1
2 References .....	1
3 Corrugated sheets .....	1
4 Fittings .....	7
5 Conformity with national standards .....	8

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**Annexes**

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<b>A</b> Receiving inspection for products which are not subject to third party certification .....	9
<b>B</b> Third party certification .....	10

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# Asbestos-cement products — Part 2: Asbestos-cement-cellulose corrugated sheets and fittings for roofing and cladding

## 1 Scope and field of application

This part of ISO 393 specifies the characteristics of straight asbestos-cement-cellulose corrugated sheets and asbestos-cement-cellulose fittings to be used mainly for roofing and cladding. It also lays down tests to check them, marking and conditions of acceptance.

This part of ISO 393 covers products intended for use mainly in temperate or tropical areas. Where more severe climatic conditions (frost) are encountered, national standards may lay down a higher value for density.

Some of these requirements can apply, after agreement between manufacturer and purchaser, to curved asbestos-cement-cellulose corrugated sheets.

## 2 References

ISO 393, *Asbestos-cement products* —

*Part 1: Corrugated sheets and fittings for roofing and cladding.*

*Part 3: Asymmetrical section corrugated sheets and fittings for roofing and cladding.*

*Part 4: Trapezoidal section sheets for roofing and cladding.*<sup>1)</sup>

*Part 5: Short corrugated and asymmetrical section sheets and fittings for roofing.*<sup>1)</sup>

ISO 7337, *Asbestos reinforced cement products — Guidelines for on-site work practices.*

ISO 8108, *Guidelines for the fixing of asbestos-cement corrugated and asymmetrical section sheets and fittings for roofing.*

## 3 Corrugated sheets

### 3.1 Composition

Corrugated sheets to which this part of ISO 393 applies consist essentially of an inorganic hydraulic binder<sup>2)</sup>, reinforced with asbestos and cellulose fibres to which other fibres may be added.

Fillers and pigments may be added.

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

### 3.2 General appearance and finish (see figure 1)

Sheets are straight components, the cross-section of which consists of regular corrugations defined by their pitch  $a$  and their height  $h$  where the inner radius  $R_1$  and the outer radius  $R_2$  do not differ by more than 20 % of  $R_1$ .

The surface intended to be exposed to the weather shall be of smooth finish. Variations of the surface appearance are permitted if they do not impair the characteristics of the sheets as defined in this part of ISO 393.

1) At present at the stage of draft.

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

Edges shall be straight, clean and square. Sheets may have one or two mitred corners and may be drilled for fixing.

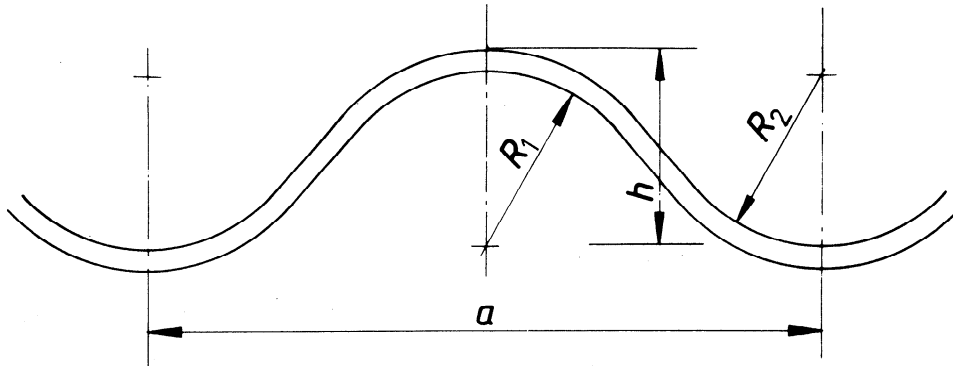


Figure 1

3.3 Classification

3.3.1 According to the nominal height of the corrugations

The sheets are classified according to the nominal height of their corrugations  $h$ .

Table 1

Category	Nominal height of corrugations $h$ mm
Shallow corrugations	15 to 25
Medium corrugations	26 to 45
Deep corrugations	46 to 60

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3.3.2 According to the thickness (see figure 2)

The thickness of the sheets may:

- be approximately constant throughout the width of the profile (sheets type A);
- vary regularly from the valley to the crown and along the side (sheets type B).

