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# International Standard



# 393 / 1

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

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## Asbestos-cement products — Part 1: Corrugated sheets and fittings for roofing and cladding

*Produits en amiante-ciment — Partie 1: Plaques ondulées et leurs accessoires pour couvertures et revêtements*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

International Standard ISO 393/1 was developed by Technical Committee ISO/TC 77, *Products in fibre reinforced cement*, and was circulated to the member bodies in November 1980.

It has been approved by the member bodies of the following countries:

Australia	India	South Africa, Rep. of
Austria	Iran	Spain
Belgium	Iraq	Switzerland
Brazil	Ireland	Thailand
China	Israel	United Kingdom
Colombia	Italy	USSR
Czechoslovakia	Korea, Rep. of	Venezuela
Egypt, Arab Rep. of	Netherlands	Yugoslavia
France	New Zealand	
Greece	Philippines	

The member bodies of the following countries expressed disapproval of the document on technical grounds:

Denmark  
Germany, F.R.  
Mexico  
Nigeria  
Romania

This International Standard cancels and replaces ISO Recommendation R 393-1964, of which it constitutes a technical revision.

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# Asbestos-cement products — Part 1: Corrugated sheets and fittings for roofing and cladding

## 1 Scope and field of application

This International Standard specifies the characteristics of straight asbestos-cement corrugated sheets and their asbestos-cement fittings to be used mainly for roofing and cladding. It also specifies tests for checking these characteristics as well as marking and conditions of acceptance.

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

It is not applicable either to asymmetrical section corrugated sheets which are covered by ISO 394, or to "short" corrugated sheets<sup>1)</sup> which are covered by a separate International Standard.

## 2 Corrugated sheets

### 2.1 Composition

Corrugated sheets to which this International Standard is applicable consist essentially of an inorganic hydraulic binder<sup>2)</sup>,

(ground silica may be added in order to obtain a calcium-silicate reaction) reinforced with asbestos fibres to which other fibres may be added.

Fillers and pigments may be added.

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

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

Sheets are 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 %.

The surface intended to be exposed to the weather shall be of smooth finish. Variations of the surface appearance which do not impair the specified characteristics of the sheets are permitted.

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

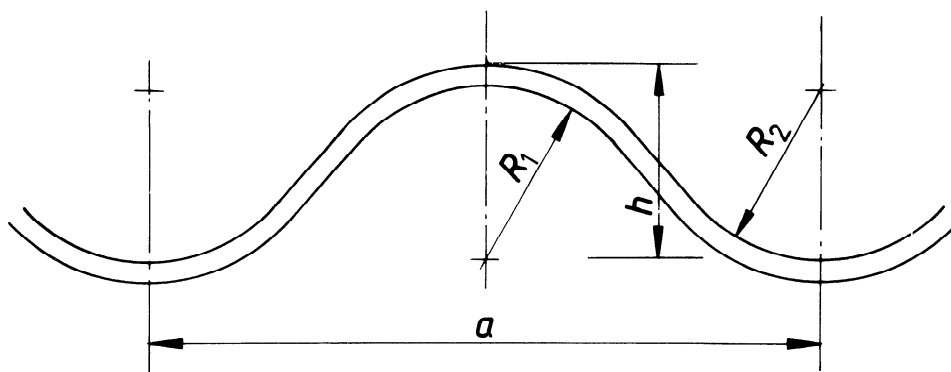


Figure 1

1) These sheets (about 0,6 m long) are small roofing components.

