SEASONED HARD WOOD FOR ELECTRICAL PURPOSES

1.0 GENERAL :

This specification governs the quality requirements of a seasoned hard wood for electrical purposes supplied in the form of planks, beams, round rods and components.

2.0 APPLICATION :

Suitable for use in Transformers, Switchgear, and other electrical machines.

3.0 COMPLIANCE WITH NATIONAL STANDARDS :

The is no Indian Standard covering this grade of wood.

4.0 TERMINOLOGY:

For the purpose of this specification, the definitions given in IS : 707 Glossary of Terms applicable to timber technology and utilisation shall apply.

5.0 Species :

Standard trade name shall be stated on the order from the following.

Sl.No.	Botanical Name	Standard Trade Name	Local Names in Regional languages of India
1.	Terminalia tomentosa wight et Arn	Laurel	Banappu, Karumarudu, karimarudu, asna, sain, aisan, asan, hatana saj, pucca saj, sahaja, ain, sadar, matti, karimatti, sajad, nallamaddi.
2.	Adina cardifokia Hook	Haldu	haldwan, heddi, yetagal, hedu, haldu yettaga, bimbu, Kadambari, manja kadambai, bandaru taraksopa rangkat, karam, kumbha, kuruma, haladwar
3.	Tectono grandis linn.	Teak	Sagoon, shegun, sagwan saguan, saguvain, thega, thekinamara, theku, teku, sag, tegu
4.	Dysoxylum malabaricum bedd.	White cedar	Biliderdari, vella-gil

Sl.No.	Botanical Name	Standard Trade Name	Local Names in Regional languages of India
5.	Lagerstrocmia lanceolata wall.	Benteak	bendeku, nandi, venteak, bethekku, venthekhu, nana
6.	Terminalia paniculata Roth	Kindal	honagalu, honal, hunal, pillamarudu, nallapulaga.
7.	Shorea Robusta	Sal	Sakhu, sal, sarjam, Raigala, sargi

6.0 FINISH :

Unless otherwise specified, the planks / beams shall have sawn finish and the components shall have planner finish.

7.0 DIMENSIONS AND TOLERANCES :

7.1 Sizes :

Thickness, Width and length of timber shall be stated on the order from the following standard dimensions :

Thickness (mm)	Width x Length
25, 50, 75, 100	250 - 300 X 2400 - 2800

However, any other size can also be ordered. Dimensions of components shall be in accordance with the relevant drawing.

7.2 Tolerances :

7.2.1 Width and Thickness :

Over (mm)	Upto & incl. (mm)	Tolerance (mm)
-	25	± 2
25	75	± 3
75	125	± 4
125	-	± 5

7.2.2 Length

Standard Length, m	Tolerance
1, 1.5, 2, 2.5, 3.5 and 4	± 2 Percent or ± 50 mm whichever is less

Note : 1. Minus tolerances shall not be permitted in more than 25 percent of timber supplied.

2. Minus tolerance shall be permissible in one dimension only.

8.0 TEST METHODS :

Unless otherwise specified, the tests shall be conducted in accordance with the relevant methods of IS : 1708.

9.0 SAMPLE FOR TESTS :

A set of test samples as per Annexure I shall be supplied for testing and approval.

10.0 FREEDOM FROM DEFECTS :

Timber shall be free from the following defects :
Brashness, splits across the grain, shakes, cup, bow, wane, spring, twist, insect attack, any kind of decay (rot), any sign of infection, open centre heart, centre heart on planks upto a thickness of 75 mm and any other defect.
Defects to the extent specified below are permissible. These defects shall be measured in accordance with IS : 3364,

10.1 Centre Heart :

Shall be permissible on planks above 75 mm thick only and on sleepers when it is not farther than 25 mm from the nearest edge and is sound and boxed.

10.2 End Splits :

The longest end split at each end shall be measured and the lengths added together.
The added lengths of these shall not exceed 6mm per metre run of the piece.

10.3 Live Knots upto 25mm diameter :

A maximum of 3 knots / metre length are permissible, However, the knots shall not be so grouped or located as to affect the strength of the piece.
Live knots above 25mm diameter are not permissible.

10.4 Dead knots upto 10 mm diameter :

One knot/metre length shall be permissible provided the knot does not move across thickness with a moderate pressure.
Dead knots above 10 mm diameter are not permissible.

10.5 Surface Cracks :

Surface cracks with a maximum depth of 5 mm are permissible. A continuous crack of any depth, all along the length, is not permissible.

10.6 Sap Wood :

Shall be permissible upto a maximum of 10 percent of the cross-sectional area but not in more than 10 percent of the total supply.

11.0 SEASONING & MOISTURE CONTENT :

The timber shall be seasoned to a moisture content of 10% maximum at the time of inspection, within a depth of 15 mm from the surface excluding a length of 300 mm from each end.

12.0 MECHANICAL PROPERTIES :

12.1 Compressive Strength (Perpendicular to grain) :

14 MPa, Min.

12.2 Machinability :

Shall be free from tendency to warp, crack, split at any stage of machining.

13.0 ELECTRICAL PROPERTIES :

13.1 Electric Strength (Proof for 5 minutes) :

13.1.1 Parallel to grain : 25 kV

13.1.2 Perpendicular to grain : 16 kV

Two specimens of size 100 X 25 X 25 mm shall be prepared in parallel to grain as well as perpendicular to grain directions. The specimens shall be predried at 105 $\pm$ 2 deg C for 48 $\pm$ 0.5 hours and the voltage shall be applied for 5 minutes along 100 mm length, using two pieces of 25 mm square aluminium foil as electrodes.

14.0 CHEMICAL PROPERTIES :

14.1 pH of 5% Aqueous extract :

5.5 to 9.0

14.2 Effect of wood on insulating oil (Annexure II) :

14.2.1 Increase in Acidity :

0.1 mg KOH / g. Max

14.2.2 Increase in sludge content :

0.05 % Max.

15.0 END COATING :

Timber shall be coated after inspection with any of the following compositions, upto a distance of 80 mm from each end.

15.1 Thick coal tar or bituminous paint.

15.2 Resin and lamp black (10:1) melted, mixed and applied hot.

15.3 Hardened gloss oil

15.4 Paraffin wax

15.5 Molassess and lime (3:1)

16.0 TEST CERTIFICATE :

Unless otherwise stated, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to send one copy of test certificates along with despatch documents to facilitate quick clearance of the material .

The test certificates shall bear the following information :

AA 211 51 (Rev 01) : Seasoned Hard Wood for Electrical Purposes

BHEL Order No.

Batch / Lot No.

Thickness, Width and Length

No. of Boards / Components

Net Volume (cubic metre)

Test Values obtained and certificate for compliance with clauses 5 to 7 and 10 to 15.

17.0 PACKING AND MARKING :

Components shall be suitably packed in a wooden crate. The crate and plank / Beam shall be marked with the following information :

AA 21151 : Seasoned Hard Wood for Electrical Purposes

BHEL Order No.

Batch / Lot No.

Manufacturer's Name & Grade

Thickness, Width and Lengths

No. of Boards / Components

Net Volume

ANNEXURE - I

SIZE OF TEST SAMPLES

1. 25 X 25 X 100 mm - 4 Nos, parallel to the grain & 4 Nos. perpendicular to the grain.
2. 50 X 50 X 200 mm - 3 Nos. along the grain.
3. 25 X 25 X 25 mm - 2 Nos
4. 25 X 25 X Thickness mm - 4 Nos.
5. 7.5 X 12.5 X 9.0 mm Thick - 4 Nos.
6. Chips - 50 gms.

ANNEXURE - II

Sludge and Oil Acidity :

Conditioning : Condition the test piece for 168 ± 2 hours in controlled atmosphere of 65 ± 5% RH and 27 ± 2 C.

Test Specimen : Cut the specimen to dimension of 75 mm X 12.5 mm X thickness.

Note: Thickness above 9 mm shall be machined to 9 mm. Both the surfaces shall be machined evenly to achieve thickness of 9 mm.

Procedure : Into a 150 mm X 25 mm test tube weigh 25 g of transformer oil. Transformer oil complying with the requirements of IS 335 is suitable. Prepare the test specimen, weigh it to the nearest 0.01 g and introduce it into the oil. Lightly plug the mouth of the tube with cotton wool and place it in a constant temperature bath maintained at 100 ± 0.5 deg. C for 164 ± 1 hour.

Place a similar quantity of the same oil in a second tube and maintain this under the same conditions as "Blank" sample.

At the end of the specified heating period, remove the tubes from the bath and allow them to cool to room temperature. If it can be seen that delamination has occurred, the specimen has failed. If there is no visible delamination, determine the sludge content of the oil in which the pressboard has been immersed as follows.

Pour the oil into a 600 ml beaker and wash the test tube and pressboard sample with n-heptane until oil-free, adding the washings to the oil in the beaker. Make the contents of the beaker upto approximately 300 ml with n-heptane. Cover the beaker with a watch glass and allow to stand in the dark for 24 ± 0.5 hrs. at room temperature.

Filter the solution through a tared, dried, sintered glass filter, of no. 4 filter transferring all the sediment to the filter with the aid of n-heptane from a wash-bottle. Dry the filter at 105 ± 2 deg. C to constant mass. Express the amount of sediment as a percentage of the original sample mass.

Make the filtrate up to 500 ml in a measuring cylinder with n-heptane. Make the "Blank" sample upto 500 ml a second cylinder. Determine the acid values of the heptane solutions as follows.

Place 60 ml toluene and 40 ml industrial methylated spirit (66 over proof) in a 600 ml conical flask. Add 2 to 3 ml Alkali blue 6B indicator solution (2% by mass in industrial methylated spirit and one drop of 0.1N hydrochloric acid). Neutralize this mixture, with 0.1N alcoholic potassium hydroxide (KOH), to give a red colour which persists for 15 s.

Add 100 ml of the above filtrate to the neutralized solvents and titrate to the same end point with the 0.1N alcoholic KOH. Repeat the titration on 100 ml of the "Blank" solution.

Results : Calculate the increase in the acid value of the oil per gram of Wood in mg KOH/g from the expression :

$$\text{Increase in Acid Value} = \frac{(t_2 - t_1) \times 5.61 \times 5}{W}$$

Where

t_1 is the number of milliliters of 0.1N KOH required to neutralize 100 ml n-heptane in blank solution;

t_2 is the number of milliliters of 0.1N KOH required to neutralize 100 ml of filtrate; and

W is the sample mass of Wood (grams).