3.4 Characteristics

3.4.1 Geometrical characteristics

The specified dimensions are the nominal dimensions defined by national standards or, if not, by the manufacturer.

3.4.1.1 Preferred dimensions for the profile

Table 2

Category	Preferred dimensions in category	
	Pitch $a$ mm	Height $h$ mm
Shallow corrugations	75	21
Medium corrugations	130	30
	145	43
Deep corrugations	146	48
	177	51

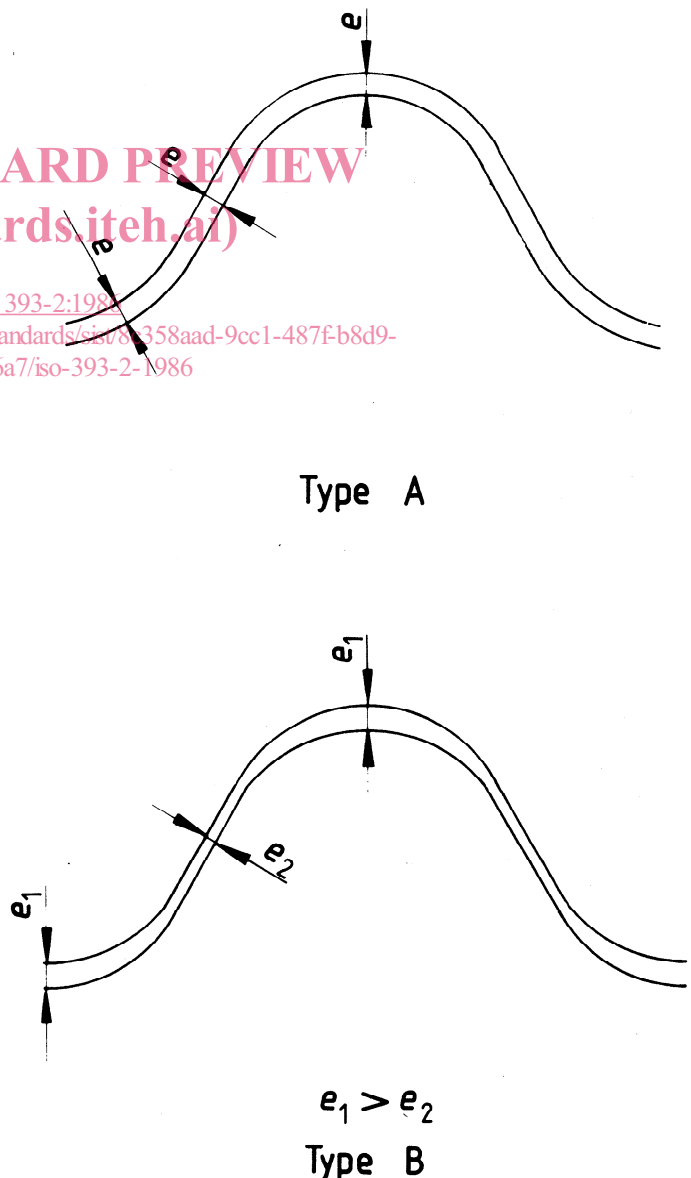


Figure 2

### 3.4.1.2 Width

The width is defined by:

- the pitch of the corrugation  $a$ ;
- the number of complete corrugations;
- the dimension of longitudinal overlapping corrugations.

### 3.4.1.3 Thickness

In all cases the thickness measured according to 3.5.3 shall not be less than the values in table 3.

Table 3

Category	Minimum thickness mm
Shallow corrugations	3,0
Medium and deep corrugations	4,0

### 3.4.1.4 Number of corrugations

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

### 3.4.1.5 Tolerances on the dimensions

The tolerances specified below apply to nominal dimensions:

- a) on the pitch  $a$  and on the height  $h$  (see table 4);

Table 4

Category	Tolerances mm	
	on the pitch $a$	on the height $h$
Shallow corrugations	$\pm 1,5$	$\pm 2,0$
Medium corrugations	$\pm 2,0$	$\pm 2,0$
Deep corrugations	$\pm 2,0$	$\pm 3,0$

- b) on the length  $L$ :  $\pm 10$  mm;
- c) on the width  $l$ :  $+ 10$   
 $- 5$  mm;
- d) on the thickness  $e$ :  $\pm 10$  % with a maximum of 0,6 mm;
- e) on the corrugations of the edges: out-of-squareness  $\leq 6$  mm;
- f) height of edges (only for sheets having a rising corrugation on one side and a descending corrugation on the other). Deviations, positive as well as negative, on the nominal height of an edge shall be such that the difference between extreme values is always  $\leq 8$  mm (see figure 7).

