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मानक

IS 15476 (2004): Bamboo Mat Corrugated Sheets -Specification [CED 20: Wood and other Lignocellulosic products]









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IS 15476 : 2004 Reaffirmed 2009

भारतीय मानक

बाँस की चटाई की नालीदार चादरें — विशिष्टि

Indian Standard BAMBOO MAT CORRUGATED SHEETS — SPECIFICATION

ICS 79.060.99

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BUREAU OF INDIAN STANDARDS MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG NEW DELHI 110002

Price Group 6

AMENDMENT NO. 1 OCTOBER 2005 TO

IS 15476: 2004 BAMBOO MAT CORRUGATED SHEETS --- SPECIFICATION

(Page 2, clause 7.2) — Substitute the following for the existing clause:

'7.2 The finished sheets shall be given a brush coating with light organic solvent preservative (LOSP) such as zinc napthonate or copper napthate to avoid fungus growth and the edges sealed with suitable adhesive/sealant.'

(CED 20)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 DECEMBER 2008 TO IS 15476 : 2004 BAMBOO MAT CORRUGATED SHEETS --- SPECIFICATION

[Second cover page, Foreword (see also Amendment No. 1)] — Insert the following after the third para as a new para:

'A scheme of labelling environment friendly products to be known as Eco-Mark has been introduced at the instance of the Ministry of Environment and Forests (MoEF), Government of India. The Eco-Mark shall be administered by the Bureau of Indian Standards (BIS) under the *BIS Act*, 1986 as per the Resolution No. 71 dated 21 February 1991 and Resolution No. 425 dated 28 October 1992 published in the Gazette of the Government of India. For a product to be eligible for Eco-Mark, it shall also carry the Standard Mark of the BIS besides meeting additional environment friendly requirements. For this purpose, the Standard Mark of BIS would be a single mark being a combination of the ISI Mark and the Eco logo. Requirements to be satisfied for a product to qualify for the BIS Standard Mark for Eco friendliness will be optional. Manufacturing units will be free to opt for ISI Mark alone also.

The Eco-Mark criteria is based on the Gazette Notification No. 170 dated 18 May 1996 for Wood Substitutes as Environment Friendly Products published in the Gazette of the Government of India.'

(Page 1, clause 4.1) — Insert the following at the end:

'For Eco-Mark, only bamboo from sources other than natural forests shall be used for manufacture of the bamboo mat corrugated sheets.'

(Page 3, clause 9.2.3) — Insert the following new clause after the clause and renumber the subsequent clauses:

10 ADDITIONAL REQUIREMENTS FOR ECO-MARK

10.1 General Requirements

10.1.1 The bamboo mat corrugated sheet shall conform to the requirements of quality specified in this standard.

10.1.2 The manufacturer shall produce to BIS environmental consent clearance

Amend No. 2 to IS 15476 : 2004

from the concerned State Pollution Control Board as per the provisions of *Water* (*Prevention and Control of Pollution*) Act, 1974 and Air (*Prevention and Control of Pollution*) Act, 1981 and *Water* (*Prevention and Control of Pollution*) Act, 1977 along with the authorization, if required under the *Environment* (*Protection*) Act, 1986 while applying for Eco-Mark appropriate with enforced Rules and Regulations of forest department.

10.2 Specific Requirements

The bamboo mat corrugated sheet shall conform to the specific requirements given for Eco-Mark under relevant clauses of the standard.

NOTE --- The manufacturer shall provide documentary evidence by way of certificate or declaration to Bureau of Indian Standards while applying for Eco-Mark.

[Page 3, clause 10.1 (renumbered as 11.1)] — Insert the following matter at the end:

'e) The criteria for which the bamboo mat corrugated sheets have been labelled as Eco-Mark.'

(CED 20)

Reprography Unit, BIS, New Delhi, India

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Wood and Other Lignocellulosic Products Sectional Committee, CED 20

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Wood and Other Lignocellulosic Products Sectional Committee had been approved by the Civil Engineering Division Council.