Report the acid value of the "blank" oil together with the increase in acid value due to the sample as calculated from the above equation. Report also the percentage sludge produced by the sample.

PHENOLIC LAMINATED COTTON FABRIC SHEET GRADE- F4

1.0 GENERAL:

This specification governs the quality requirements of laminated sheet made from layers of cotton fabric using thermosetting phenolic resin as the bonding medium. The material has temperature index of at least 105.

2.0 APPLICATION:

Suitable for components used in indoor type electrical apparatus where in addition to mechanical properties, good electrical properties are also required.

3.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply, in general, with the following standard and also meet the requirements of this specification.

IS: 2036 - 1995 : "Phenolic Laminated Sheets"
Grade: F 4

4.0 DIMENSIONS AND TOLERANCES:

4.1 Sizes:

Nominal thickness, width and length shall be stated on BHEL order.

4.2 Nominal Thickness, mm:

As given in table below:

However, other thicknesses can also be ordered.

4.3 Tolerance on Thickness:

Nominal Thickness, mm	Tolerance (±) mm	Nominal Thickness, mm	Tolerance (±) mm
-	-	12.0	0.76
-	0.18	14.0	0.84
0.8	0.19	16.0	0.91
1.0	0.20	20.0	1.06
1.2	0.21	25.0	1.24
1.6	0.24	30.0	1.41
2.0	0.27	35.0	1.56
2.5	0.31	40.0	1.71
3.0	0.34	50.0	1.87
4.0	0.40	60.0	2.42
5.0	0.45	70.0	2.80
6.0	0.50	80.0	3.20
8.0	0.59	90.0	3.60
10.0	0.68	100.0	4.00

4.4 Tolerance on Width and Length:

Width or Length, mm	Tolerance, mm
Below 1000	± 35
Above 1000	± 50

4.5 Flatness:

This is applicable to sheets of thickness 3mm above. The flatness of sheets shall be such that when a sheet is placed without restraint on a flat surface, concave side, if present up, departure at any point of the surface from a light straight edge laid in any direction upon it shall not exceed the following:

a) 0.50 mm under a 300 mm straight edge.
b) 3.00 mm under a 360 mm straight edge.
c) 6.00 mm under a 1000 mm straight edge.

5.0 FINISH:

The surface of the sheets be even, smooth, free from visible defects like blisters, loose fibres, resin concentration, delamination, wrinkles, local deformation and dents. The material shall be supplied with trimmed edges and the colour shall be preferably natural tan or natural brown.

6.0 TEST METHODS:

Unless other wise specified, the tests shall be conducted in accordance with the relevant methods specified in BHEL standard AA 085 17 01.

7.0 TEST SAMPLES:

Three sheets of ordered thickness and size 300 X 300 mm, prepared from the same batch shall be supplied for testing.

8.0 PHYSICAL PROPERTIES:

8.1 Water Absorption:

Maximum permissible water absorption after immersion in water 20^0C for 24 hours shall be as follows:

Nominal thickness, mm	Mg., max	Nominal thickness, mm	Mg., max
0.8	133	6.0	183
1.0	136	8.0	194
1.2	139	10.0	204
1.6	145	12.0	214
2.0	151	14.0	224
2.5	157	16.0	234
3.0	162	20.0	253
4.0	169	25.0	277
5.0	176	* Above 25	277

* Thickness above 25mm shall be machined down to 25±2.5mm keeping one side intact.

8.2 Resistance to Hot Oil:

When a specimen is immersed in hot oil at 110 ± 2^0C for 24 ± 1 hours, it shall not show any sign of splitting, blistering, disintegration or appreciable warping.

8.3 Heat Ageing:

When a test piece of 100 x 100mm of ordered thickness is kept at 125 ± 2^0C for 24 ± 1 hours and then cooled, it shall not show any sign of crumbling, cracking or blistering.

9.0 MECHANICAL PROPERTIES:

9.1 Cross Breaking Strength:

For sheets 1.5mm thickness and above: 100 N/mm^2, min.

9.2 Shear Strength, Flatwise:

For sheets 1.5mm thickness and above: 65 N/mm^2, min.

9.3 Impact Strength Charpy Edgewise:

For sheets above 5mm thickness: 7.0 kJ/m^2, min.

9.4 Splitting Load Edgewise:

For sheets 10mm thickness and above: 3.0 kN, min.

9.5 Punching:

This is applicable for sheets below 2.5mm thickness. When the sheet under test is pierced in a single operation with a pattern given in IS : 1998, there shall be no excessive lifting or cracking around the holes.

9.6 Machinability:

This test shall be applicable for sheets of thickness 3mm and above. The sheet shall be capable of being sawn, milled, drilled and tapped with a M3.5mm tap and shall be capable of being shaped in a shaping machine without showing any signs of splitting, cracking or chipping.

10.0 ELECTRICAL PROPERTIES:

10.1 Insulation Resistance:

Insulation resistance of sheets below 25mm thickness, after immersion in water at 20^0C for 24 hours shall be 150 Megohms, min.

10.2 Proof Voltage in Oil at 90±2^0C:

10.2.1 Flatwise:

For sheets upto 3.0mm thickness:

Thickness, mm	Proof voltage, KV/mm
0.8	7.0
1.0	6.3
1.2	5.8
1.6	5.1
2.0	4.6
2.5	4.2
3.0	4.0

10.2.2 Edgewise:

For sheets above 3mm thickness: 15 KV.

11.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their despatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

AA 22216 (Rev.No 04): Phenolic Laminated Cotton Fabric Sheet Grade F4
BHEL order No.
Batch/Lot No.
Test Values obtained and certificate for compliance with clauses 8 to 10.

12.0 PACKING AND MARKING:

Identification slips shall be pasted suitably on all corners of each board/sheet giving the size of the board and manufacturers code number. The boards shall be sealed in a polythene sheet which shall then be covered all round with water proof bituminised brown paper and packed in wooden crate.

AA 22216: Phenolic Laminated Cotton Fabric Sheet Grade F4
BHEL order No.
Manufacturer's / Supplier's Name
Grade/Trade mark, if any
Batch/Lot No.
Thickness, Width & Length
No. of sheets
Net weight and Gross weight

13.0 REFERRED STANDARDS (Latest Publications Including Amendments) :

1) IS:1998 2) IS:2036 3) AA 085 17 01

PRESSPAPER FOR ELECTRICAL PURPOSES

1. GENERAL:

This specification governs the quality requirements of dense calendered multi-layered paper made by continuous process from 100% sulphate wood pulp and of high chemical purity and in natural colour without any dye. It is free from conducting particles and other extraneous matter. The paper in insulating oil has temperature index of atleast 105.

2. APPLICATION:

Used for the insulation in Transformers and turbogenerators.

3. COMPLIANCE WITH NATIONAL STANDARDS:

The material is technically identical to Type D of IS: 8570-1977 (Reaffirmed 1990), "Specification for Press paper for electrical purposes" with additional property of Flexibility.

4. DIMENSIONS AND TOLERANCES:

Thickness, width and length shall be as stated on the order.

4.1 Thickness:

Standard thickness and tolerances are given in Table 1. of annexure 1.

4.2 Width:

Standard widths are 1000, 1500, 1800 and 2000 mm. However, any other widths can also be ordered.

5. FINISH:

The presspaper shall have a smooth calendered but unglazed finish.

6. **TEST METHODS:**

Unless otherwise specified, the tests shall be conducted in accordance with IS: 8570.

7. **SAMPLE FOR TEST:**

20 sheets of size 300 x 300 mm of required thickness suitably packed shall be sent for test and approval.

8. **PHYSICAL PROPERTIES:**

8.1 **Density:**

1.0 g/cm^3, Min.

8.2 **Moisture Centent:**

8% Max.

8.3 **Oil Absorption:**

Density (g/cm^3)	Oil Absorption, Min percent.
1	21
1.05	17
1.1	13
1.15	10
1.2	7
1.25	5
1.3	3

8.4 **Flexibility:**

When tested as per IS: 1576, the presspaper shall withstand one 360° fold without any sign of splitting or cracking of either surface or delamination along the plies.

9. **MECHANICAL PROPERTIES:**

9.1 **Tensile Strength:**

As per table 1 of Annexure I.

9.2 **Heat ageing in air:**

Decrease in Bursting Strength: 60% Max.

10. ELECTRICAL PROPERTIES:

10.1 Electric Strength (BDV) in air at 90 ± 2°C:

As per table 1 of Annexure - I.

11. CHEMICAL PROPERTIES:

11.1 Ash Content:

2.0% Max.

11.2 Conductivity of 1% aqueous extract:

3.0 mS/m, Max.

11.3 p^H Value:

5.0 to 8.5

12. TEST CERTIFICATE:

Unless otherwise stated, three copies of test certificates shall be sent along with each consignment.

In addition, the supplier shall ensure to send one copy of test certificates along with the despatch documents to facilitate quick clearance of the material.

The test certificates shall bear the following information:

AA 21103 : Presspaper for Electrical Purposes
(Rev.No. 02)
BHEL Order No.
Batch No.
Net Weight/No of Rolls
Thickness, Width
Gross weight
Test values obtained and certificate for compliance with claus 4,5 and 8 to 11.

13. PACKING AND MARKING:

The presspaper shall be supplied in rolls or sheets as specified on the order. The material shall be packed in moisture-proof wrappers, boxes or cartons, as applicable, so constructed as to prevent damage and contamination in transit.

CORPORATE PURCHASING SPECIFICATION

Each package shall be marked with the following information:

AA 21103: Presspaper for Electrical Purposes.
BHEL Order No.
Manufacturer's Name and Grade
Batch No.
Thickness, Width
Net Weight/No of Rolls.