### 3.4.2 Mechanical characteristics

Tested as provided for in 3.5.5 (compulsory test), the sheets shall have a breaking load at least equal to values specified in table 5 according to their category.

Table 5

Category	Breaking load for one metre width* N/m
Shallow corrugations	800
Medium corrugations	1 800
Deep corrugations	3 000

\* National standards may, for medium and deep corrugations only, lay down the unit bending strength in addition to the minimum breaking load, on condition that the manufacturer:

- a) defines the profile, including the shape of edges;
- b) indicates consequently the calculation method of inertia modulus.

In this case, the unit bending strength calculated with the effective thickness as measured in 3.5.3 shall be more than 12 N/mm<sup>2</sup>.

### 3.4.3 Physical characteristics

#### 3.4.3.1 Watertightness

Tested as indicated in 3.5.6.1, traces of moisture may appear on the lower surface of the sheets but in no instance shall there be any formation of drops of water.

#### 3.4.3.2 Frost cracking (if justified by national conditions of use and/or if specified by national standards)

Once sheets have been tested as indicated in 3.5.6.2, a visual examination shall not show any cracking, surface alteration or delamination. This specification does not apply to surface coatings. <sup>1)</sup>

#### 3.4.3.3 Density

Tested as indicated in 3.5.6.3, the density shall not be less than 1,10 g/cm<sup>3</sup>. <sup>2)</sup>

### 3.5 Tests

The acceptance tests shall be carried out at the manufacturer's works on sheets and test pieces cut off the sheets which the manufacturer guarantees to be sufficiently matured.

- a) Compulsory tests<sup>3)</sup>
  - 1) Geometrical characteristics (3.4.1)
  - 2) Mechanical characteristics (3.4.2)

1) This material is normally used in temperate or tropical areas where the frost cracking test is not warranted. If, however, such a test is required, the method laid down in this part of ISO 393 shall be specified.

2) National standards may specify a higher value if climatic conditions require it.

3) See annex A.

- b) Optional tests (at purchaser's request)<sup>1)</sup>
  - 3) Watertightness (3.4.3.1)
  - 4) Frost cracking test (3.4.3.2)
  - 5) Density (3.4.3.3)

**3.5.1 Corrugation profile check**

The necessary apparatus is as follows:

- a) a flat, smooth checking area;
- b) steel rolls: length 200 mm and the diameter twice the external radius  $R_2$ , with a conical point at their axes;
- c) a micrometer with a hemispheric head, accurate to 0,1 mm;
- d) a metal rule of one metre, graduated in half-millimetres.

**3.5.1.1 Measurement of the pitch of corrugation  $a$**

At one end of the sheet, lay the rolls in each corrugation dip with the conical point of each roll slightly outside the sheet (see figure 3). With the graduated rule, measure the horizontal distance between two consecutive conical points to the nearest 0,5 mm.

Each measurement for the corrugations pitch shall be in accordance with the specifications of 3.4.1.5 a) (table 4).

**3.5.1.2 Measurement of the corrugation height  $h$**

Choose three complete corrugations on a sheet. With the micrometer, take three regularly spaced measurements on each of them over the length of the sheet. Calculate, for each corrugation, the arithmetic average of the three measurements. This shall be in accordance with the specifications of 3.4.1.5 a) (table 4).

**3.5.2 Length and width check (see figure 4)**

The apparatus consists of a smooth flat surface, with dimensions appropriate to the dimensions of the sheets, and a two-metre rule graduated in half-millimetres.

The sheet shall be laid flat on the checking area; it shall be verified that the valley of every corrugation is in contact with the surface.

For each dimension, take three measurements: in the middle and approximately at 50 mm from the end. Read to the nearest 0,5 mm. The arithmetic average of the three measurements shall be in accordance with the specifications of 3.4.1.5 b) and c).

**3.5.3 Thickness check**

The apparatus consists of a micrometer with hemicylindrical plates (see figure 5) of 4 mm x 10 mm, accurate to 0,05 mm.

The measurement shall be made at each end of the sheet:

- at the valley and the crown of the corrugation for sheets of type A;
- at the crown and along the side for sheets of type B.

