Zambian Standard

ASBESTOS-CEMENT CORRUGATED SHEETS AND
DECKING FOR ROOFING AND CLADDING -
Specifications and testing

ZAMBIA BUREAU OF STANDARDS
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<th>Date</th>
<th>Text affected</th>
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ZS 004:1973 ASBESTOS-CEMENT CORRUGATED SHEETS AND DECKING

The following organizations were consulted and participated in the working of the Technical
committee for this standard:

T.A.P. Building Products Ltd
Chilanga Cement Ltd
Cement and Concrete Advisory Services
Department of Works, Buildings Branch
Department of Works, Structural branch
University of Zambia, Department of civil Engineering
Engineering Institution of Zambia
Zambia Institute of Architects
Lusaka city Council
National Housing authority
And other professional and construction firms, as well as standards organizations in other countries.

* * *

ZAMBIA STANDARDS INSTITUTE

The Zambian Standards institute is a national body sponsored by the Government of Zambia for the establishment of standardization in industry. It functions in a similar manner as national standards organizations in other countries and is affiliated to the international Standards Organization which is a world body.

Its principal object is to prepare and establish standards for quality, specifications and codes of practice on a national and international basis, by co-operation and agreement among all the interested parties, viz., manufacturers, consumers, professionals and Government departments, and to promote their adoption and promulgation. The principles observed in preparation of standards are that they are in accordance with the needs of industry, suitable to local conditions, meet a general recognized demand and take into account the progressive requirements of the experts, producers and users. The use of ZS Certification Mark by manufacturers on their products provides a third party guarantee to the consumers of the equality of goods produced.

These are the first series of publications issued as national standards and are subject to amendments as the need arises.

The Zambian Standards are grouped in divisions as noted below:

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<tr>
<td>ELC</td>
<td>Electrical</td>
</tr>
<tr>
<td>MIN</td>
<td>Mechanical, Mining and Metals</td>
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<td>TEX</td>
<td>Textile</td>
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<td>Agriculture and Food</td>
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<tr>
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<td>Drugs</td>
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<tr>
<td>CHE</td>
<td>Chemicals</td>
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<tr>
<td>GEN</td>
<td>General Industries</td>
</tr>
<tr>
<td>MIS</td>
<td>Miscellaneous</td>
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</table>
FOREWORD

This Zambian Standard has been based on British standards BS 690: 1963, BS 3717: 1964, and ISO Recommendation R393. The alterations made are to allow for the difference between local conditions and practices and those in other countries, the main changes being as follows:

All references to frost testing have been omitted.

A deeper corrugation B1 has been introduced to accommodate local rainfall conditions.

Symmetrical, asymmetrical and decking profiles have been combined into a common standard.

The temperature during the performance of the various operations required throughout this standard has been increased to conform to local conditions.

SI metric units have been adopted for this standard.

NOTE:

The Appendices B and C show profiles in use at present. The standard will however include any new metric module co-ordinated profiles, when those become available.

1. SCOPE

This Standard applies to straight or curved asbestos-cement corrugated sheets, asbestos-cement decking and fittings, to be used for roofing and cladding.

2. REQUIREMENTS

2.1 COMPOSITION

The sheets shall be made from a close and homogeneous mixture consisting essentially of cement to comply with the requirements of ZS 001: 1993, asbestos fibre and water, and shall exclude any materials liable to cause ultimate deterioration in the quality in the quality of the sheets.

The sheets may be left in their natural colour or may be coloured by the addition of pigments suitable for colouring asbestos cement products. Suitable pigments are specified in B.S. 1014 ‘Pigments for colouring cement, magnesium oxychloride and concrete.’

They may also receive adherent coloured and uncoloured coatings on their surfaces.
This standard also applies to autoclaved products when the cement is partially replaced by ground silica.

2.2 CLASSIFICATION

The sheets shall be classed both according to their dimensions and profile, and according to their load bearing capacity.

2.3 GENERAL APPEARANCE AND FINISH

The sheets shall have at least one smooth surface and shall be free from visual manufacturing defects.