14.0 ***REFERRED STANDARDS (Latest Publications Including Amendments):***

1. IS: 8570

TABLE - 1 Annexure - I

Nom.Tkns. (mm)	Tolerance (mm)	Tensile Strength per 15mm width. Min at 90 + 2°C. Min. M/c Direction N	Cross Direction N	Elec. Strength (BDV) In Air (KV)
0.10	±0.01	105	35	1.00
0.15	+0.02 -0.01	135	45	1.40
0.20	±0.02	160	55	1.75
0.25	±0.02	190	70	2.05
0.30	+0.03 -0.02	215	80	2.25
0.40	+0.04 -0.03	275	102	2.70
0.50	±0.04	335	122	3.00

Note: For the thickness other than the nominal thickness, the corresponding values shall be that given for the next higher thickness.

SOFT CALENDERED PRESSBOARD - SOLID

1.0 GENERAL:

This specification governs the quality requirements of a soft porous calendered pressboard characterised by high oil absorption and good electrical properties in oil and is intended primarily for use in that medium. The pressboard shall also be capable of being sheared without showing ragged edges. The pressboard shall be made from a mixture of cotton and other fibres such as jute and wood pulp without the addition of any additive/adhesive and supplied in natural colour without addition of any adhesive and supplied in natural colour without addition of any dye. The pressboard shall be free from soluble electrolytes such as chlorides, sulphates, and carbonates and conduction path. The pressboard insulating oil has temperature index of at least 105.

2.0 APPLICATION:

Used for making barriers, washers, wraps and edge block etc. in transformers and switch gears.

3.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply, in general, with the following standard and also meet the requirements of this specification.

IS 1576 – 1992, Type – C : "Specification for solid pressboard for electrical purposes"

4.0 DIMENSIONS AND TOLERANCES:

Thickness, Width and Length of the Sheet board shall be as stated on the order.

The sheet shall be rectangular in shape with the two diagonals being equal Sheet shall not form parallelogram. The diagonals of the sheet shall be with ± 5mm.

4.1 Preferred Thickness:

1, 1.5, 2, 3, 4 and 6 mm

4.1.1 Tolerance on Thickness:

± 5%

4.2 Preferred Length & width, and Tolerance:

1800 X 3000 and 1500 X 3000 mm with a tolerance of ± 5%.

4.3 Bow (Edge Camber):

Lateral departure of the four edges of the sheet from on straight line forming a cord shall not be more than 2 mm.

CORPORATE PURCHASING SPECIFICATION

5.0 FINISH:

The pressboard shall flat and have a smooth calendered finish.

6.0 TEST METHODS:

Unless otherwise specified, when tested in accordance with the relevant methods of IS 1576. The test sample shall show the following properties.

7.0 TEST SAMPLES:

Two boards of ordered thickness in 500 X 500 mm size shall be supplied for testing and approval. However, for sheets of 1.5 mm and below, six sheets of size 500 X 500 mm shall be supplied.

8.0 PHYSICAL PROPERTIES:

8.1 Density:

0.9 to 1.10 g/cm^3

8.2 Oil Absorption:

20%, min.

8.3 Moisture Content:

8%, max.

8.4 Shrinkage:

8.4.1 In Air:

Direction	Shrinkage (%), max
Machine (MD)	1.0
Cross (XD)	1.5
Thickness (TK)	4.0

8.4.2 In Oil:

Direction	Shrinkage (%), max
Machine (MD)	0.3
Cross (XD)	0.3
Thickness (TK)	1.5

8.5 Cohesion between plies (Visual Test):

The specimen shall not readily split by delamination i.e. between two adjacent plies and exposed torn surfaces shall have distinctly hairy and ragged appearance.

8.6 Flexibility:

The pressboard shall withstand (a) bending once round a mandrel detailed in Table - 1 without sign of splitting or cracking of either surface or delamination along the plies or (b) the appropriate number of 360° folds detailed in Table - 1 without actual splitting or parting of either surface ply across the full width of the test pieces.

Table - 1

Direction	Nominal Thickness, mm					
	1	1.5	2	3	4	6
	No. of Folds		Mandrel Diameter, mm			
Machine (MD)	50	20	19	25	38	76
Cross (XD)	50	20	13	19	25	51

9.0 MECHANICAL PROPERTIES:

9.1 Tensile Strength:

Direction	MPa, min.
Machine (MD)	50
Cross (XD)	25

9.2 Compressibility:

9.2.1 In Air:

8% max.

9.2.2 Total Compressibility after Subsequent Oil Immersion:

12% max.

10.0 ELECTRICAL PROPERTIES:

10.1 Electric Strength (Proof test) in Oil at 90±2°C:

Nominal thickness, mm	KV
1	18
1.5	23
2.0	28
3.0	34
4.0	40
6.0	50

11.0 CHEMICAL PROPERTIES:

11.1 Conductivity of 5% aqueous extract:

70 micro - mhos/cm, max.
(or)
7 mili – siemens / meter, max.

11.2 pH value of aqueous extract :

7.0 to 9.5

11.3 Ash Content:

2% max.

12.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their despatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

AA21105 (Rev. No 05): SOFT CALENDERED PRESSBOARD - SOLID
BHEL order No.
Batch/Lot No.
Thickness, width and Length
Quantity Supplied (kg)
Test Values obtained and certificate for compliance with clauses 4, 5 & 8 to 11.

13.0 PACKING AND MARKING:

Identification slips shall be pasted suitably on all corners of each board/sheet giving the size of the board and manufacturers code number. The boards shall be sealed in a polythene sheet which shall then be covered all round with water proof bituminised brown paper and packed in wooden crate.

AA21105 : SOFT CALENDERED PRESSBOARD - SOLID
BHEL order No.
Manufacturer's / Supplier's Name
Grade/Trade mark, if any
Batch/Lot No.
Thickness, Width & Length
No. of sheets/boards
Quantity Supplied (kg)

14.0 REFERRED STANDARDS (Latest Publications Including Amendments):

Nil.

PRESSPAPER FOR ELECTRICAL PURPOSES

1. GENERAL:

This specification governs the quality requirements of dense calendered multi-layered paper made by continuous process from 100% sulphate wood pulp and of high chemical purity and in natural colour without any dye. It is free from conducting particles and other extraneous matter. The paper in insulating oil has temperature index of atleast 105.

2. APPLICATION:

Used for the insulation in Transformers and turbogenerators.

3. COMPLIANCE WITH NATIONAL STANDARDS:

The material is technically identical to Type D of IS: 8570-1977 (Reaffirmed 1990), "Specification for Press paper for electrical purposes" with additional property of Flexibility.

4. DIMENSIONS AND TOLERANCES:

Thickness, width and length shall be as stated on the order.

4.1 Thickness:

Standard thickness and tolerances are given in Table 1. of annexure 1.

4.2 Width:

Standard widths are 1000, 1500, 1800 and 2000 mm. However, any other widths can also be ordered.

5. FINISH:

The presspaper shall have a smooth calendered but unglazed finish.

6. **TEST METHODS:**

Unless otherwise specified, the tests shall be conducted in accordance with IS: 8570.

7. **SAMPLE FOR TEST:**

20 sheets of size 300 x 300 mm of required thickness suitably packed shall be sent for test and approval.

8. **PHYSICAL PROPERTIES:**

8.1 **Density:**

1.0 g/cm^3, Min.

8.2 **Moisture Centent:**

8% Max.

8.3 **Oil Absorption:**

Density (g/cm^3)	Oil Absorption, Min percent.
1	21
1.05	17
1.1	13
1.15	10
1.2	7
1.25	5
1.3	3

8.4 **Flexibility:**

When tested as per IS: 1576, the presspaper shall withstand one 360° fold without any sign of splitting or cracking of either surface or delamination along the plies.

9. **MECHANICAL PROPERTIES:**

9.1 **Tensile Strength:**

As per table 1 of Annexure I.

9.2 **Heat ageing in air:**

Decrease in Bursting Strength: 60% Max.

10. ELECTRICAL PROPERTIES:

10.1 Electric Strength (BDV) in air at 90 ± 2°C:

As per table 1 of Annexure - I.

11. CHEMICAL PROPERTIES:

11.1 Ash Content:

2.0% Max.

11.2 Conductivity of 1% aqueous extract:

3.0 mS/m, Max.

11.3 p^H Value:

5.0 to 8.5

12. TEST CERTIFICATE:

Unless otherwise stated, three copies of test certificates shall be sent along with each consignment.

In addition, the supplier shall ensure to send one copy of test certificates along with the despatch documents to facilitate quick clearance of the material.

The test certificates shall bear the following information:

AA 21103 : Presspaper for Electrical Purposes
(Rev.No. 02)
BHEL Order No.
Batch No.
Net Weight/No of Rolls
Thickness, Width
Gross weight
Test values obtained and certificate for compliance with claus 4,5 and 8 to 11.

13. PACKING AND MARKING:

The presspaper shall be supplied in rolls or sheets as specified on the order. The material shall be packed in moisture-proof wrappers, boxes or cartons, as applicable, so constructed as to prevent damage and contamination in transit.

CORPORATE PURCHASING SPECIFICATION

Each package shall be marked with the following information:

AA 21103: Presspaper for Electrical Purposes.
BHEL Order No.
Manufacturer's Name and Grade
Batch No.
Thickness, Width
Net Weight/No of Rolls.

14.0 ***REFERRED STANDARDS (Latest Publications Including Amendments):***

1. IS: 8570

TABLE - 1 Annexure - I

Nom.Tkns. (mm)	Tolerance (mm)	Tensile Strength per 15mm width. Min at 90 + 2°C. Min. M/c Direction N	Cross Direction N	Elec. Strength (BDV) In Air (KV)
0.10	±0.01	105	35	1.00
0.15	+0.02 -0.01	135	45	1.40
0.20	±0.02	160	55	1.75
0.25	±0.02	190	70	2.05
0.30	+0.03 -0.02	215	80	2.25
0.40	+0.04 -0.03	275	102	2.70
0.50	±0.04	335	122	3.00

Note: For the thickness other than the nominal thickness, the corresponding values shall be that given for the next higher thickness.

PRECOMPRESSED PRESSBOARD - SOLID

1.0 GENERAL :-

This specification governs the quality requirements of a very hard and rigid solid pressboard characterised by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears cloth mesh marks. It is manufactured by hot pressing 100% sulphate wood pulp board without the addition of any additive/adhesive into the solid plastic state. The material shall be free from soluble electrolytes such as chlorides, sulphates and carbonates and also from conducting particles. The material in insulating oil shall has temperature index of at least 105.

