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SPECIFICATION FOR
CORRUGATED COIR, WOODWOOL,
CEMENT ROOFING SHEETS

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Indian Standard

SPECIFICATION FOR CORRUGATED COIR, WOODWOOL, CEMENT ROOFING SHEETS

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Indian Standard
SPECIFICATION FOR
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CEMENT ROOFING SHEETS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 31 December 1982, after the draft finalized by the Building Construction Practices Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Bulk of raw asbestos fibres used in the manufacture of asbestos cement roofing sheets in this country are imported from abroad. Recent investigations, however, have indicated that its use may lead to serious and incurable health hazards. This hazard coupled with the soaring cost of asbestos fibres make it imperative that new, indigeneous and cheap roofing material be made available for mass scale use. Optimum utilization of national resources also demand that use of indigeneous building material should be promoted. Coir, woodwool and few other vegetable fibres which are available in large quantity in this country, have been found suitable for the manufacture of sheets for roofing purposes. The sheets may be either plain or corrugated and manufactured by mixing and pressing coir, woodwool and cement in suitable proportions. The sheets possess better thermal insulation and fire resistant properties. This standard has been formulated to provide guidance in respect of manufacture and selection of such roofing sheets.

0.3 In the formulation of this standard, assistance has been provided by Central Building Research Institute (CSIR), Roorkee.

0.4 This standard contains clause **3.1.1** which permits the manufacturer to manufacture the sheets for sizes other than specified if agreed to by the purchaser.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accord-

ance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard lays down the requirements regarding materials, dimensions and physical properties for corrugated roofing sheets made from coir, woodwool and cement.

2. MATERIALS

2.1 Cement — This shall conform to either IS : 269-1976† or IS : 8041-1978‡ or IS : 8112-1976§.

NOTE — Use of Portland pozzolana cement and slag cement is under investigation.

2.2 Woodwool — These shall be obtained from any species of soft timber in fibre form having following dimensions:

Length of fibre	=	200 to 500 mm
Width	=	0.5 to 2.5 mm
Thickness	=	0.2 to 0.35 mm

2.2.1 The species of timber suitable for obtaining the woodwool fibres are fir (*Abies pindrow*), Chir (*Podocarpus spp*), Kail (*Pinus excelsa*), and Deodar (*Cedrus deodara*).

2.3 Coir — These shall be baby fibres, free from pith and shall be capable of absorbing cement.

3. DIMENSIONS AND TOLERANCES

3.1 The sheets shall conform to the dimensions and tolerances given in Table 1.

3.1.1 The sheets may be supplied in other dimensions if so agreed between the purchaser and the manufacturer.

*Rules for rounding off numerical values (*revised*).

†Specification for ordinary and low heat Portland cement (*third revision*).

‡Specification for rapid hardening Portland cement (*first revision*).

§Specification for high strength ordinary Portland cement.

TABLE 1 DIMENSIONS AND TOLERANCES FOR CORRUGATED COIR, WOODWOOL, CEMENT ROOFING SHEETS

(Clause 3.1)

All dimensions in millimetres.

LENGTH	WIDTH	THICKNESS	DEPTH OF CORRUGATION	PITCH OF CORRUGATION
(1)	(2)	(3)	(4)	(5)
1 500 } 1 750 } 2 000 }	1 000	6.5	48	146
Tolerance	± 10	+ free - 0.5	+ 3 - 6	+ 6 - 2

NOTE 1 — The thickness of the sheets shall be taken as the average of six measurements and shall be measured along the width (except at the valleys) with a suitable screw gauge.

NOTE 2 — The depth of each of the six corrugations shall be measured and the maximum deviation in any of the cases measured shall not exceed the limits, specified in Table 1. The depth shall be measured with suitable depth gauge.

NOTE 3 — Tolerances given for pitch of corrugation relate to measurement over six pitches. The total length over six pitches shall be measured and it shall not vary from six times the specified pitch with tolerance.

4. PHYSICAL REQUIREMENTS

4.1 The sheets shall conform to the requirements given in col 3 of Table 2 when tested in accordance with the provision given in col 4.

