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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION
R 394

ASYMMETRICAL SECTION CORRUGATED SHEETS IN ASBESTOS-CEMENT FOR ROOFING AND CLADDING

1st EDITION
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For each individual country the only valid standard is the national standard of that country.

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BRIEF HISTORY

The ISO Recommendation R 394, *Asymmetrical section corrugated sheets in asbestos-cement for roofing and cladding*, was drawn up by Technical Committee ISO/TC 77, *Products in asbestos-cement*, the Secretariat of which is held by the Association Suisse de Normalisation (SNV).

Work on this question by the Technical Committee began in 1958 and led, in 1963, to the adoption of a Draft ISO Recommendation.

In December 1963, this Draft ISO Recommendation (No. 692) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Australia	Israel	Republic of South Africa
Austria	Italy	Romania
Belgium	Japan	Spain
Colombia	Lebanon	Sweden
Denmark	Morocco	Switzerland
Finland	Netherlands	Turkey
France	New Zealand	U.A.R.
Germany	Norway	United Kingdom
Greece	Poland	U.S.S.R.
Hungary	Portugal	Venezuela
Ireland		Yugoslavia.

Three Member Bodies opposed the approval of the Draft:

Brazil, Mexico, Peru.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in November 1964, to accept it as an ISO RECOMMENDATION.

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ASYMMETRICAL SECTION CORRUGATED SHEETS IN ASBESTOS-CEMENT FOR ROOFING AND CLADDING [1]

1. SCOPE

This Recommendation applies to straight or curved asymmetrical section corrugated sheets and fittings in asbestos-cement without any metallic reinforcing media, to be used for roofing and cladding.

It defines certain conditions of manufacture, dimensions and acceptance tests for these products.

2. ASYMMETRICAL SECTION CORRUGATED SHEETS

2.1 Composition

The sheets are made from a close and homogeneous mixture essentially consisting of a suitable inorganic hydraulic binder, asbestos fibre and water, excluding any materials liable to cause ultimate deterioration in the quality of the sheets. [2]

The 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.

2.2 Classification

The sheets are classified both according to the height of their corrugations and according to their load bearing capacity.

2.2.1 *Geometrical classification*

(Classification according to the height of the corrugations)

DEFINITION — The height h of the asymmetrical corrugations is the height measured from the flats separating the corrugations to the crowns of the adjacent corrugations (see Figure 1). This dimension includes one thickness only.

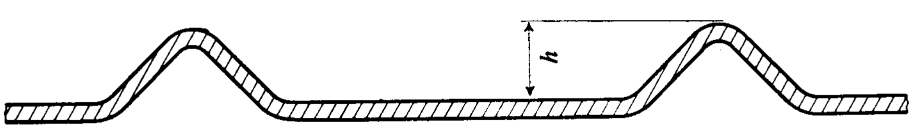

Fig. 1

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[1] Symmetrical corrugated sheets are covered by Recommendation ISO/R 393.

[2] This Recommendation also applies to autoclaved sheets when the binder is partially replaced by ground silica.

DESIGNATION OF THE CATEGORY

(1) deep corrugations
height not less than 42 mm

(2) medium corrugations
height less than 42 mm
and not less than 30 mm

(3) shallow corrugations
height less than 30 mm
and not less then 15 mm.

2.2.2 *Mechanical classification*

(Classification according to the load bearing capacity)

DEFINITION — The sheets are classified according to their load bearing capacity (2.5.2.2), on the condition that the minimum unit stress value of 200 kgf/cm² measured on test pieces that defines the intrinsic quality of the asbestos-cement material, provided for in 2.4.2, is maintained.

The classifying index C_m represents a minimum acceptable load bearing capacity related to a width of one metre.

DESIGNATION OF THE CLASS

(1) class 150 C_m: 150 kgf/m
(2) class 212 C_m: 212 kgf/m
(3) class 300 C_m: 300 kgf/m
(4) class 425 C_m: 425 kgf/m.