2.0 APPLICATION :

Used as insulating blocks, spacer strips, cylinders & other insulating components, barriers etc. in transformers, reactors and capacitors etc.

3.0 COMPLIANCE WITH NATIONAL STANDARDS :

The material shall comply, ingeneral, with the requirements of the following International Standard and also meet the requirements of this specification.

IEC : 60641-3-1, Type B 3.1; (First edition 1992-04)	Specification for Pressboard and Presspaper for electrical Purposes.

4.0 DIMENSIONS AND TOLERANCES :

Thickness, Width and Length of the pressboard shall be as stated on the order.

The sheet shall be rectangular in shape with the two diagonals being equal. Sheet shall not form parallelogram. Two diagonals of the sheet shall be within ± 3 mm.

4.1 Preferred Thickness :

1, 1.5, 2, 3, 4, 5, 6 and 8 mm

4.1.1 Tolerance On Thickness :

Thickness, mm	Tolerance, ± %
Upto and including 1.6	7.5
Over 1.6	5

4.2 Preferred Length And Width And Tolerance :

2100 X 3200, 2000 X 3000, 2250 X 2250 and 2500 X 2500 mm with a tolerance of ±0.5%

4.3 Bow (Edge Camber) :

Lateral departure of the four edges of the sheet from a straight line forming a cord shall not be more than 1 mm.

5.0 FINISH

Shall have matt finish with no irregularities except regular indentations due to wire mesh used during pressing operation.

6.0 TEST METHODS :

Unless otherwise specified, when tested in accordance with the relevant methods of IEC 60641-2 : Specification For Pressboard And Presspaper For Electrical Purposes - Methods of Test, the test samples shall show the following properties.

For drying of test specimens, air drying for 96 hours to method B of IEC 763 Part II,, may be carried out as an alternative.

7.0 TEST SAMPLES :

Three boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.

8.0 PHYSICAL PROPERTIES :

8.1 Apparent Density :

Thickness, mm		g/cm³
Above	Upto & incld.	
-	1.6	1.0 to 1.2
1.6	3	1.10 to 1.25
3	6	1.15 to 1.3
6	8	1.2 to 1.3

8.2 Oil Absorption

Thickness, mm		Oil Absorption, % Max
Above	Upto & incld.	
-	1.6	11
1.6	3.0	9
3.0	8.0	7

8.3 Moisture Content :

6% Maximum

8.4 Shrinkage in Air :

Direction	Shrinkage, % Max.
Machine (MD)	0.5
Cross (XD)	0.7
Thickness (TK)	5.0

8.5 Cohesion Between Plies - Visual Test :

The split shall show a rupture one or more plies and have a distinctly ragged or hairy appearance.

9.0 MECHANICAL PROPERTIES :

9.1 Tensile Strength :

Thickness, mm		Tensile strength, N/mm2	
Above	Upto & incld.	Machine Direction	Cross machine Direction
	1.6	100	75
1.6	3.0	105	80
3.0	6.0	110	85
6.0	8.0	110	85

9.2 Elongation :

Machine Direction (MD) 3% minimum

Cross Machine Direction (MD) 4% minimum

9.3 Compressibility In Air :

Thickness, mm		Compressibility C % max	Reversible Compressibility C Rev. % min
Above	Upto & incld.		
	1.6	10	45
1.6	3.0	7.5	50
3.0	6.0	5	50
6.0	8.0	4	50

10.0 ELECTRICAL PROPERTIES :

10.1 Electric Strength in oil at room temp. short time (Rapid ~~Rix~~ Rise) Test :

Thickness, mm		KV / mm, Min
Over	Upto & incld.	Oil
-	1.6	40
1.6	3.0	35
3.0	6.0	30
6.0	8.0	30

Note : Thickness of test piece shall be thickness of sheet under test except that where it exceeds 2 mm, the thickness at electrode contact area may be reduced to 2.0 ± 0.1 mm by machining from one side only keeping the other side intact. In this option required value shall be 35kv/mm min irrespective of nominal thickness of pre compressed press board sheet under test.

11.0 CHEMICAL PROPERTIES :

11.1 Ash Content :

1.0%, Max.

11.2 pH of 5% Aqueous Extract :

6.0 to 9.0

11.3 Conductivity of 5% Aqueous Extract :

Thickness, mm		
Over	Upto & incl.	mS / m, Max.
-	1.6	5
1.6	3.0	6
3.0	7.0	8
"	8.0	10

12.0 TEST CERTIFICATES :

Unless and otherwise stated, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to send one copy of test certificates along with their despatch documents to facilitate quick clearance of the material.

The test certificates shall bear the following information.

AA 21108 (Rev. No. 04) : Precompressed Pressboard - Solid

BHEL order no.

Manufacturer's / supplier's name.

Trade mark, if any.

Batch / lot no.

Size and quantity supplied.

Date of manufacture.

Test results of clause 4 and 7.

13.0 PACKING AND MARKING :

Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS : 335 / IEC 296. The boards shall be sealed in high density polyethylene sheets which shall then be covered all around with water proof bituminised brown paper to prevent entry of rain water. These boards then shall be packed in a wooden case to avoid damage during transit.

The packing shall be marked legibly with the following information :

AA 21108 : Precompressed pressboard - Solid

BHEL : Order No.

Manufacturer's / Supplier's name.

Grades / Trade mark, if any.

Batch / lot No.

Thickness, Length and width of boards

Quantity of boards (kg)

Date of manufacture.

No of boards

11.0 REFERRED STANDARDS (Latest Publications Including Amendments)

1. IS : 335 / IEC 296
2. IEC 60641 - Part II-

LAMINATED PRECOMPRESSED PRESSBOARD BONDED WITH NON - AQUEOUS AGENT

1.0 GENERAL :

This specification governs the quality requirements of a very hard and rigid laminated Pre-compressed pressboard made from 100% sulphate wood pulp characterized by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears cloth/mesh marks The laminates are manufactured by building up laminae of the solid precompressed pressboard complying with CPS No AA 21108 by hot pressing with appropriate non aqueous adhesive free from extraneous matter in the solid plastic state. The material shall also be free from soluble electrolytes such as chlorides, sulphates and carbonates and conducting particles. The material in insulating oil shall have temperature index of at least 105.

2.0 APPLICATION :

Used in transformers, as coil spacers, flat-washers, edge blocks and clamping rings etc.

3.0 COMPLIANCE WITH NATIONAL STANDARDS :

The material shall comply, in general, with the requirements of the following Inter National Standard and also meet the requirements of this specification.

IEC : 60673-3-1 (l992-09)-first edition : Specification for Laminated press board
Type : LB 3.1.2

4.0 DIMENSIONS AND TOLERANCES :

Thickness, width and length of the board shall be as stated on our order.
The sheets shall be rectangular in shape and shall not form a parallelogram. The variation in length of the two diagonals of a sheet shall be within + 5 mm.

4.1 Preferred Thickness :

12, 16, 20, 25, 30, 40 & 50 mm

4.2 Tolerance on thickness :

Upto and including 12 mm : ± 5 %

Above 12 mm :± 4 %

4.3 Length nnd Width

1000 X 3000; 2000 X 3000; 2250 X 2250 and 2500 X 2500 mm and 3100 X 4100mm with a tolerance of ± 0.5 %.

However, any other size can also be ordered

4.4 Bow (Edge Camber):

Lateral departure of the four edges of a sheet from a straight line forming a cord shall not be more than 2 mm

5.0 FINISH :

Shall have matt finish with no irregulaties except regular indentations due to wire mesh used during pressing operation

6.0 TEST METHOD :

Unless otherwise stated, when tested in accordance with the relevant methods of IEC 60763-2; "Laminates Pressboard' -Method of test" the test sample shall show the following properties.

7.0 TEST SAMPLE :

Two boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.

8.0 PHYSICAL PROPERTIES :

When tested in accordance with the relevant methods of IEC : 763-2 : Laminated Press Board –
Method of Test. The test samples shall show tiie following properties.

8.1 Apparent Density : 1.15 to 1.50 g/cni^{J}

8.2 Oil Absorption : 5% minimum

8.3 Moisture Content : 5 % maximum

8.4 Shrinkage In Air :

Machine Du tion (MP)	:	0 4 % maximum
Cross Direction (XD)	:	0 6 % maximum
Thickness (TK)	:	4.0 % maximum

9.0 MECHANICAL PROPERTIES

9.1 Flexural Strength
(Cross-Breaking Strength)- Perpendicular To Layers

Machine Direction (MD)	:	100 MPa, minimum
Cross Machine Direction (CMD)	:	85 Mpa. minimum
Thickness (TK)	:	4.0 % maximum

9.2 Compressibility In Air :

Compressibility (C) : 3% maximum
Reverse Compressibility (C_{Krv}) : 60% minimum

10.0 ELECTRICAL PROPERTIES

10.1 Electric Strength Parallel To Layer,, Method-1, Fig 2 of IEC : 60763-2 for all Thickness:

8 kv/mm, minimum

11.0 CHEMICAL PROPERTIES

11.1 PH of Aqueous Extract:

5 to 8

11.2 Conductivity of Aqueous Extract: 10 mS/m, maximum

12.0 TEST CERTIFICATES:

Unless otherwise stated, three copies of test certificates shall be supplied along each consignment

In addition the supplier shall ensure to send one copy of test certificates along with despatch documents/shipping or packing test to facilitate quick clearance of the material.

The test certificates shall bear the following information:

AA 211 09 (Rev. No.04) . Laminated precompressed press board bonded with non Aqueous Agent.