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

2.4 CHARACTERISTICS

2.4.1 Geometrical characteristics

Profile and sizes:

Metric module co-ordinated profiles will be adopted for this standard. Examples of existing profiles and sizes are shown as appendices A, B and C.

Length, width and coverage:

These nominal dimensions should be as specified in the manufacturers’ catalogues.

Thickness:

The nominal thickness shall be as stated in Appendix A.

Tolerances on dimension:

(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

<table>
<thead>
<tr>
<th>Type of sheet</th>
<th>Minimum Classifying Index (C) N/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1370</td>
</tr>
<tr>
<td>B, B1 and C</td>
<td>Minimum Bending Strength (f) MN/m²</td>
</tr>
<tr>
<td>D and D1</td>
<td>16.0</td>
</tr>
</tbody>
</table>

2.4.3 Physical characteristics

Impermeability:
When tested as described in 2.5.5 traces of moisture may appear on the lower surfaces of the sheets but in no instance should there be any formation of drops of water.

2.5 TESTS

2.5.1 Thickness

Apparatus:

Use a thickness gauge, such as a dial gauge, having a semi cylindrical anvil 10 mm long and not greater than 5 mm radius, and a spindle fitted with a 10 mm diameter metal plate.

Procedure:

Measure the Thickness of each sheet in the sample at three points taken towards the edge of the sheet, that is, on the crown, in the valley and at a point in between these two points. Repeat those measurements at the opposite side of the sheet. The thickness being the arithmetical average of the six measurements so taken.

Reporting of results:

Record thickness in millimetres to one place of decimals.

2.5.2 Classifying index (C)

(Symmetrically corrugated sheets exampled by profiles A, B and B1).

Preparation of specimen:

Cut a test piece of 1200 mm to 1400 mm in length from a straight sheet, the width of which shall correspond to the total width of the sheet reduced at the edges by cutting along the axis of the outer valleys.

Immerse test pieces in water at 20° C to 25° C for 24 hours before the test.

Procedure:

Place the test piece with its weather-side uppermost on two transverse fixed rigid flat parallel supports 150 mm x 50 mm wide, leaving between them a clear span of 1100 mm. Place at mid-span a self-aligning rigid flat beam 50 mm x 225 mm wide parallel to the supports. Place strips of rubber, felt or soft fibre not more than 10 mm thick between the test piece and the supports and under the beam by which the load is applied (see fig. 1). Apply the load at a constant rate of approximately 100 N/s until breaking point is reached.

Determination of classifying index (C)

When it is required to classify sheets in terms of the breaking load per metre width, calculate C from:

\[ C = \frac{W}{b} \text{ N/m} \]

Where \( W \) = breaking load (N)

\( b \) = width of test piece (m)

2.5.3 Classifying Index (C)

(Asymmetrically corrugated sheets, exampled by

Preparation of specimens:
Cut test pieces to the full width of the sheet and to a minimum length of 1200 mm from straight sheets. Immerse the test pieces in water at 20°C to 25°C for 24 hours before the test.

Procedure:

Place a test piece with its weather-side uppermost (normal) and its corrugations at right angles to two transverse fixed rigid flat parallel supports 150 mm x 50 mm wide, leaving between them a clear span of 1100 mm. Place at mid-span a self-aligning rigid flat beam 225 mm wide parallel to the supports. Place strips of rubber, felt or soft fibre not more than 10 mm thick between the test piece and the supports and under the beam by which the load is applied (see Fig. 1.) Apply the load at a constant rate of about 100 N/a until breaking point is reached.

Repeat the procedure on a second test piece placed with its weather-side downwards (inverted.)

Calculate the index C from:

\[ C = \frac{W_1 + W_2}{2b} \text{ N/m} \]

Where

\[ W_1 = \text{ breaking load of the ‘normal’ test piece (N)} \]
\[ W_2 = \text{ breaking load of the ‘inverted’ test piece (N)} \]
\[ B = \text{ width of test piece (m)} \]

2.5.4 Bending Strength (f)

(Asymmetrically corrugated sheets, exemplified by profiles D and D1).