Roofing is an essential ingredient of any house and in India several roof cladding materials are in use including burnt clay/Mangalore tiles, thatch and corrugated sheet of galvanized iron, aluminium and asbestos. Of these, for semi permanent structures corrugated sheets are preferred.

A need was felt for developing alternate eco-friendly, energy efficient and cost effective roofing sheets. This standard on bamboo mat corrugated sheets (BMCS) has been formulated to provide guidance in respect of manufacture, testing and selection of such roofing sheets. These sheets have been found to be resistant to water, decay and fire. They are light but strong and possess high resilience and offer thermal comforts. In the preparation of this standard, considerable assistance has been rendered by IPIRTI, Bangalore.

The composition of the Committee responsible for the formulation of this standard is given at Annex J.

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 accordance with IS 2: 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard BAMBOO MAT CORRUGATED SHEETS — SPECIFICATION

1 SCOPE

This standard covers the requirement of bamboo mat corrugated sheets (BMCS) for roofs of industrial, residential, agricultural, commercial and institutional types of buildings.

2 REFERENCES

The standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 707, IS 6874, IS 13958 and the following shall apply.

3.1.1 Bamboo

Bamboos are tall perennial grasses belonging to the family *Poaceae* and sub-family *Bambusoidae*.

3.1.2 Sliver

Slivers are thin uniform strips of bamboo processed from splits of bamboo culm.

3.1.3 Mat

Mat is a woven sheet in suitable geometric pattern using slivers.

3.1.4 Bamboo Mat Corrugated Sheet

A sheet made up of adhesive soaked and coated mats assembled and pressed under specified temperature and pressure to obtain sinusoidal or other suitable corrugations.

3.1.5 Delamination

Inter-sliver separation within the mat or between the mats.

4 MATERIALS

4.1 Bamboo

Any species of bamboo suitable for mat making may be used for BMCS.

4.1.1 Bamboo Mats

Bamboo mats required for the manufacture of BMCS shall be compactly woven in suitable pattern from slivers of uniform thickness and width. Thickness of slivers shall be in the range of 0.6 mm to 0.8 mm and with a minimum width of 5 mm. Care shall be taken to exclude the slivers with epidermal and endodermal layer.

4.1.2 Prophylactic Treatment

If the storage time including the time of transportation is one month or more, the mats shall be given prophylactic treatment as per Group 9 in Table 2 of IS 401 and IS 1902.

4.2 Adhesive

Resin for BMCS shall be of phenolic type conforming to BWP grade specified in IS 848. For the outermost layers of mats of BMCS, resin admixed with suitable filler shall be used.

4.3 Preservative

Preservative treatment shall be given by incorporating the suitable preservatives like sodium pentachloro phenate into the resin before soaking the mats to protect against biodegradation.

5 MANUFACTURE

5.1 Application of Adhesive

Adhesive shall be applied by soaking the mats in the adhesive as explained in 4.2. A second coat of adhesive shall be applied on the soaked and dried mats which are used as outer layers, using a mechanical glue spreader.

5.2 Conditioning of Adhesive Coated Bamboo Mats

Adhesive coated mats shall be conditioned to bring down the moisture content to 12 ± 2 percent.

5.3 Hot Pressing

Assembled mats shall be hot pressed to obtain the specified properties.

5.4 Conditioning of BMCS

After hot pressing the finished bamboo mat corrugated sheet shall be stored at ambient conditions at least for 24 h.

6 DIMENSIONS AND TOLERANCES

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

6.1.1 Any other dimension as agreed to between the manufacturer and the purchaser may also be used.



FIG.1 PITCH AND DEPTH OF CORRUGATED SHEETS

Table 1 Dimensions and Tolerances (Clause 6.1.)