BHEL Order No.
Manufacturer's / Supplier's name.
Batch/Lot No.
Grade/Trade mark, if any
Thickness, width and length of the board
No. of Boards
Quantity supplied (kg)
Test results for clause 4,5 and 8 & 11

13.0 PACKING AND MARKING:

Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS : 335/1EC : 296 The boards shall be sealed in polythene sheet which sh: !1 then be covered all round with water proof bituminised brown paper and packed m a wooden crate to prevent damage during transit

Each packing case shall be marked with the following information

AA 21109: Laminated Precompressed Pressboard - Bonded with non-Aqueous Agent

BHEL Order No

Manufacturers/Suppliers Name and Grade
Batch/Lot No.
Grade/Trade Mark, if any
Thickness, Width and Length of Board
No. of boards
Quantity supplied (kg)

14.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1) EC: 60763-2 2) IS 335 3) IEC 296

SOLID PRECOMPRESSED PRESSBOARD

1. **General** - This specification governs the quality requirements of a very hard and rigid solid pressboard characterised by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears mash marks. It is manufactured by hot pressing 100% sulphate wood pulp without the addition of any additive/ adhesive into the solid plastic state. The material shall be free from soluble electrolyte such as chlorides, sulphates and carbonates and also from conducting particles. The material in insulating oil shall have temperature index of atleast 105^0C.
2. **Applications** - The material can be used as insulating blocks, spacer strips, cylinders & other insulating components, barriers etc. in transformers, reactors and capacitors etc.
3. **Compliance with International Standard** – The material shall comply, in general with the requirements of the latest edition of IEC: 60641-3-1(2008) TYPE B 3.1A.
4. **Dimensions and Tolerances** – Thickness, width and length of the pressboard shall be stated on the order. The sheet shall be rectangular in shape with the two diagonals being equal. Sheet shall not form parallelogram. Two diagonals of the sheet shall be within ±3 mm.
5. **Preferred Thickness** – 1, 1.5, 2, 3, 4, 5, 6 and 8mm
6. **Preferred size** – 1800 x 3000mm or bigger (With a tolerance of ±0.5% on length & width)
7. **Bow (Edge camber)** – Lateral departure of the four edges of the sheet from the straight line forming a cord shall not be more than 1 mm.
8. **Finish** – Shall have matt finish with no irregularities except regular indentations due to wire mesh used during pressing operation and welt marks/ waves within thickness. Each board should be printed with brand name/ mark along the length or width with carbon free ink.
9. **Test Methods** – Unless otherwise specified, when tested in accordance with the relevant methods of the IEC: 60641-2 : Pressboard and presspaper for electrical purposes – Method of tests, the test sample shall follow the properties as per table A of this document.

   For drying of test specimens, air drying for 96 hours to method B of IEC:60763-2, may be carried out as an alternative.
10. **Test samples** – Four boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.
11. **Properties** – The pressboard supplied against this spec. to confirm the requirement as per table A.
12. **Test certificates** - Unless otherwise stated, 3 copies of test certificates shall be supplied alongwith each consignment. In addition, the supplier shall ensure to send one copy of test certificates alongwith their dispatch documents to facilitate quick clearance of the material. The test certificates shall bear the information indicated in clause 13 and test results of clause 4,5,6,7 &Table A.
13. **Packing & marking** – Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS:335 or IEC:60296. The boards shall be sealed in high density polyethylene sheets, which shall then be covered all around with water proof bituminised brown paper to prevent entry of rain water. These boards then shall be packed in a wooden case to avoid damage during transit. Packing shall be marked legibly with the following information -

    TRE-184 : Solid Precompressed Pressboard
    BHEL Order No.

Manufacturer's/ Supplier's name
Grade / trade mark, if any
Batch/ Lot no.
Thickness, Length & Width of the board
Quantity of boards / Net weight/ Gross weight (kg)
Date of manufacturer
No. of boards

14. **Preferred standards** (Latest publications including amendment)
1. IS:335/ IEC:60296 2. IEC-60641-2 3. IEC: 60641-3-1 4. IEC: 60763-2

Table A

	Thickness → Properties ↓	**Up to 1.6mm**	**Above 1.6mm-Up to 3.0mm**	**Above 3.0mm-Up to 6.0mm**	**Above 6.0mm-Up to 8.0mm**
1.	Tolerance on thickness	±7.5%	±5%	±5%	±5%
2.	**Physical properties**				
2.1	Apparent density [g/cm^3]	1.0 to 1.2	1.1 to 1.25	1.15 to 1.3	1.15 to 1.3
2.2	Oil absorption	11% Min.	9% Min.	7% Min.	6% Min.
2.3	Moisture content	6% Max.			
2.4	Shrinkage in air	MD – 0.5% Max. XD - 0.7% Max. Thickness – 6.0% Max.			
3.	**Mechanical properties**				
3.1	Tensile strength [N/mm^2]	MD – 100 Min. XD – 75 Min.	MD – 105 Min. XD – 80 Min.	MD – 110 Min. XD – 85 Min.	MD – 110 Min. XD – 85 Min.
3.2	Elongation [Type test]	MD – 2.5% Min. XD – 3.5% Min.			
3.3	Compressibility in air **C**	10% Max.	7.5% Max.	5% Max.	4.5% Max.
3.4	Reverse Compressibility in air C_{rev}	45% Min.	50% Min.	50% Min.	50% Min.
4.	**Electrical properties**				
4.1	Electrical strength [1] [kV/mm]	45 Min.	35 Min.	35 Min.	35 Min.
5.	**Chemical properties**				
5.1	Ash content	0.7% Max.			
5.2	PH of 5% aqueous extract	6.0 to 9.0			
5.3	Conductivity of 5% aqueous extract [mS/m]	5 Max.	6 Max.	8 Max.	10 Max.

MD- Machine Direction, XD – Cross Machine Direction

1) Electrical strength in oil at room temp., short time (Rapid rise) test. Thickness of test piece shall be thickness of sheet under test, except that where it exceeds 2mm, the thickness at electrode contact area may be reduced to 3.0 ± 0.2mm by machining from one side, keeping the other side intact. When it is necessary to avoid flashover or because of limitation of available equipment, specimens may be prepared by reducing at electrode contact area to 2.0 ± 0.1mm.

LAMINATED PRECOMPRESSED PRESSBOARD

1. **General** - This specification governs the quality requirements of a very hard and rigid laminated precompressed pressboard made by 100% sulphate wood pulp board characterised by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears mash marks. The laminates are manufactured by building up laminate of solid precompressed pressboard complying with TRE-184 by hot pressing with casein based adhesive or non-aqueous adhesive, free from extraneous matter in the solid plastic state. The material shall be free from soluble electrolyte such as chlorides, sulphates and carbonates and also from conducting particles. The material in insulating oil shall have temperature index of atleast 105^0C.
2. **Applications** - The material can be used as coil spacers, flat washers, edge blocks and clamping rings etc. in transformers, reactors etc.
3. **Compliance with International Standard** – The material shall comply, in general with the requirements of the latest edition of IEC: 60763-3-1 TYPE LB 3.1 A.1 or LB 3.1 A.2.
4. **Dimensions and Tolerances** – Thickness, width and length of the pressboard shall be stated on the order. The sheet shall be rectangular in shape with the two diagonals being equal. Sheet shall not form parallelogram. Two diagonals of the sheet shall be within ±5 mm.
5. **Preferred Thickness** – 8, 12, 16, 20, 25, 30, 40, 50mm and above in multiple of 10mm
6. **Preferred size** – 1800 x 3000mm or bigger (With a tolerance of ±0.5% on length & width)
7. **Bow (Edge camber)** – Lateral departure of the four edges of the sheet from the straight line forming a cord shall not be more than 2 mm.
8. **Finish** – Shall have matt finish with no irregularities except regular indentations due to wire mesh used during pressing operation. Each board should be printed with brand name/ mark along the length or width with carbon free ink.
9. **Test Methods** – Unless otherwise specified, when tested in accordance with the relevant methods of the IEC: 60763-2 : Laminated pressboard – Method of tests, the test sample shall follow the properties as per table A of this document.
10. **Test samples** – Three boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.
11. **Properties** – The pressboard supplied against this spec. to confirm the requirement as per table A.
12. **Test certificates** - Unless otherwise stated, 3 copies of test certificates shall be supplied alongwith each consignment. In addition, the supplier shall ensure to send one copy of test certificates alongwith their dispatch documents to facilitate quick clearance of the material. The test certificates shall bear the information indicated in clause 13 and test results of clause 4,5,6,7 &Table A.
13. **Packing & marking** – Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS:335 or IEC:60296. The boards shall be sealed in high density polyethylene sheets, which shall then be covered all around with water proof bituminised brown paper to prevent entry of rain water. These boards then shall be packed in a wooden case to avoid damage during transit. Packing shall be marked legibly with the following information -

    TRE-185 : Laminated Precompressed Pressboard
    BHEL Order No.
    Manufacturer's/ Supplier's name

Grade / trade mark, if any
Batch/ Lot no.
Thickness, Length & Width of the board
Quantity of boards / Net weight/ Gross weight (kg)
Date of manufacturer

14. **Preferred standards** (Latest publications including amendment)
1. IS:335/ IEC:60296 2. IEC-60763-2 3. IEC: 60763-3-1

Table A

	Properties	**Limits**
1.	Tolerance on thickness	±5% for ≤12mm ±4% for >12mm
2.	**Physical properties**	
2.1	Apparent density [g/cm^3]	1.15 to 1.35
2.2	Oil absorption	5% Min.
2.3	Moisture content	8% Max.
2.4	Shrinkage in air	Machine Direction - 0.4% Max. Cross Machine Direction - 0.6% Max. Thickness - 6.0% Max.
3.	**Mechanical properties**	
3.1	Flexural strength [MPa]	Machine Direction - 100 Min. Cross Machine Direction - 85 Min.
3.2	Compressibility in air **C**	3% Max.
3.3	Reverse Compressibility in air $\mathbf{C_{rev}}$	60% Min.
4.	**Electrical properties**	
4.1	Electrical strength [1)] [kV/mm]	8 Min.
5.	**Chemical properties**	
5.1	PH of 5% aqueous extract	5 to 8
5.2	Conductivity of 5% aqueous extract [mS/m]	15 Max.

1) Electrical strength parallel to layers, Method 1, Fig. 2 of IEC: 60763-2, for all thickness.

SOFT CALENDERED PRESSBOARD - SOLID

1.0 GENERAL:

This specification governs the quality requirements of a soft porous calendered pressboard characterised by high oil absorption and good electrical properties in oil and is intended primarily for use in that medium. The pressboard shall also be capable of being sheared without showing ragged edges. The pressboard shall be made from a mixture of cotton and other fibres such as jute and wood pulp without the addition of any additive/adhesive and supplied in natural colour without addition of any adhesive and supplied in natural colour without addition of any dye. The pressboard shall be free from soluble electrolytes such as chlorides, sulphates, and carbonates and conduction path. The pressboard insulating oil has temperature index of at least 105.