Preparation of specimen:

Cut a test piece from the flat portion of the sheet and mark the direction of the corrugations. The test piece shall be 250 mm long and shall be as wide as possible governed by the dimensions of the flat portions of the sheet width but not greater than 200 mm.

Immerse the test piece in water at 20°C to 25°C for 24 hours before the test.

Procedure:

Place the test piece with its weather-side uppermost on two parallel supports with edges rounded at a radius of 3 mm, leaving between them a clear span of 215 mm, the supports being at right angles to the marks indicating direction of corrugations. Load the test piece at midspan by means of a bar of the same shape and parallel to the supports (see fig. 2.)

The apparatus is shown in Fig 3.

Apply the load at a constant rate of about 0.1 N/s per mm width until breaking point is reached.

Calculate of bending strength:

Calculate bending strength \( f \) in newtons per square millimetre (N/mm\(^2\)) from:

\[ F = \frac{M}{Z} \]

Where \( M = \frac{W_1}{b} \)
\[ Z = \frac{bt^2}{6} \]

\( W \) = breaking load (N)
\( l \) = clear span between supports (mm)
\( t \) = the average of three measurements of thickness (mm) taken along the line of fracture and determined in accordance with 1.1
\( b \) = width of test piece (mm)

Report of results:

Record results in terms of MN/m²

NOTE: 1 N/mm²

2.5.5 Impermeability

Preparation of specimen:

Cut a test specimen of approximately 100 mm, from the material to be tested.

Procedure:

Carry out the test in air with a relative humidity of over 70%. Seal a vertical transparent tube 300 mm long with an internal diameter of 35 mm to the middle of the test specimen, placed horizontally on a transparent container. If the test specimen is corrugated, use a vertical tube with the lower end shaped to fit into the valley of a corrugation, or attach the tube to a flat between corrugations. Fill the tube with water and maintain the level at a height of about 250 mm, measured from the upper surface of the test specimen. After 24 hours examine the lower surface of the test specimen.

Reporting of results:

Record any formation of drops of water. Trace of moisture on the lower surface may be ignored.

3. SAMPLING AND TESTING

All items in a consignment purporting to comply with this standard shall meet the requirements of 2.1, 2.2, 2.3 and 2.4.

If the purchaser requires the manufacturer to test the products in a particular consignment for compliance with 2.4.2 and 2.4.3, this shall be stated in the enquiry or order and in addition, whether the tests are to be made in the presence of the purchaser or his representative. Sampling for these tests shall be carried out in accordance with Appendix D and the number of specimens tested shall be laid down in Table 1 Appendix D.

When the number of specimens required to be tested exceeds the numbers in Table 1, Appendix D, the costs of such additional tests, unless otherwise specified, shall be borne by:

(1) the manufacturer, if the results show that the material does not comply.

(2) the purchaser, if the results show that the material complies with the specification.

4. CERTIFICATION MARK
The manufacturers under license from the Zambian Bureau Standards may use the certification mark shown below. The presence of this mark on a product is an assurance to the consumers that the goods have been produced to comply with the requirements of this Zambian Standard under a system of supervision, control and testing operated during manufacture and including periodical inspections at the manufacturer’s works in accordance with the certification mark scheme.
## APPENDIX A

### DIMENSIONS OF ASBESTOS-CEMENT CORRUGATED SHEETS

<table>
<thead>
<tr>
<th>Type of sheet</th>
<th>Pitch of corruga-moulded corrugations</th>
<th>Nominal overall depth</th>
<th>Nominal thickness</th>
<th>Net moulded covering width</th>
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<tr>
<td></td>
<td>P</td>
<td>T</td>
<td>B</td>
<td>C</td>
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<tr>
<td>A</td>
<td>mm</td>
<td>mm</td>
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<tr>
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<td>C</td>
<td>338</td>
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<td>6.35</td>
<td>1092</td>
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<tr>
<td>D</td>
<td>279.4</td>
<td>51</td>
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<td>D₁</td>
<td>119</td>
<td>9.5</td>
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APPENDIX D

SAMPLING AND INSPECTION OF

ASBESTOS-CEMENT CORRUGATED SHEETS

Based on ISO Recommendation R390

D1 DIVISION OF A CONSIGNMENT INTO INSPECTION LOTS

D1.1 Homogeneous consignments:

(1) Any homogeneous consignment (or sub-consignment D1.2) should be divided by the manufacturer into inspection lots, the maximum size of which is given in Table 1.