TABLE 2 PHYSICAL REQUIREMENT OF WOODWOOL, COIR/CEMENT CORRUGATED ROOFING SHEETS

Sl No.	CHARACTERISTICS	REQUIREMENTS	METHOD OF TEST (REF TO APPENDICES)
(1)	(2)	(3)	(4)
i)	Transverse strengths	1.5×10^{-3} N/m width, <i>Min</i>	A
ii)	Water absorption	30 percent, <i>Max</i>	B
iii)	Impermeability	Shall not show any formation of drops of water except traces of moisture on the lower surface	C
iv)	Acid resistance	Amount of acetic acid to be used = 1 150 g/m ² , <i>Max</i>	D

NOTE — The age of specimens for testing shall be at least 4 weeks.

5. FINISH

5.1 The finished sheets when delivered shall be free from visible defects that impair appearance or serviceability. The corrugation of the sheets shall be regular and well defined. The surface of the sheets shall be of uniform texture and shall have rectangular shape with neatly trimmed edges.

6. MARKING

6.1 Each sheet shall be stamped or marked by any suitable method with the following information:

- a) Manufacturer's name or his trade-mark, if any; and
- b) Year and date of manufacture.

6.2 Each sheet may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. SAMPLING AND CRITERION FOR CONFORMITY

7.1 Scale of Sampling

7.1.1 Lot — In any consignment, all the sheets of the same size and manufactured under similar conditions of production shall be grouped together to constitute a lot.

7.1.2 All the sheets in the lot shall be inspected for finish requirements as given in **5.1**. The defective sheets shall be removed from the lot.

7.1.3 The lot shall then be examined for dimensional requirements. For this purpose, the number of sheets to be selected at random from the lot shall be in accordance with col 1 and 2 of Table 3.

7.1.3.1 These sheets shall be selected from the lot at random. In order to ensure the randomness of selection, the procedure given in IS : 4905-1968* may be followed.

*Methods for random sampling.

7.2 Number of Tests and Criteria for Conformity

7.2.1 All the sheets selected in accordance with col 1 and 2 of Table 3, shall be subjected to dimensional requirements. A sheet failing to satisfy this requirement shall be termed as defective. The lot shall be considered as conforming to dimensional requirements, if the number of defectives found in the sample is less than or equal to the corresponding acceptance number given in col 3 of Table 3; otherwise the lot shall be rejected without further testing.

TABLE 3 SAMPLE SIZE AND ACCEPTANCE NUMBER

(Clause 7.1.3)

LOT SIZE	SAMPLE SIZE FOR DIMENSIONAL REQUIREMENTS	ACCEPTANCE NUMBER	SAMPLE SIZE FOR PHYSICAL TESTS
(1)	(2)	(3)	(4)
Up to 500	20	1	3
501 to 1 000	32	2	5
1 001 to 3 000	50	3	7
3 001 and above	80	5	10

7.2.2 The lot which has been found as conforming to the dimensional requirements shall be tested for the physical tests, namely, wet breaking load, water absorption, impermeability and acid resistance. For this purpose, the sample size shall be in accordance with col 1 and 4 of Table 3. The criteria for conformity for these tests is as follows.

7.2.2.1 For impermeability test, no defective shall be found in the sample.

7.2.2.2 For transverse strength $\bar{X} - 0.5 R$ shall be greater than or equal to the minimum limit specified in Table 2, where \bar{X} and R are the average and range of the test results.

7.2.2.3 For water absorption and acid resistance $\bar{X} + 0.5 R$ shall be less than or equal to the respective upper limits specified in Table 2.

7.2.3 A lot shall be considered as conforming to the requirements of this standard if **7.2.1** and **7.2.2** are satisfied.

APPENDIX A

[Table 2, Item (i)]

TRANSVERSE STRENGTH

A-1. SPECIMEN

A-1.1 The specimens for test shall be selected in accordance with the method given in 7. The age of specimens shall be at least 4 weeks and shall be kept in the open air vertically or inclined for one week.