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

2.3 Classification

2.3.1 According to the nominal height of the corrugations

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

Table 1

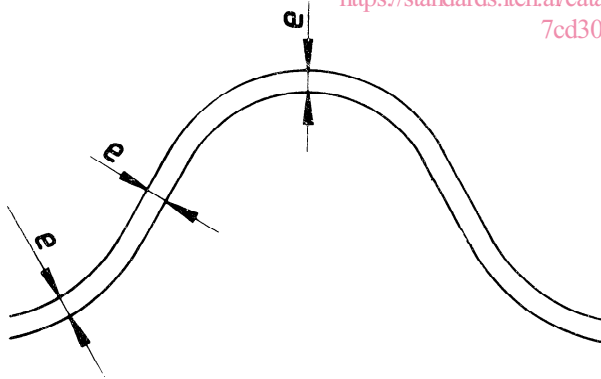
Category	Nominal height of corrugations $h$
Shallow corrugations	15 to 25
Medium corrugations	26 to 45
Deep corrugations	46 à 60
Very deep corrugations	> 60

2.3.2 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 between the crown and the valley of the corrugations on one hand, and the sides of the corrugations on the other hand (sheets type B).

Type A



Type B

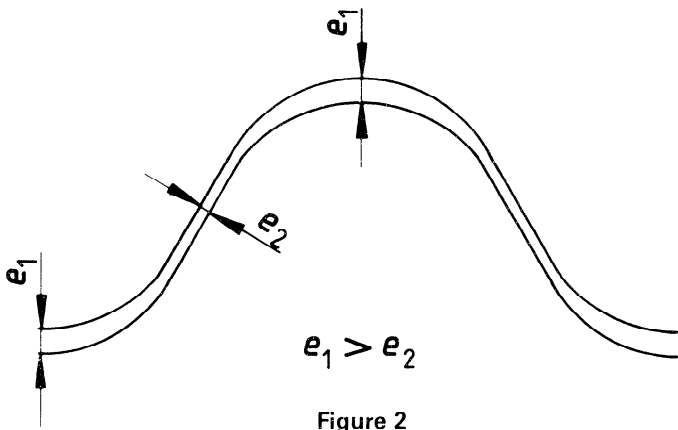


Figure 2

2.4 Characteristics

2.4.1 Geometrical characteristics

The specified dimensions are the nominal dimensions defined by national standards or, failing this, by the manufacturer.

2.4.1.1 Preferential dimensions for the profile

Table 2

Category	Preferential dimensions in the category	
	Pitch $a$ mm	Height $h$ mm
Shallow corrugations	75	21
Medium corrugations	130	30
Deep corrugations	146 177	48 51
Very deep corrugations	1)	

1) This category of sheets is only manufactured in a limited number of countries; therefore no preferred profiles have been included for the moment on an international level. Examples of these profiles manufactured are given below:

Pitch $a$ mm	Height $h$ mm
300	85
342	125

2.4.1.2 Width

The width is defined by

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

2.4.1.3 Thickness

The effective thickness measured according to 2.5.3 shall be not less than the values in table 3.

Table 3

Category	Minimum thickness mm
	Types A and B
Shallow corrugations	3,0
Medium and deep corrugations	5,0
Very deep corrugations	6,0

2.4.1.4 Number of corrugations

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

2.4.1.5 Tolerance on the dimensions

The tolerances specified as follows apply to nominal dimensions:

- a) on the pitch  $a$  and the height of the corrugations  $h$ ;

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	$\pm 2,0$	$\pm 3,0$
Very deep corrugations	$\pm 3,0$	$\pm 3,0$

- b) on the length  $L$ :  $\pm 10$  mm;
- c) on the width  $l$ :  $+ 10$  mm ;  
 $- 5$  mm ;
- d) on the thickness  $e$ :  $\pm 10$  % with a maximum of 0,6 mm;
- e) on the corrugations of the edges: squareness  $\leq 6$  mm;
- f) height of edges (only for sheets having an ascending corrugation on one side and a descending corrugation on the other side).

The difference between extreme values for tolerances, positive or negative, on the nominal height of a given side shall be  $\leq 8$  mm.

2.4.2 Mechanical characteristics

Tested as provided for in 2.5.5 (compulsory test), the sheets shall have a breaking load at least equal to the values specified in table 5, according to their category.