One lower class may be introduced into this classification; it has to be chosen from the same series of preferred numbers as the classes above.

2.2.3 *Choice of the classifications*

The national standards may prescribe one or other or both the above classifications.

(a) In order to facilitate the interchangeability of the sheets and consequently to ensure the tightness of the roofs when matching sheets, a sheet should keep within the category of its geometrical profile irrespective of its minimum load bearing capacity.

(b) It is not permissible to change the class according to the minimum acceptable load bearing capacity of a sheet as determined by 2.2.2, even if the verification of bearing capacities carried out according to 2.5.2.2 indicates an index corresponding to a higher class than the classifying index C_m for the sheet.

2.3 General appearance and finish

The sheets are elements the cross section of which presents a succession of linear portions and corrugated portions so arranged to make the sheet rigid. The surface intended to be exposed to the weather should be finished smooth.

The edges of the sheets should be square, straight and clean.

2.4 Characteristics

2.4.1 *Geometrical characteristics*

2.4.1.1 PROFILES AND SIZES

The profiles and sizes of the sheets should conform to those in the national standards of the producing country or, failing this, should be as specified in the manufacturers' catalogues.

2.4.1.2 LENGTH, WIDTH AND COVERAGE

These nominal dimensions should conform to those in the national standards of the producing country or, failing this, should be as specified in the manufacturers' catalogues.

2.4.1.3 THICKNESS

The nominal thickness of the sheets should conform to that in the national standards of the producing country or, failing this, should be as specified in the manufacturers' catalogues.

The actual thickness measured according to 2.5.1 should at no point be less than 5.5 mm for those sheets of the categories (2.2.1) "deep" and "medium" corrugations, and 3.5 mm for those sheets of the category "shallow" corrugations.

2.4.1.4 TOLERANCES ON THE NOMINAL DIMENSIONS

(a) on the length

Upper deviation: + 5 mm
Lower deviation: — 10 mm.

(b) on the width

Upper deviation: + 10 mm
Lower deviation: — 5 mm.

(c) on the thickness

Upper deviation: free
Lower deviation: — 0.5 mm.

2.4.2 *Mechanical characteristics*

Tested as provided for in 2.5.2.1 (compulsory test), the sheets should give a minimum unit bending stress of 200 kgf/cm².

2.4.3 *Physical characteristics*

2.4.3.1 IMPERMEABILITY

Tested as provided for in 2.5.3 (optional test), traces of moisture may appear on the lower surface of the sheets, but in no instance should there be any formation of drops of water.

2.4.3.2 FROST CRACKING

Tested as provided for in 2.5.4 (optional test), the sheets should not show signs of cracking or surface alteration.

2.5 Tests

The acceptance tests should 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. Measurement of the thicknesses (method as defined in 2.5.1).
2. Bending tests (methods as defined in 2.5.2.1 and 2.5.2.2, number of tests as indicated in the extract of the table in Appendix B).

(b) Optional tests at purchaser's request

3. Impermeability test (method as defined in 2.5.3, number of tests as indicated in the extract of the table in Appendix B).
4. Frost cracking test (method as defined in 2.5.4, number of tests as indicated in the extract of the table in Appendix B).

2.5.1 *Measurement of the thicknesses*

The methods of assessing these measurements and the instruments used should be in accordance with the national standards of the producing country.

The actual thickness measured at any point should be not less than the minimum provided for in 2.4.1.3.

2.5.2 *Bending tests*

2.5.2.1 Bending test on test pieces — Unit bending stress

This test serves to determine the unit bending stress of the material of the sheets.

It is carried out on flat test pieces cut off the linear portions of the sheets and on which the direction of the corrugations should be marked. These test pieces should be 25 cm long taken from the sheet length and be as wide as possible governed by the dimension of the linear portions in the sheet width, but limited to 20 cm. Before testing the test pieces should be immersed in water for 24 hours.