At this end of the sheet, measure at least three corrugations, in which both complete side corrugations shall be included.

Each individual measurement shall be compared with the corresponding specification of table 3 (3.4.1.3) for compliance with the minimum value.

The average of at least six measurements made on one sheet shall be compared with the specification of 3.4.1.5 d) and shall be in accordance with this tolerance.

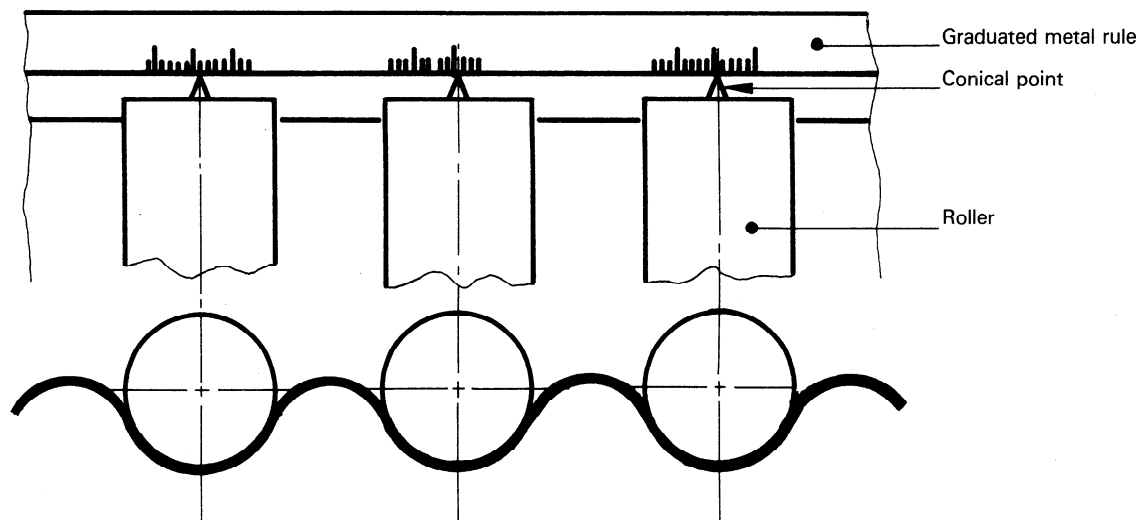


Figure 3

1) See annex A.



3.5.4 Edge check

3.5.4.1 Squareness (see figure 6)

The apparatus consists of a rectangular frame with two corrugated ends and two straight sides or any other appropriate device. The out-of-squareness shall be in accordance with the specifications of 3.4.1.5 e).