2.0 APPLICATION:

Used for making barriers, washers, wraps and edge block etc. in transformers and switch gears.

3.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply, in general, with the following standard and also meet the requirements of this specification.

IS 1576 – 1992, Type – C : "Specification for solid pressboard for electrical purposes"

4.0 DIMENSIONS AND TOLERANCES:

Thickness, Width and Length of the Sheet board shall be as stated on the order.

The sheet shall be rectangular in shape with the two diagonals being equal Sheet shall not form parallelogram. The diagonals of the sheet shall be with ± 5mm.

4.1 Preferred Thickness:

1, 1.5, 2, 3, 4 and 6 mm

4.1.1 Tolerance on Thickness:

± 5%

4.2 Preferred Length & width, and Tolerance:

1800 X 3000 and 1500 X 3000 mm with a tolerance of ± 5%.

4.3 Bow (Edge Camber):

Lateral departure of the four edges of the sheet from on straight line forming a cord shall not be more than 2 mm.

CORPORATE PURCHASING SPECIFICATION

5.0 FINISH:

The pressboard shall flat and have a smooth calendered finish.

6.0 TEST METHODS:

Unless otherwise specified, when tested in accordance with the relevant methods of IS 1576. The test sample shall show the following properties.

7.0 TEST SAMPLES:

Two boards of ordered thickness in 500 X 500 mm size shall be supplied for testing and approval. However, for sheets of 1.5 mm and below, six sheets of size 500 X 500 mm shall be supplied.

8.0 PHYSICAL PROPERTIES:

8.1 Density:

0.9 to 1.10 g/cm^3

8.2 Oil Absorption:

20%, min.

8.3 Moisture Content:

8%, max.

8.4 Shrinkage:

8.4.1 In Air:

Direction	Shrinkage (%), max
Machine (MD)	1.0
Cross (XD)	1.5
Thickness (TK)	4.0

8.4.2 In Oil:

Direction	Shrinkage (%), max
Machine (MD)	0.3
Cross (XD)	0.3
Thickness (TK)	1.5

8.5 Cohesion between plies (Visual Test):

The specimen shall not readily split by delamination i.e. between two adjacent plies and exposed torn surfaces shall have distinctly hairy and ragged appearance.

8.6 Flexibility:

The pressboard shall withstand (a) bending once round a mandrel detailed in Table - 1 without sign of splitting or cracking of either surface or delamination along the plies or (b) the appropriate number of 360° folds detailed in Table - 1 without actual splitting or parting of either surface ply across the full width of the test pieces.

Table - 1

Direction	Nominal Thickness, mm					
	1	1.5	2	3	4	6
	No. of Folds		Mandrel Diameter, mm			
Machine (MD)	50	20	19	25	38	76
Cross (XD)	50	20	13	19	25	51

9.0 MECHANICAL PROPERTIES:

9.1 Tensile Strength:

Direction	MPa, min.
Machine (MD)	50
Cross (XD)	25

9.2 Compressibility:

9.2.1 In Air:

8% max.

9.2.2 Total Compressibility after Subsequent Oil Immersion:

12% max.

10.0 ELECTRICAL PROPERTIES:

10.1 Electric Strength (Proof test) in Oil at 90±2°C:

Nominal thickness, mm	KV
1	18
1.5	23
2.0	28
3.0	34
4.0	40
6.0	50

11.0 CHEMICAL PROPERTIES:

11.1 Conductivity of 5% aqueous extract:

70 micro - mhos/cm, max.
(or)
7 mili – siemens / meter, max.

11.2 pH value of aqueous extract :

7.0 to 9.5

11.3 Ash Content:

2% max.

12.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their despatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

AA21105 (Rev. No 05): SOFT CALENDERED PRESSBOARD - SOLID
BHEL order No.
Batch/Lot No.
Thickness, width and Length
Quantity Supplied (kg)
Test Values obtained and certificate for compliance with clauses 4, 5 & 8 to 11.

13.0 PACKING AND MARKING:

Identification slips shall be pasted suitably on all corners of each board/sheet giving the size of the board and manufacturers code number. The boards shall be sealed in a polythene sheet which shall then be covered all round with water proof bituminised brown paper and packed in wooden crate.

AA21105 : SOFT CALENDERED PRESSBOARD - SOLID
BHEL order No.
Manufacturer's / Supplier's Name
Grade/Trade mark, if any
Batch/Lot No.
Thickness, Width & Length
No. of sheets/boards
Quantity Supplied (kg)

14.0 REFERRED STANDARDS (Latest Publications Including Amendments):

Nil.

PRECOMPRESSED PRESSBOARD - SOLID

1.0 GENERAL :-

This specification governs the quality requirements of a very hard and rigid solid pressboard characterised by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears cloth mesh marks. It is manufactured by hot pressing 100% sulphate wood pulp board without the addition of any additive/adhesive into the solid plastic state. The material shall be free from soluble electrolytes such as chlorides, sulphates and carbonates and also from conducting particles. The material in insulating oil shall has temperature index of at least 105.

2.0 APPLICATION :

Used as insulating blocks, spacer strips, cylinders & other insulating components, barriers etc. in transformers, reactors and capacitors etc.

3.0 COMPLIANCE WITH NATIONAL STANDARDS :

The material shall comply, ingeneral, with the requirements of the following International Standard and also meet the requirements of this specification.

IEC : 60641-3-1, Type B 3.1; (First edition 1992-04)	Specification for Pressboard and Presspaper for electrical Purposes.

4.0 DIMENSIONS AND TOLERANCES :

Thickness, Width and Length of the pressboard shall be as stated on the order.

The sheet shall be rectangular in shape with the two diagonals being equal. Sheet shall not form parallelogram. Two diagonals of the sheet shall be within ± 3 mm.

4.1 Preferred Thickness :

1, 1.5, 2, 3, 4, 5, 6 and 8 mm

4.1.1 Tolerance On Thickness :

Thickness, mm	Tolerance, ± %
Upto and including 1.6	7.5
Over 1 6	5

4.2 Preferred Length And Width And Tolerance :

2100 X 3200, 2000 X 3000, 2250 X 2250 and 2500 X 2500 mm with a tolerance of ±0.5%

4.3 Bow (Edge Camber) :

Lateral departure of the four edges of the sheet from a straight line forming a cord shall not be more than 1 mm.

5.0 FINISH

Shall have matt finish with no irregularities except regular indentations due to wire mesh used during pressing operation.

6.0 TEST METHODS :

Unless otherwise specified, when tested in accordance with the relevant methods of IEC 60641-2 : Specification For Pressboard And Presspaper For Electrical Purposes - Methods of Test, the test samples shall show the following properties.

For drying of test specimens, air drying for 96 hours to method B of IEC 763 Part II,, may be carried out as an alternative.

7.0 TEST SAMPLES :

Three boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.

8.0 PHYSICAL PROPERTIES :

8.1 Apparent Density :

Thickness, mm		g/cm³
Above	Upto & incld.	
-	1.6	1.0 to 1.2
1.6	3	1.10 to 1.25
3	6	1.15 to 1.3
6	8	1.2 to 1.3

8.2 Oil Absorption

Thickness, mm		Oil Absorption, % Max
Above	Upto & incld.	
-	1.6	11
1.6	3.0	9
3.0	8.0	7

8.3 Moisture Content :

6% Maximum

8.4 Shrinkage in Air :

Direction	Shrinkage, % Max.
Machine (MD)	0.5
Cross (XD)	0.7
Thickness (TK)	5.0

8.5 Cohesion Between Plies - Visual Test :

The split shall show a rupture one or more plies and have a distinctly ragged or hairy appearance.

9.0 MECHANICAL PROPERTIES :

9.1 Tensile Strength :

Thickness, mm		Tensile strength, N/mm2	
Above	Upto & incld.	Machine Direction	Cross machine Direction
	1.6	100	75
1.6	3.0	105	80
3.0	6.0	110	85
6.0	8.0	110	85

9.2 Elongation :

Machine Direction (MD) 3% minimum

Cross Machine Direction (MD) 4% minimum

9.3 Compressibility In Air :

Thickness, mm		Compressibility C % max	Reversible Compressibility C Rev. % min
Above	Upto & incld.		
	1.6	10	45
1.6	3.0	7.5	50
3.0	6.0	5	50
6.0	8.0	4	50

10.0 ELECTRICAL PROPERTIES :

10.1 Electric Strength in oil at room temp. short time (Rapid ~~Rix~~ Rise) Test :

Thickness, mm		KV / mm, Min.
Over	Upto & incld.	Oil
-	1.6	40
1.6	3.0	35
3.0	6.0	30
6.0	8.0	30

Note : Thickness of test piece shall be thickness of sheet under test except that where it exceeds 2 mm, the thickness at electrode contact area may be reduced to 2.0 ± 0.1 mm by machining from one side only keeping the other side intact. In this option required value shall be 35kv/mm min irrespective of nominal thickness of pre compressed press board sheet under test.

11.0 CHEMICAL PROPERTIES :

11.1 Ash Content :

1.0%, Max.

11.2 pH of 5% Aqueous Extract :

6.0 to 9.0

11.3 Conductivity of 5% Aqueous Extract :

Thickness, mm		mS / m, Max.
Over	Upto & incl.	
-	1.6	5
1.6	3.0	6
3.0	7.0	8
6.0	8.0	10

12.0 TEST CERTIFICATES :

Unless and otherwise stated, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to send one copy of test certificates along with their despatch documents to facilitate quick clearance of the material.

The test certificates shall bear the following information.

AA 21108 (Rev. No. 04) : Precompressed Pressboard - Solid

BHEL order no.

Manufacturer's / supplier's name.

Trade mark, if any.

Batch / lot no.

Size and quantity supplied.

Date of manufacture.

Test results of clause 4 and 7.

13.0 PACKING AND MARKING :

Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS : 335 / IEC 296. The boards shall be sealed in high density polyethylene sheets which shall then be covered all around with water proof bituminised brown paper to prevent entry of rain water. These boards then shall be packed in a wooden case to avoid damage during transit.

The packing shall be marked legibly with the following information :

AA 21108 : Precompressed pressboard - Solid

BHEL : Order No.

Manufacturer's / Supplier's name.

Grades / Trade mark, if any.