The test piece should be placed on two parallel supports with edges rounded at a radius of 3 mm, leaving between them a clear span of 21.5 cm, the supports being at right angles to the direction indicated by the marks. It should be loaded at mid-span by means of a piece of the same shape and parallel to the supports, the surface which is intended to be exposed working under compression.

The speed of application of the load should be regulated so as to realize an increase of the unit stress of about 10 kgf/cm²s up to breaking point. [3]

The unit bending stress expressed in kilogrammes-force per square centimetre is given by the formula:

$$R_f = \frac{M}{W}$$

[3] When national standards provide for a constant speed of application of the load, it should be of about 0.100 kgf/cm width per second up to breaking point.

where

$$M = \frac{P\,l}{4}$$

$$W = \frac{b\,e^2}{6}$$

P = breaking load, expressed in kilogrammes-force
l = clear span between the supports, expressed in centimetres
e = actual thickness of the test piece in the breaking section, expressed in centimetres
b = actual width of the test piece, expressed in centimetres.

The unit bending stress R_f should be not less than 200 kgf/cm².

2.5.2.2 BENDING TEST ON WHOLE SHEETS — CLASSIFYING INDEX

This test serves to verify the classifying index C_m according to the classification by the load bearing capacity.

It includes a test on a sheet placed in its normal conditions of use (" normal ") and a test on another sheet placed in the reversed position (" reversed ").

The test is carried out on straight sheets of a minimum length of 1.22 m. Before testing they should be immersed in water for 24 hours.

Fig. 2

The sheet should be placed on two transverse fixed rigid flat parallel supports 5 cm wide, leaving between them a clear span of 1.10 m. It should be loaded at mid-span by means of a self-aligning rigid flat beam 23 cm wide, parallel to the supports and loaded at mid-span.

Strips of felt or soft fibre not more than 1 cm thick are interposed between the sheet and the supports and under the beam by which the load is applied.

The speed of application of the load should be of about 10 kgf/s up to breaking point.

When the sheets are classified according to their load bearing capacity expressed in kilogrammes-force for a width of one metre, the index C which is used to classify them is determined by the conventional formula:

$$C = \frac{P1 + P2}{2b}\ kgf/m$$

where

$P1$ = breaking load of the normal test, expressed in kilogrammes-force
$P2$ = breaking load of the reversed test, expressed in kilogrammes-force
b = width of the test piece, expressed in metres.

The index C determined by the test should be not less than the classifying index C_m of the sheet defined in 2.2.2.

2.5.3 *Impermeability test*

The impermeability should be tested on test pieces cut off the sheets in air with a relative humidity of over 70 per cent. A vertical transparent tube 30 cm long with a bore of 3.5 cm is sealed to the middle of the flat separating the corrugations of a test piece placed horizontally on a transparent container. The tube is filled with water, the level of which is maintained at a height of about 25 cm measured from the flat separating the corrugations.

During the 24 hours of the test, traces of moisture may appear on the lower surface, but in no instance should there be any formation of drops of water.

2.5.4 *Frost cracking test*

Test pieces cut off the sheets after immersion for 48 hours in water, are submitted to alternate freezing and de-freezing between temperatures of — 20 °C and + 20 °C (with a tolerance of ± 3 °C). The size of the test pieces, the number of cycles and the duration of the test at the utmost temperatures should be in accordance with the national standards of the producing country.

The test is considered to be satisfactory if the test pieces after testing do not show signs of cracking or surface alteration.

2.6 Marking

The sheets should be marked legibly and indelibly so as to show:

— the origin of manufacture,
— the date of manufacture.

The method of marking should conform to that in the national standards of the producing country.

3. FITTINGS

3.1 Composition

The fittings are of similar composition to the sheets (2.1).

3.2 General appearance and finish

The fittings should have straight and clean edges. They may have a lapped joint.

3.3 Characteristics

3.3.1 *Geometrical characteristics*

3.3.1.1 SHAPES

The shapes of the fittings should conform to those in the national standards of the producing country or, failing this, should be as specified in the manufacturers' catalogues.

If requested, they should belong to the same type and category as the sheets with which they are to be used.