A-2. PROCEDURE

A-2.1 Immediately prior to test, the sheets shall be completely immersed in water at $27 \pm 2^\circ\text{C}$ for a period of 24 hours. Each sheet shall be freely and evenly supported on parallel rigid hardwood bearers 75 mm wide and 150 mm deep and of a length at least as great as width of the specimen, and set at right angles to the corrugation. The bearer shall be placed one metre from centre to centre. The load shall be applied at a uniform rate not greater than 20 N/min, along the centre line of the sheet through the 225 mm face of a 225 × 75 mm runner of the full width of the sheet upon the upper surface and parallel to the supports.

A-3. REPORT

A-3.1 The load at which the sheet breaks shall be recorded and the load per metre width shall be computed.

APPENDIX B

[Table 2, Item (ii)]

WATER ABSORPTION TEST

B-1. SPECIMEN

B-1.1 From each of the sheets selected in accordance with 7 a specimen 175 × 75 mm shall be cut.

B-2. PROCEDURE

B-2.1 The specimen shall be completely immersed in water at $27 \pm 2^\circ\text{C}$ for a period of 18 hours, taken out and weighed after removing surplus water with a damp cloth (W_1). The specimens shall then be placed in

an air oven maintained constantly at a temperature of 150°C for 4 hours. The test piece shall then be cooled for 1 to 2 hours in a desiccator and weighed (W_2).

B-3. REPORT

B-3.1 The water absorption shall be calculated as follows:

$$\text{Absorption, percent} = \frac{W_1 - W_2}{W_2} \times 100$$

where

W_1 = weight after absorption in g.

W_2 = weight after heating in g.

A P P E N D I X C

[*Table 2, Item (iii)*]

IMPERMEABILITY TEST

C-1. SPECIMEN

C-1.1 The specimen for test shall be selected in accordance with 7. The test may be conducted either on the sheets or specimens of suitable dimensions taken from them.

C-2. PROCEDURE

C-2.1 The sheet or specimen shall be tested in an atmosphere of minimum relative humidity 70 percent at a temperature of $27 \pm 2^\circ\text{C}$. A vertical glass tube 300 mm long with a bore of 25 mm shall be sealed to the valley or the flat separating the corrugations of the sheet or specimens which shall be placed horizontally on two supports. The tube shall be filled with water to a height of 250 mm measured from the valley or flat separating the corrugations.

C-3. REPORT

C-3.1 During 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.

APPENDIX D

[Table 2, Item (iv)]

ACID RESISTANCE TEST

D-1. From each of the sheets selected in accordance with 7, three specimens each 65 × 65 mm shall be taken.

NOTE — The dimensions refer to actual edge length of the specimen.

D-2. PROCEDURE

D-2.1 Each specimen shall be placed upright for 24 hours in 270 ml of 5 percent acetic acid solution at $27 \pm 2^\circ\text{C}$ contained in a vessel of such a size that the specimen is entirely immersed. Separate vessels and solution shall be used for each specimen. The concentration of the acetic acid shall be determined before and after immersion of the specimen by titration against a solution of sodium hydroxide of known concentration (approximately 0.5 N) using thymol blue as indicator. For titration 10 ml of the acid solution shall be first stirred, then diluted to 100 ml and 10 drops of thymol blue solution (0.040 g in 100 ml, 95 percent alcohol) added to it. The end point to be taken is that of the colour change from yellow to blue corresponding at a pH 8.0 to 9.5; the small amount of gelatinous precipitate formed does not interfere.

D-3. REPORT

D-3.1 The amount of acetic acid used per square metre of area of the specimen shall be calculated from the fall in concentration, assuming that one millilitre of 0.5 N sodium hydroxide solution is equivalent to 0.030 g of acetic acid as follows:

$$\begin{aligned} \text{Weight of g of acetic acid used} \\ \text{per square metre} &= \frac{0.030 \times 270 (x - y)}{10 A} \times 10^6 \\ &= \frac{0.81 (x - y)}{A} \times 10^6 \end{aligned}$$

where

x = volume, in ml of 0.5 N sodium hydroxide used at the initial titration,

y = volume in ml of 0.5 N sodium hydroxide used at the final titration, and

A = area in mm^2 of unprotected coir/woodwool cement of the specimen.

D-4. The average of the test results for the three specimens from the same sheet shall be considered as the test result for the sheet as a whole.

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive-force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²