Table 5

Category	Breaking load for 1 m width <sup>1)</sup> N/m
Shallow corrugations	1 500
Medium corrugations	2 500
Deep corrugations	4 250
Very deep corrugations	7 400

1) National standards may prescribe, in addition to the minimal breaking load, the unit bending stress for deep and medium corrugations only, provided that the manufacturer

- a) defines the profile, including the shape of the edge corrugations;
- b) indicates the method of calculation of the inertial modulus.

In this case, the unit bending stress calculated with the thickness measured according to 2.5.3 should be greater than 14 N/mm<sup>2</sup>.

2.4.3 Physical characteristics

2.4.3.1 Water tightness

Tested as specified in 2.5.6.1, 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.

2.4.3.2 Frost cracking (If local conditions justify it or if national standards specify it)

When sheets are tested as specified in 2.5.6.2, a visual examination shall not show any cracking, surface alteration or delamination. This specification does not apply to surface coatings.

2.4.3.3 Density

Measured as specified in 2.5.6.3, the density shall be not less than 1,40 g/cm<sup>3</sup>.

In those countries where local conditions justify it, national standards may reduce this value by stages to 1,20 g/cm<sup>3</sup> minimum.

2.5 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 \*
  - 1) Geometrical characteristics (2.4.1)
  - 2) Mechanical characteristics (2.4.2)
- b) Optional tests (at purchaser's request) \*
  - 3) Water tightness (2.4.3.1)
  - 4) Frost cracking (2.4.3.2)
  - 5) Density (2.4.3.3)

2.5.1 Control of the corrugated profile

The necessary apparatus is as follows:

- a) a control area, plane and smooth;
- b) steel rolls: length 200 mm and diameter approximately twice the external radius  $R_2$ , having a conical point at their axes on one end;
- c) a micrometer with an hemispherical head accurate to 0,1 mm;
- d) a metal rule 1 m long graduated in half-millimetres.

\* See annex A.

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

At one end of the sheet, lay the rolls in each valley of the corrugations, the conical point of each roll slightly outside of the sheet (see figure 3).

Measure to the nearest 0,5 mm with the graduated rule, the distance between two consecutive conical points.

Each measurement obtained for the pitch of the corrugations shall be in accordance with the specifications of 2.4.1.5 a) (table 4).

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

Choose, on a sheet, three complete corrugations. On each of them with the micrometer, take three measurements regularly spaced on the length of the sheet. Calculate, for each corrugation, the arithmetic mean of the three measurements, which shall be in accordance with the specifications of 2.4.1.5 a) (table 4).

**2.5.2 Control of the length and the width (see figure 4)**

The apparatus shall consist of a smooth flat plane, with dimensions appropriate to the dimensions of the sheets, a double ruler or measuring rod graduated in half-millimetres in both directions and two tip-squares.

The sheet shall be laid flat and square on the control area; verify that the valley of every corrugation is in contact with the surface.

For both width and length, take three measurements, in the middle and at approximately 50 mm from each end of the sheet. Read to the nearest 0,5 mm. The arithmetic mean of the three measurements shall be in accordance with the specifications of 2.4.1.5 b) and c).

**2.5.3 Control of the thickness**

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

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

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

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

Each individual measurement shall be compared with the specifications of table 3 (2.4.1.3) and shall be not less than the minimum value.

The arithmetic mean of at least six measurements made on one sheet shall be compared with the specifications of 2.4.1.5 d), and shall be in accordance with those tolerances.

**2.5.4 Control of the corrugations of the edges**

**2.5.4.1 Squareness (see figure 6)**

The apparatus shall consist 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 specifications of 2.4.1.5 e).

**2.5.4.2 Height of the edges (see figure 7)**

The height of edges shall be verified with appropriate frames: frame for rising corrugation (om), frame for descending corrugation (od).

At any point on the edge of the sheet, the measured height shall be within the tolerances fixed in 2.4.1.5 f).