All dimensions in millimetre.						
Length	Width	Thickness (7)	Depth of Corrugation (D)	Pitch of Corrugation (P)		
(1)	(2)	(3)	(4)	(5)		
1 800	1 050	3.8	30	120		
2 140	1 050	3.8	30	120		
2 440	1 050	3.8	30	120		
Tolerances						
± 10 mm	± 10 mm	± 10 percent	+ 2 - 0 mm	± 2 mm (<i>see</i> Note 3)		

NOTES

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

2 The depth of each of the six corrugations shall be measured randomly and the 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.

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

4 Any alternate design of corrugation may be used as per agreement between the manufacturer and the purchaser provided all requirements of this standard are met. In such cases the manufacturer shall specify the corrugation details including a section specifying thickness, depth and pitch and tolerance thereon.

7 FINISH

7.1 The faces of bamboo mat corrugated sheet shall be reasonably smooth and uniform in colour.

7.2 The cut edge of sheet shall be given a brush coating with a suitable preservative and edge sealed with suitable resin.

8 TESTS AND REQUIREMENTS

8.1 Requirements

BMCS shall conform to the requirements given in Table 2 when tested in accordance with the provision given in col 4 of Table 2.

9 SAMPLING AND CRITERIA FOR CONFORMITY

9.1 Scale of Sampling

9.1.1 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.

9.1.2 All the sheets in the lot shall be inspected for finish requirements as given in 7. The defective sheets shall be removed from the lot.

9.1.3 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 2 and 3 of Table 3.

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

9.2 Criteria for Conformity

9.2.1 All the sheets selected in accordance with col 2 and 3 of Table 3, shall be subjected to dimensional

SI No.	Properties	Requirements	Method of Test, Ref to Annex of this Standard
(1)	(2)	(3)	(4)
i)	Density, g/cm ³	0.75, <i>Min</i>	В
ii)	Load bearing capacity, N/mm:		С
	 Dry state Wet state 	4.0, Min 3.0, Min	
iii)	Impermeability	The lower surface shall not show any formation of drops of water except for traces of moisture	D
iv)	Water absorption, Percent (after 24 h soaking)	15, Max	E
v)	Cyclic test	No delamination	F
vi)	Resistance to falling weight	The test piece shall not break or show any crack or tear	G
vii)	Resistance to fire:		н
	1) Flame penetration	Not less than 10 min	
	2) Rate of burning	Not less than 20 min	
	 Surface spread of flame, maximum area of char in mm² 	4 500	

Table 2 Requirements of BMCS

(Clause 8.1)

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 4 of Table 3; otherwise the lot shall be rejected without further testing.

9.2.2 The lot which has been found as conforming to the dimensional requirements shall be tested as per Table 2. For this purpose, the sample size shall be in accordance with col 2 and 5 of Table 3.

9.2.3 A lot shall be considered as conforming to the requirements of this standard, if 9.2.1 and 9.2.2 are satisfied.

10 MARKING

10.1 Each bamboo mat corrugated sheet shall be legibly and indelibly marked or stamped with the following:

a) Indication of the source of manufacture,

- b) Nominal dimensions,
- c) Year of manufacture, and
- d) Batch No.

10.1.1 All markings shall be done on the face of the sheet near one edge.

10.2 BIS Certification Marking

The bamboo mat corrugated sheet may also be marked with Standard Mark.

10.2.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made there under. The details of conditions under which the license for the use of the Standard Mark may be granted to the manufacturers or producers may be obtained from the Bureau of Indian Standards.