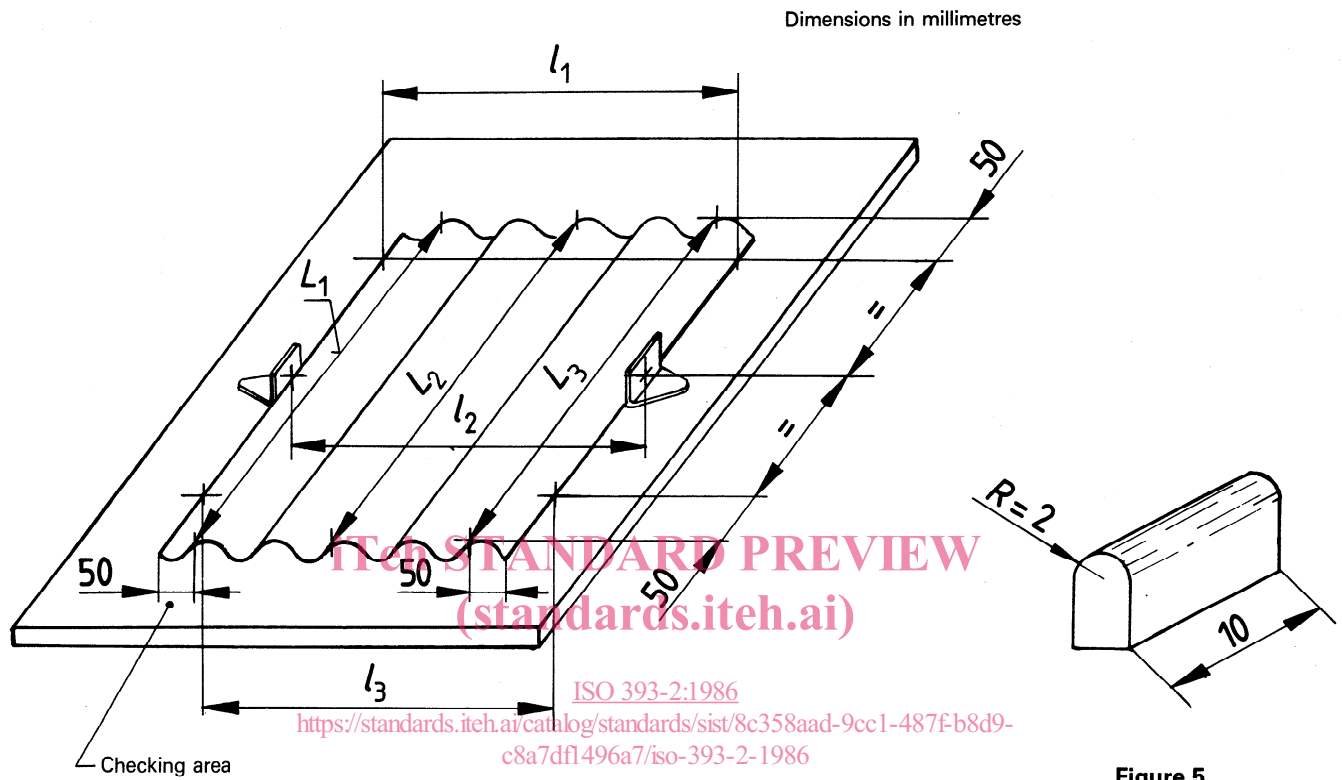


Figure 4

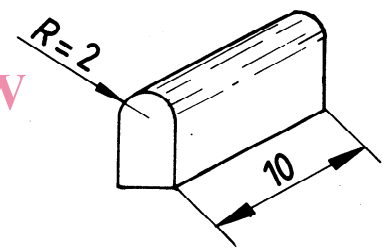


Figure 5

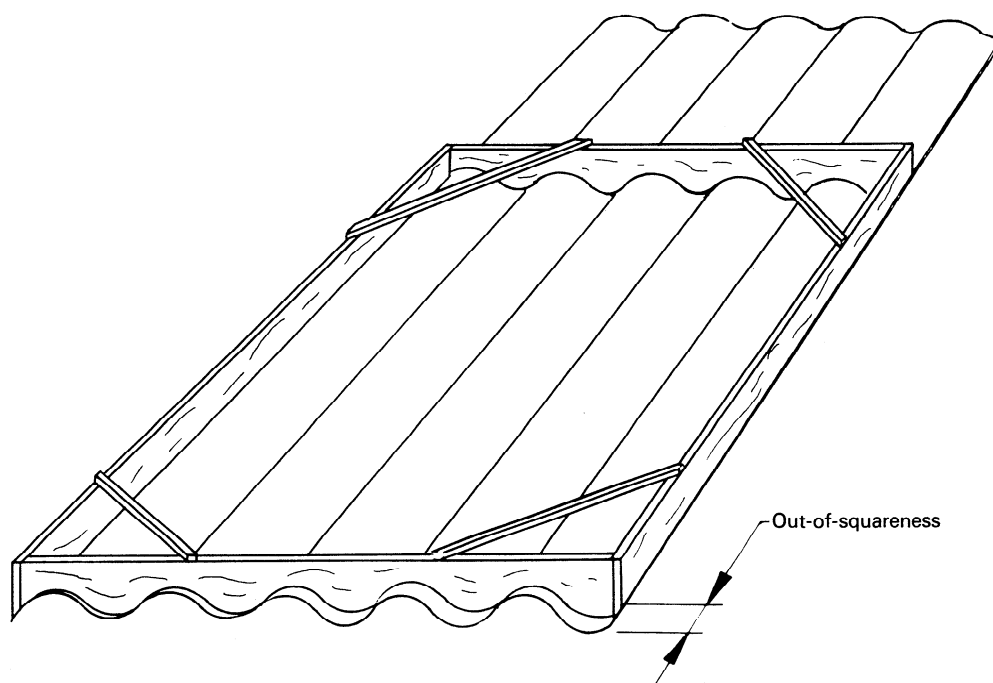


Figure 6