(2) Any fraction of a consignment remaining after taking out the highest possible number of maximum inspection lots and any homogeneous consignment (or sub-consignment) smaller than the maximum lot size, form an inspection lot if larger than the minimum lot size given in Table 1.

(3) Consignments or fractions of consignments smaller than the minimum lot size given in Table 1.

D1.2 Non-homogeneous consignments:

Any consignment which is known to be or is expected to be non-homogeneous as regards any of the properties to be tested by sampling should be divided by the manufacturer into assumed homogeneous sub-consignments prior to the division into inspection lots in D1.1.

D2 SAMPLING

D2.1 From each inspection lot D1.1 (1) and D1.1 (2) the purchaser may draw a sample, the size of which is indicated in Table 1 (D2.2 and D2.3).

D2.2 The entry to Table I is the number of units of product in the inspection lot (column 1), the sample size being indicated in Column 2.

D2.3 For products where all units undergo a compulsory non-destructive test during manufacture, the reduced sample size obtained by entering Table 1.

D2.4 The possibility mentioned in D2.3 is also available when the manufacturer guarantees or has his production guaranteed by an independent control organisation.

D2.5 When test pieces are cut from the units of the sample, the cutting is carried out by the manufacturer in the presence of the purchaser.

D2.6 When the relevant Recommendation calls for more than one property to be tested, the sample size should be appropriately multiplied so as to secure for each test a number of test pieces equal to the sample size (D2.2 and D2.3). From one unit of a sample one test piece only should be cut for a particular test, but for different tests the necessary test pieces may be cut from the same unit of the sample.
D3 DETERMINATION OF ACCEPTABILITY OF INSPECTION LOTS

D3.1 Inspection by attributes

D3.1.1 When the number of non-conforming units found in the sample is equal to or less than the acceptance number \( Ac_1 \) indicated in column 3 of Table 1, the inspection lot from which the sample was drawn should be considered acceptable.

D3.1.2 When the number of non-conforming units found in the sample is equal to or greater than the rejection number \( Re_1 \) indicated in Column 4 of Table 1, this may justify rejection of the inspection lot.

D3.1.3 When the number of non-conforming units found in the sample lies between the acceptance number and the rejection number (Columns 3 and 4 of Table 1), a second sample of the same size as the initial supply (D2.2, D2.3 and D2.4) should be drawn and examined.

D3.1.4 The second sample should be inspected as indicated in D2.5 and D2.6.

D3.1.5 The number of non-conforming units found in the initial and in the second samples should be totalled.

D3.1.6 If the total number of non-conforming units is equal to or less than the acceptance number \( Ac_2 \) indicated in Column 5 of Table 1, the Inspection lot should be considered acceptable.

D3.1.7 If the total number of non-conforming units is equal to or greater than the second rejection number \( Re_2 \) indicated in Column 6 of Table 1, this may justify rejection of the inspection lot.

D3.1.8 The relevant Recommendation calls for more than one property to be tested, the second sample taken (D3.1.3) should only be inspected in accordance with those tests which at the inspection of the initial sample gave number of non-conforming units between the acceptance number \( Ac_1 \) and the rejection number \( Re_1 \).
<table>
<thead>
<tr>
<th>Size of Inspection lot</th>
<th>Sample size</th>
<th>Acceptance Number ( Ac_1 )</th>
<th>Rejection Number ( Re_1 )</th>
<th>Acceptance Number ( Ac_2 )</th>
<th>Rejection Number ( Re_2 )</th>
<th>Size of Inspection lot for products tested during manufacture</th>
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