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(Clauses 9.1.3, 9.2.1 and 9.2.2)					
SI No.	Lot Size	Sample Size for Dimensional Requirement	Acceptance Number	Sample Size for Other Requirement	
(1)	(2)	(3)	(4)	(5)	
i)	Up to 500	20	1	3	
ii)	501 to 1 000	32	2	5	
iii)	1 001 to 3 000	50	3	7	
iv)	3 001 and above	80	5	10	

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	Title	IS No.	Title				
321 : 1964	Specification for absolute alcohol		and aminoplastic) (first revision)				
	(revised)	1902 : 1993	Code of practice for preservation of				
401 : 2001	Preservation of timber — Code of practice (<i>fourth revision</i>)		bamboo and cane for non-structural purposes (<i>first revision</i>)				
707 : 1 976	Glossary of terms applicable to timber	4905 : 1968	Method of random sampling				
	technology and utilization (<i>second</i> revision)	6874 : 1973	Methods for tests for round bamboos				
848 : 1974	Specification for synthetic resin adhesives for plywood (pnenolic	13958 : 1994	Bamb oo mat board for general purposes — Specification				

ANNEX B

[*Table 2, Sl No.* (i)]

METHOD OF TEST AND CALCULATION OF DENSITY OF BMCS

B-1 SPECIMEN

Three test specimen each of size 300 mm \times 300 mm shall be taken and preconditioned to a constant mass at a relative humidity of 65 ± 5 percent and a temperature of 27 ± 2°C.

B-2 PROCEDURE

After conditioning, each test specimen shall be weighed to an accuracy of 1 g. This is followed by determination of dimension of specimen with regard to:

Thickness: average of 6 readings randomly taken excepting valley portion;

Length: average of 6 readings randomly taken;

Width: average of 6 readings randomly taken. The actual width is derived by multiplying with a factor of 1.376 7 for sinusoidal corrugation and thereafter the density is calculated.

ANNEX C

[*Table* 2, *Sl No*. (ii)]

LOAD BEARING CAPACITY TEST FOR BMCS

C-1 SPECIMEN

The full sheet shall be cut into two halves across the width, one half sheet shall be tested in dry state and the other half in wet state (after 24 h soaking in water at ambient temperature).

C-2 PROCEDURE

Each specimen shall be freely and evenly supported on parallel rigid hardwood, cast iron or steel bearers 50 mm wide and of a length at least as great as the width of the specimen, and set at right angles to the corrugations as shown in Fig. 2. The bearers shall be placed one meter from centre to centre. The sheets shall be loaded at mid span by means of a self aligning rigid flat beam 230 ± 5 mm wide, parallel to the supports.

Alternatively the test shall be carried out in UTM using roller supports to the full width of the specimen. The load shall be applied in increments of 20 kg at uniform rate not greater than 2 000 N/min.

C-3 REPORTING OF RESULT

The load at which the sheet breaks shall be recorded and the load, in N/mm, width of the specimen shall be computed.



FIG. 2 LOAD BEARING CAPACITY TEST FOR CORRUGATED SHEET



All dimensions in millimetres. FIG. 3 PERMEABILITY TEST FOR CORRUGATED SHEETS

ANNEX D

[Table 2, Sl No. (iii)]

TEST FOR IMPERMEABILITY

D-1 SPECIMEN

D-2 PROCEDURE

This test is carried out on a whole sheet with a minimum length of 1.20 m, which has been kept for at least 5 days in a controlled environment at a temperature of $27 \pm 2^{\circ}$ C and relative humidity 65 ± 5 percent.

A frame, the form and dimensions of which are given in Fig. 3 shall be scaled on the test piece. After sealing the frame onto the sheet, fill up with water until the level is 20 mm above the top of the corrugations. Then

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place the whole assembly in a controlled environment at $27 \pm 2^{\circ}$ C and at a relative humidity of 65 ± 5 percent.

D-3 REPORTING OF RESULTS

Examine the under-face after 24 h. The specimen is

reported to have passed the test, if drops of water are not formed at the lower surface of the sheets. Appearance of the traces of moisture at the lower surface is permissible.

ANNEX E

[*Table* 2, *Sl No*. (iv)]

WATER ABSORPTION TEST

E-1 SPECIMEN

Three test specimens each of size 300 mm \times 300 mm shall be taken and preconditioned to a constant mass at a relative humidity of 65 ± 5 percent and at temperature of 27 ± 2°C.