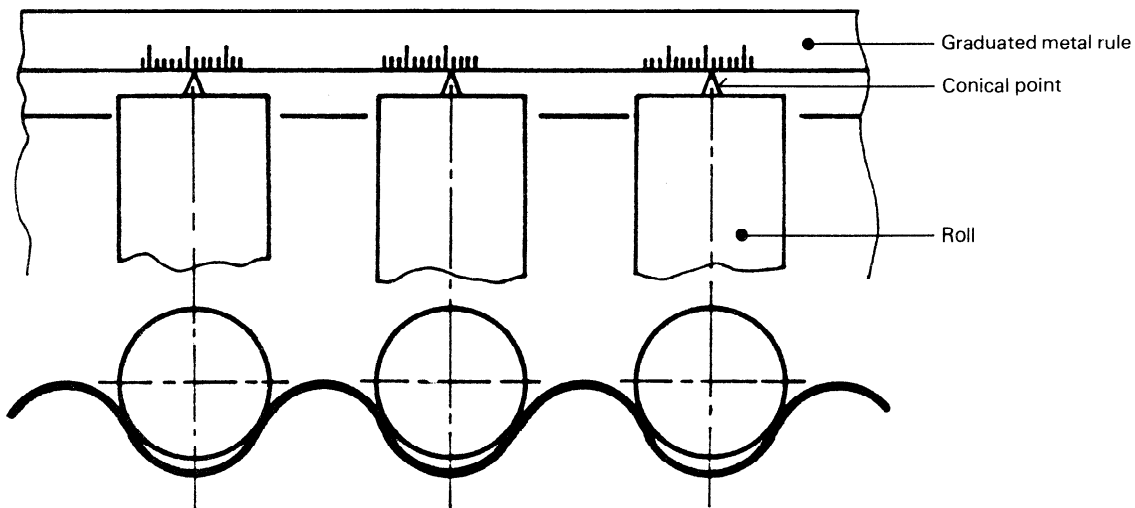
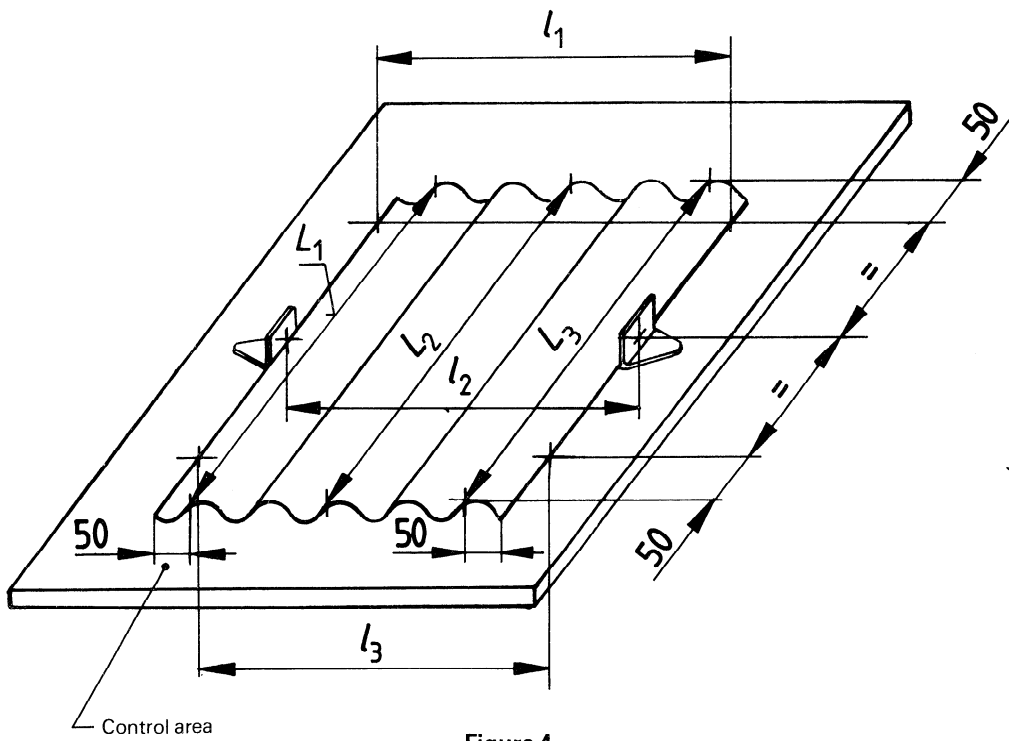
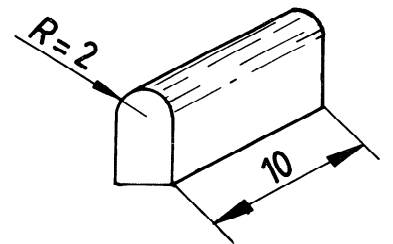