Batch / lot No.

Thickness, Length and width of boards

Quantity of boards (kg)

Date of manufacture.

No of boards

11.0 REFERRED STANDARDS (Latest Publications Including Amendments)

1. IS : 335 / IEC 296
2. IEC 60641 - Part II-

LAMINATED PRECOMPRESSED PRESSBOARD BONDED WITH NON - AQUEOUS AGENT

1.0 GENERAL :

This specification governs the quality requirements of a very hard and rigid laminated Pre-compressed pressboard made from 100% sulphate wood pulp characterized by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears cloth/mesh marks The laminates are manufactured by building up laminae of the solid precompressed pressboard complying with CPS No AA 21108 by hot pressing with appropriate non aqueous adhesive free from extraneous matter in the solid plastic state. The material shall also be free from soluble electrolytes such as chlorides, sulphates and carbonates and conducting particles. The material in insulating oil shall have temperature index of at least 105.

2.0 APPLICATION :

Used in transformers, as coil spacers, flat-washers, edge blocks and clamping rings etc.

3.0 COMPLIANCE WITH NATIONAL STANDARDS :

The material shall comply, in general, with the requirements of the following Inter National Standard and also meet the requirements of this specification.

IEC : 60673-3-1 (l992-09)-first edition : Specification for Laminated press board
Type : LB 3.1.2

4.0 DIMENSIONS AND TOLERANCES :

Thickness, width and length of the board shall be as stated on our order.
The sheets shall be rectangular in shape and shall not form a parallelogram. The variation in length of the two diagonals of a sheet shall be within + 5 mm.

4.1 Preferred Thickness :

12, 16, 20, 25, 30, 40 & 50 mm

4.2 Tolerance on thickness :

Upto and including 12 mm : ± 5 %

Above 12 mm :± 4 %

4.3 Length nnd Width

1000 X 3000; 2000 X 3000; 2250 X 2250 and 2500 X 2500 mm and 3100 X 4100mm with a tolerance of ± 0.5 %.

However, any other size can also be ordered

4.4 Bow (Edge Camber):

Lateral departure of the four edges of a sheet from a straight line forming a cord shall not be more than 2 mm

5.0 FINISH :

Shall have matt finish with no irregulaties except regular indentations due to wire mesh used during pressing operation

6.0 TEST METHOD :

Unless otherwise stated, when tested in accordance with the relevant methods of IEC 60763-2; "Laminates Pressboard' -Method of test" the test sample shall show the following properties.

7.0 TEST SAMPLE :

Two boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.

8.0 PHYSICAL PROPERTIES :

When tested in accordance with the relevant methods of IEC : 763-2 : Laminated Press Board –
Method of Test. The test samples shall show tiie following properties.

8.1 Apparent Density : 1.15 to 1.50 g/cni^{J}

8.2 Oil Absorption : 5% minimum

8.3 Moisture Content : 5 % maximum

8.4 Shrinkage In Air :

Machine Du tion (MP)	:	0 4 % maximum
Cross Direction (XD)	:	0 6 % maximum
Thickness (TK)	:	4.0 % maximum

9.0 MECHANICAL PROPERTIES

9.1 Flexural Strength
(Cross-Breaking Strength)- Perpendicular To Layers

Machine Direction (MD)	:	100 MPa, minimum
Cross Machine Direction (CMD)	:	85 Mpa. minimum
Thickness (TK)	:	4.0 % maximum

9.2 Compressibility In Air :

Compressibility (C) : 3% maximum
Reverse Compressibility (C_{Krv}) : 60% minimum

10.0 ELECTRICAL PROPERTIES

10.1 Electric Strength Parallel To Layer,, Method-1, Fig 2 of IEC : 60763-2 for all Thickness:

8 kv/mm, minimum

11.0 CHEMICAL PROPERTIES

11.1 PH of Aqueous Extract:

5 to 8

11.2 Conductivity of Aqueous Extract: 10 mS/m, maximum

12.0 TEST CERTIFICATES:

Unless otherwise stated, three copies of test certificates shall be supplied along each consignment

In addition the supplier shall ensure to send one copy of test certificates along with despatch documents/shipping or packing test to facilitate quick clearance of the material.

The test certificates shall bear the following information:

AA 211 09 (Rev. No.04) . Laminated precompressed press board bonded with non Aqueous Agent.

BHEL Order No.
Manufacturer's / Supplier's name.
Batch/Lot No.
Grade/Trade mark, if any
Thickness, width and length of the board
No. of Boards
Quantity supplied (kg)
Test results for clause 4,5 and 8 & 11

CORPORATE PURCHASING SPECIFICATIONS

13.0 PACKING AND MARKING:

Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS : 335/1EC : 296 The boards shall be sealed in polythene sheet which sh: !1 then be covered all round with water proof bituminised brown paper and packed m a wooden crate to prevent damage during transit

Each packing case shall be marked with the following information

AA 21109: Laminated Precompressed Pressboard - Bonded with non-Aqueous Agent

BHEL Order No

Manufacturers/Suppliers Name and Grade
Batch/Lot No.
Grade/Trade Mark, if any
Thickness, Width and Length of Board
No. of boards
Quantity supplied (kg)

14.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1) EC: 60763-2 2) IS 335 3) IEC 296

PHENOLIC LAMINATED COTTON FABRIC SHEET GRADE- F4

1.0 GENERAL:

This specification governs the quality requirements of laminated sheet made from layers of cotton fabric using thermosetting phenolic resin as the bonding medium. The material has temperature index of at least 105.

2.0 APPLICATION:

Suitable for components used in indoor type electrical apparatus where in addition to mechanical properties, good electrical properties are also required.

3.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply, in general, with the following standard and also meet the requirements of this specification.

IS: 2036 - 1995 : "Phenolic Laminated Sheets"
Grade: F 4

4.0 DIMENSIONS AND TOLERANCES:

4.1 Sizes:

Nominal thickness, width and length shall be stated on BHEL order.

4.2 Nominal Thickness, mm:

As given in table below:

However, other thicknesses can also be ordered.

4.3 Tolerance on Thickness:

Nominal Thickness, mm	Tolerance (±) mm	Nominal Thickness, mm	Tolerance (±) mm
-	-	12.0	0.76
-	0.18	14.0	0.84
0.8	0.19	16.0	0.91
1.0	0.20	20.0	1.06
1.2	0.21	25.0	1.24
1.6	0.24	30.0	1.41
2.0	0.27	35.0	1.56
2.5	0.31	40.0	1.71
3.0	0.34	50.0	1.87
4.0	0.40	60.0	2.42
5.0	0.45	70.0	2.80
6.0	0.50	80.0	3.20
8.0	0.59	90.0	3.60
10.0	0.68	100.0	4.00

4.4 Tolerance on Width and Length:

Width or Length, mm	Tolerance, mm
Below 1000	± 35
Above 1000	± 50

4.5 Flatness:

This is applicable to sheets of thickness 3mm above. The flatness of sheets shall be such that when a sheet is placed without restraint on a flat surface, concave side, if present up, departure at any point of the surface from a light straight edge laid in any direction upon it shall not exceed the following:

a) 0.50 mm under a 300 mm straight edge.
b) 3.00 mm under a 360 mm straight edge.
c) 6.00 mm under a 1000 mm straight edge.

5.0 FINISH:

The surface of the sheets be even, smooth, free from visible defects like blisters, loose fibres, resin concentration, delamination, wrinkles, local deformation and dents. The material shall be supplied with trimmed edges and the colour shall be preferably natural tan or natural brown.

6.0 TEST METHODS:

Unless other wise specified, the tests shall be conducted in accordance with the relevant methods specified in BHEL standard AA 085 17 01.

7.0 TEST SAMPLES:

Three sheets of ordered thickness and size 300 X 300 mm, prepared from the same batch shall be supplied for testing.

8.0 PHYSICAL PROPERTIES:

8.1 Water Absorption:

Maximum permissible water absorption after immersion in water 20^0C for 24 hours shall be as follows:

Nominal thickness, mm	Mg., max	Nominal thickness, mm	Mg., max
0.8	133	6.0	183
1.0	136	8.0	194
1.2	139	10.0	204
1.6	145	12.0	214
2.0	151	14.0	224
2.5	157	16.0	234
3.0	162	20.0	253
4.0	169	25.0	277
5.0	176	* Above 25	277

* Thickness above 25mm shall be machined down to 25±2.5mm keeping one side intact.

8.2 Resistance to Hot Oil:

When a specimen is immersed in hot oil at 110 ± 2^0C for 24 ± 1 hours, it shall not show any sign of splitting, blistering, disintegration or appreciable warping.

8.3 Heat Ageing:

When a test piece of 100 x 100mm of ordered thickness is kept at 125 ± 2^0C for 24 ± 1 hours and then cooled, it shall not show any sign of crumbling, cracking or blistering.

9.0 MECHANICAL PROPERTIES:

9.1 Cross Breaking Strength:

For sheets 1.5mm thickness and above: 100 N/mm^2, min.

9.2 Shear Strength, Flatwise:

For sheets 1.5mm thickness and above: 65 N/mm^2, min.

9.3 Impact Strength Charpy Edgewise:

For sheets above 5mm thickness: 7.0 kJ/m^2, min.

9.4 Splitting Load Edgewise:

For sheets 10mm thickness and above: 3.0 kN, min.

9.5 Punching:

This is applicable for sheets below 2.5mm thickness. When the sheet under test is pierced in a single operation with a pattern given in IS : 1998, there shall be no excessive lifting or cracking around the holes.

9.6 Machinability:

This test shall be applicable for sheets of thickness 3mm and above. The sheet shall be capable of being sawn, milled, drilled and tapped with a M3.5mm tap and shall be capable of being shaped in a shaping machine without showing any signs of splitting, cracking or chipping.

10.0 ELECTRICAL PROPERTIES:

10.1 Insulation Resistance:

Insulation resistance of sheets below 25mm thickness, after immersion in water at 20^0C for 24 hours shall be 150 Megohms, min.

10.2 Proof Voltage in Oil at 90±2^0C:

10.2.1 Flatwise:

For sheets upto 3.0mm thickness:

Thickness, mm	Proof voltage, KV/mm
0.8	7.0
1.0	6.3
1.2	5.8
1.6	5.1
2.0	4.6
2.5	4.2
3.0	4.0

10.2.2 Edgewise:

For sheets above 3mm thickness: 15 KV.