E-2 PROCEDURE

After conditioning, each test specimen shall be weighed to an accuracy of 0.1 g. Then specimen shall then be submerged horizontally under 25 mm fresh clean water maintained at a temperature of $27 \pm 2^{\circ}$ C. The test specimen shall be separated by at least 15 mm from each other and from the bottom and sides of the container. After 24 h submersion specimens shall be suspended to drain for 10 min at the end of which time the excess surface water shall be removed and the specimen immediately weighed.

E-3 REPORTING OF RESULTS

The amount of water absorbed shall be calculated from the increase in mass of the specimen during the submersion, and the water absorption shall be expressed as the percentage based on the initial mass.

ANNEX F

[*Table* 2, *Sl No.* (v)]

CYCLIC TEST

F-1 SPECIMEN

Three test specimens each of size 150 mm \times 150 mm shall be taken and preconditioned to a constant mass at a relative humidity of 65 \pm 5 percent and at temperature of 27 \pm 2°C.

F-2 PROCEDURE

Specimens shall be submerged in boiling water for

4 h and then dried for 16 h at a temperature of $65 \pm 2^{\circ}$ C and then followed by 2 more cycles of boiling and drying under the same conditions described above.

F-3 REPORTING OF RESULTS

The specimens shall be examined for delamination after each cycle.

ANNEX G

[*Table* 2, *Sl No*. (vi)]

FALLING WEIGHT TEST

G-1 SPECIMEN

This test is carried out on a whole sheet with a minimum length of 1.20 m, which has been kept for at least 5 days in a controlled environment at a temperature of $27 \pm 2^{\circ}$ C and at a relative humidity of 65 ± 5 percent.

G-2 APPARATUS

G-2.1 Shot put iron ball of weight 6.36 kg.

G-2.2 Straight tube of length 460 mm and of sufficient internal diameter to easily drop the iron ball.

G-2.3 Plumb line which enables the ball to be aimed to strike the desired portion of the test piece.

G-2.4 Two purlins 1 000 mm apart fixed to the rigid frame.

G-3 PROCEDURE

Fix the sheet rigidly to the purlins. Drop the ball freely from a height of 1.8 m, in such a way that it strikes the sheet at the desired place. Repeat the test at least 10 times to cover the entire area between two purlins. The set up is shown in Fig. 4.

G-4 REPORTING OF RESULTS

The test piece shall not break or show any crack or tear.



FIG. 4 FALLING WEIGHT TEST

ANNEX H

[Table 2, Sl No. (vii)]

RESISTANCE TO FIRE

H-0 The following three fire resistance tests are intended to evaluate performance of BMCS against its resistance to fire.

H-1 FLAME PENETRATION TEST

H-1.1 Specimen

Three test specimens each of size 125mm \times 125 mm shall be taken and pre-conditioned to a constant mass at a relative humidity of 65 ± 5 percent and at temperature of 27 ± 2°C.

H-1.2 Procedure

The test specimen is held horizontally 50 mm above the nozzle of blow-pipe/welding torch. In order to get continuous flame, a gentle flame of length around 30 mm from another burner is needed as shown in Fig. 5. The test specimen is rotated in horizontal plane 75 rev/min in such a way that the centre of the flame describes a circle of 25 mm diameter.

H-1.3 Reporting of Results

The time taken for the flame to penetrate the thickness of BMCS is recorded.

H-2 RATE OF BURNING TEST

H-2.1 Specimen

Three test specimens shall be of the full thickness of the material and size 100 mm \times 12.5 mm. The specimen shall be pre-conditioned to a constant mass at a relative humidity of 65 ± 5 percent and at temperature of 27 ± 2°C.

H-2.2 Procedure

The test specimen is suspended in a fire tube and adjusted at a height of 30 mm from the flame of the burner as shown in Fig. 6. The test specimen is ignited by a standardized gas flame and time taken for each 10 percent loss in mass is recorded.