Figure 3





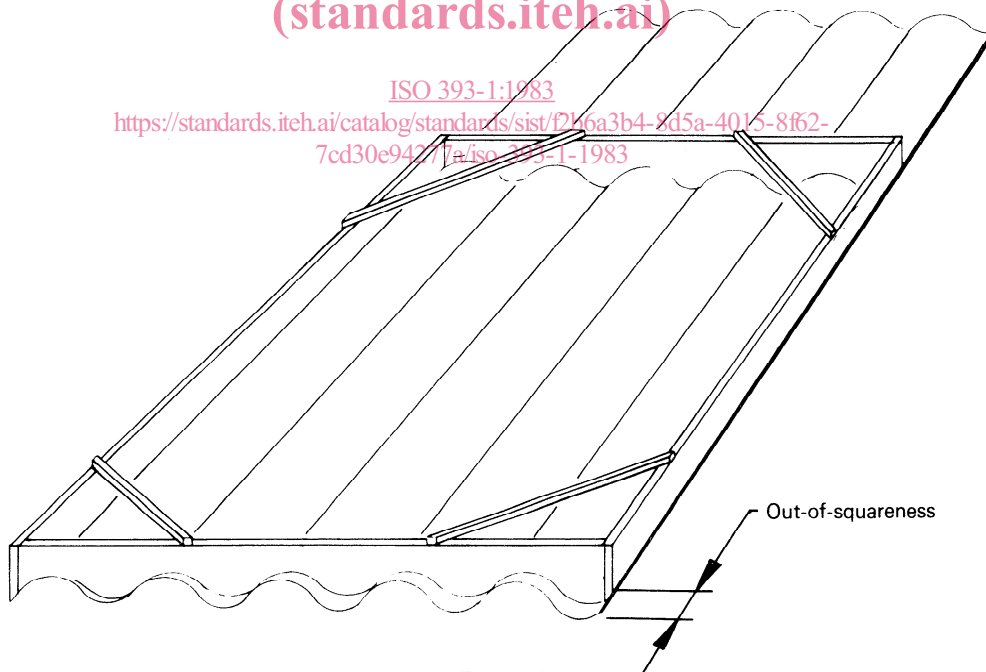
Dimensions in millimetres



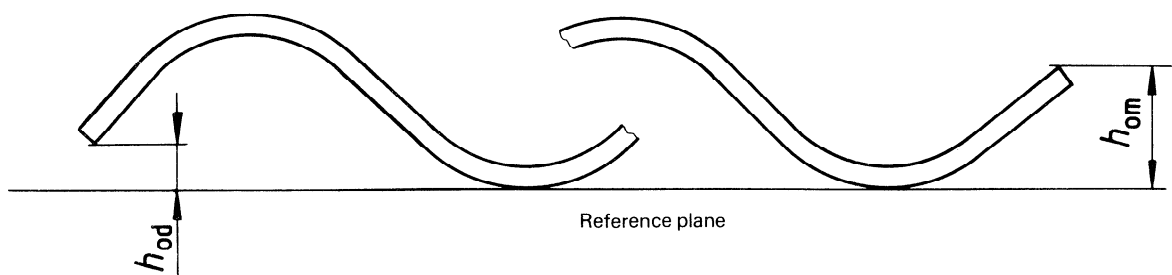
**Figure 4**  
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**Figure 5**

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**Figure 6**



**Figure 7**