LECTRIC MOTOR



FIG. 5 SCHEMATIC DIAGRAM FOR FLAME PENETRATION TEST



FIG. 6 SCHEMATIC DIAGRAM FOR RATE OF BURNING TEST

H-2.3 Reporting of Results

The time taken from 30 percent to 70 percent loss in mass is recorded.

H-3 TEST FOR SURFACE SPREAD OF FLAME

H-3.1 Apparatus and Materials

H-3.1.1 Specimen Support

Suitable means shall be provided for supporting the specimen during the test at an angle of 45° , with the upper and lower edges of the plane of support being horizontal. This may be accomplished by resting the specimen on four points; but it is necessary, whatever method of support be employed, that:

- a) Central portion of the specimen shall not be shielded from the flame,
- b) Support shall not prevent access of air for combustion, and
- c) Apparatus shall be such that the progress of the test can be observed. A suitable apparatus is shown in Fig. 7.

H-3.1.2 Flame Support

A flat bottom cup of 22 mm internal diameter and 7 mm depth shall be placed on a support. The cup shall be made of sheet iron about 0.8 mm thick. It shall be supported so that the centre of its base is 25 mm vertically below the crown portion of the test specimen, 75 mm from its lower horizontal edge, and midway between the inclined edges.

H-3.1.3 Alcohol

Absolute ethyl alcohol confirming to IS 321.

H-3.2 Specimen

Three test specimens each of size 300 mm \times 300 mm shall be taken and pre-conditioned to a constant mass at a relative humidity of 65 ± 5 percent and at temperature of 27 ± 2°C.

H-3.3 Procedure

H-3.3.1 Place the specimen on the test apparatus as detailed in H-3.1.2. Pipette 1 ml of absolute ethyl alcohol into the cup. Ignite the alcohol in the cup (with the test specimen in place) by a suitable small source of flame, which shall be removed as soon as the alcohol is ignited. The cup shall be at room temperature before each test.

H-3.3.2 One minute after the fuel had been exhausted, extinguish any flame/glow on the specimen. Calculate the area of char by measuring the length of char (a) and projected width of the charred curved surface (b) in mm using the following formula (see Fig. 7):

Area of char =
$$\frac{\pi ab}{4}$$



FIG. 7 TESTING BMCS FOR SURFACE SPREAD OF FLAME

ANNEX J

(Foreword)

COMMITTEE COMPOSITION

Wood and Other Lignocellulosic Products Sectional Committee, CED 20

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Organization	Representative(s)
Indian Plywood Industries Research and Training Institute, Bangalore	DR C. N. PANDEY (Chairman)
All India Agro-Board Association, Pune	Shri V. S. Raju Representative (<i>Alternate</i>)
Building Materials & Technology Promotion Council, New Delhi	Shri J. K. Prasad Shri A. K. Tiwari (<i>Alternate</i>)
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Ministry of Defence (DGQA), Kanpur	Shri Ram Chandra Shri J. K. Sinha (<i>Alternate</i>)
Ministry of Defence (R & D), New Delhi	Shri Ravinder Kumar

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IS 15476 : 2004

Organization

Ministry of Railways, Lucknow

National Test House (ER), Kolkata

Northern India Plywood Manufacturers' Association, Jalandhar

Novopan India Limited, Hyderabad

Nuchem Limited, New Delhi

Permalli Wallace Limited, Bhopal

The South Indian Plywood Manufacturers' Association, Chennai

The Western India Plywood Limited, Cannanore

In personal capacity (H. No. 12, HIG, 1st Stage, K.H.B. Colony, Basaveshwara Nagar, Bangalore 560079)

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SHRI S. K. JAIN, Director & Head (CED) [Representing Director General (*Ex-officio*)]

Bureau of Indian Standards

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This Indian Standard has been developed from Doc : No. CED 20 (7186).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected
	······································	······
	BUREAU OF INDIAN STANDAF	RDS
Headquarters:		
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