11.0 TEST CERTIFICATES:

Unless otherwise specified, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their despatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

AA 22216 (Rev.No 04): Phenolic Laminated Cotton Fabric Sheet Grade F4
BHEL order No.
Batch/Lot No.
Test Values obtained and certificate for compliance with clauses 8 to 10.

12.0 PACKING AND MARKING:

Identification slips shall be pasted suitably on all corners of each board/sheet giving the size of the board and manufacturers code number. The boards shall be sealed in a polythene sheet which shall then be covered all round with water proof bituminised brown paper and packed in wooden crate.

AA 22216: Phenolic Laminated Cotton Fabric Sheet Grade F4
BHEL order No.
Manufacturer's / Supplier's Name
Grade/Trade mark, if any
Batch/Lot No.
Thickness, Width & Length
No. of sheets
Net weight and Gross weight

13.0 REFERRED STANDARDS (Latest Publications Including Amendments) :

1) IS:1998 2) IS:2036 3) AA 085 17 01

UNIMPREGNATED DENSIFIED LAMINATED WOOD-LOW DENSITY

1.0 GENERAL:

This specification governs the quality requirements of an unimpregnated densified laminated wood of low density, consisting of layers or cross laminated 2 mm thick wood veneers, bonded and densified under heat and pressure. The material in insulating oil has temperature index of at least 105.

2.0 APPLICATION:

Used for coil support ring, winding support flange, supporting cleates etc. in Transformers

3.0 COMPLAINCE WITH NATIONAIL STANDARDS:

There is no Indian Standard covering this type of material.

4.0 TEST METHODS:

Unless otherwise specified, the tests shall be conducted in accordance with the relevant methods of AA 085 17 01.

5.0 SAMPLE FOR TEST:

Two sheets of ordered thickness and size 500 x 500 mm prepared from the same batch, shall be supplied for testing and approval.

6.0 DIMENSIONS AND TOLERANCES:

Thickness, width, length of the laminated wood shall be stated on the order.

6.1 Preferred Thickens (mm):

10, 12, 14, 16, 20, 25, 30, 40, 45, 50, 60, 70, 75, 80, 90 and 100.

6.2 Tolerance on Nominal Thickness:

Nominal thickness (mm)	Above Up to & Including	Tolerance (±)(mm)
10	25	0.8
25	40	1.0
40	50	1.25
50	-	1.5

6.3 Tolerance on width Length:

± 3.5 mm.

7.0 PHYSICAL PROPERTIES:

7.1 Density, as received condition (IS : 1708):

0.90 – 1.09 g/cm^3

7.2 Moisture & Volatile Content:

7% Max.

Test Specimen (40 x 12mm x thickness of board) shall be dried at 145 ± 2°C till the weight is constant. Thickness above 12 mm shall be machined down to 12 mm, keeping one surface intact.

7.3 Oil Absorption:

9%, Min.

Test specimen (100 x 100 mm x thickness of board) shall be dried at 105 ± 2°C for 72 hours and then impregnated with insulating oil (IS: 335) at 90 ± 2°C for 72 hours. Thickness above 12 mm shall be machined down to 12 mm, keeping one surface intact.

8.0 EFFECT OF OIL ON WOOD (TYPE TEST):

8.1 Sludge and Oil Acidity (Appendix – 1):

8.1.1 Increase in acidity: 0.1 mg KOH/g, Max.

8.1.2 Increase in Sludge content: 0.05% Max.

9.0 ELECTRICAL PROPERTIES;

9.1 Electric Strength (Proof) in Oil at 90 ± 2°C:

Three test specimens shall be dried at 105 ± 2°C for 72 hours and, impregnated with insulating oil (IS: 335) at 90 ± 2°C 72 hours.

9.1.1 Flatwise:

4 k v/mm

Sample size shall be at least 150 x 150 mm x thickness of board. However thickness above 12 mm shall be machined down to 12mm keeping one surface intact.

9.1.2 Edgewise:

60 kV

10.0 MECHANICAL PROPERTIES:

10.1 Tensile strength:

Along the grain 70 MPa, Min.

10.2 Cross Breaking Strength:

Along the grain : 90 MPa, Min.

Across the grain: 67 MPa Min.

10.3 Compressive Strength:

Flatwise: 160 MPa, Min.

The test shall be carried out on 20 x 20 mm x thickness of board. However thickness above 20 mm shall be machined down to 20 mm keeping one side intact.

11.0 TEST CERTIFICATES:

Unless otherwise stated, three copies of test certificates shall be sent along with each consignment.

In addition, the supplier shall ensure to send one copy of test certificates along with the dispatch documents to facilitate quick clearance of the material.

CORPORATE PURCHASING SPECIFICATIONS

The test certificates shall bear the following Information:

AA 22001 : Unimpregnated Densified Laminated Wood -
(Rev.No.02) Low Density
BHEL order No.
Batch/LOt NO.
Thickness, Width & length
Net weight/No of boards
Test values obtained and certificate tor compliance with clauses 4, 7 to 10.

12.0 PACKING AND MARKING:

The laminated wood shall be suitably packed to prevent any damage during transit, Each package shall bear the following information:

AA 22001: Unimpregnated Densified Laminated wood – Low Density
BHEL Order No.

Manufacturer's Name & Grade.
Thickness, width & Length,
No, of boards/Components,
Net weight & Gross Weight.

13.0 REFERRED STANDARDS (Latest publications Including Amendments):

1. IS: 335 2. IS: 1708 3. AA 085 17 01

Appendix – I

Slug and Oil Acidity:

1. **Conditioning:** Condition the test piece for 168 hours in controlled atmosphere of 65 ± 5% RH and 27 ± 2°C.

2. **Test Specimen:** Cut the specimen to dimension of 75mm x 12.5mm x Thickness.

NOTE: Thickness above 9 mm shall be machined to 9 mm.Both the surfaces shall be machined evenly to achieve thickness of 9 mm.

3. **Procedure:** Into a 150 mm x 25 mm test tube weigh 25 g of, transformer oil. Transformer oil complying with the requirements of IS 335 is suitable. Prepare the test specimen, weigh it to the nearest 0.01 g and introduce it into the oil. Lightly plug
the Mouth of the tube with cotton wool and place it in a constant temperature bath maintained at 100 ± 0.5° c for 164±1 hour.

Place a similar quantity of the same oil in a second tube and maintain this under the same conditions as a 'blank' sample.
At the end of the specified heating period, remove the tubes from the bath and allow them to cool to room temperature. If it can be seen that del agination has occurred, the specimen has failed. If there is no visible-n delaminating, determine the sludge content of the oil in which the pressboard has been impressed as follows.

Pour the oil into a 600 ml beaker and wash the test tube and pressboard sample with n-heptanes until oil-free, adding the washings to the oil in the beaker. Make the contents of the beaker up to approximately 300 ml with n-heptanes. cover the beaker with a watch glass and allow to stand in the dark for 24 hrs. At room temperature.

Filter the solution through a tared, dried, sintered glass filter, of no. 4 filter transferring all the sediment to the filter with the aid of n-heptane from a wash-bottle. Dry the filter at 105 ± 2°C to constant mass. Express the amount of sediment as a percentage of the original sample mass.
Make the filtrate up to 500 ml in a measuring cylinder with n-heptane. Make the 'blank' sample up to 500 ml in a second cylinder- Determine the acid values of the heptane solutions as follows.

CORPORATE PURCHASING SPECIFICATIONS

Place 60ml toluene and 40ml industrial methylated spirits(66 overproof) in a 600 ml conical flask.Add 2ml to 3 ml Alkali blue indicator solution(2% by mass in industrial methylated spirits and one drop of 0,1N hydrochloric acid),Neutralize this mixture, with 0.1N alcoholic hydrochloric potassium hydroxide '(KOH),to give a red colour which persists for 15 s .Add 100ml of the above filtrate to the neutralized solvents and titrate to the same and point with the 0.1N alcoholic KOH.Repeat the titration on 100 ml of the' blank' solution.

Results: Calculated the increases in the acid value of the oil per gram of pressboard in mg KOH//g from the expression.

$$\text{Increase in acid value} = \frac{(t_2 - t_1) \times 5.61 \times 5}{W}$$

Where

T_1 is the number of millitres of 0.1n KOH required to neutralize 100 ml n-heptane in blank solution.

T_2 is the number of millitres of 0.1n KOH required to neutralize 100 ml of filtrate: and

W is the sample mass of laminated pressboard (grams).

Report the acid value of the 'blank' oil together with the increase in acid value due to the sample as calculated from the above equation. Report also the percentage sludge produced by the sample.

SOLID PRECOMPRESSED PRESSBOARD

1. **General** - This specification governs the quality requirements of a very hard and rigid solid pressboard characterised by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears mash marks. It is manufactured by hot pressing 100% sulphate wood pulp without the addition of any additive/ adhesive into the solid plastic state. The material shall be free from soluble electrolyte such as chlorides, sulphates and carbonates and also from conducting particles. The material in insulating oil shall have temperature index of atleast 105^0C.
2. **Applications** - The material can be used as insulating blocks, spacer strips, cylinders & other insulating components, barriers etc. in transformers, reactors and capacitors etc.
3. **Compliance with International Standard** – The material shall comply, in general with the requirements of the latest edition of IEC: 60641-3-1(2008) TYPE B 3.1A.
4. **Dimensions and Tolerances** – Thickness, width and length of the pressboard shall be stated on the order. The sheet shall be rectangular in shape with the two diagonals being equal. Sheet shall not form parallelogram. Two diagonals of the sheet shall be within ±3 mm.
5. **Preferred Thickness** – 1, 1.5, 2, 3, 4, 5, 6 and 8mm
6. **Preferred size** – 1800 x 3000mm or bigger (With a tolerance of ±0.5% on length & width)
7. **Bow (Edge camber)** – Lateral departure of the four edges of the sheet from the straight line forming a cord shall not be more than 1 mm.
8. **Finish** – Shall have matt finish with no irregularities except regular indentations due to wire mesh used during pressing operation and welt marks/ waves within thickness. Each board should be printed with brand name/ mark along the length or width with carbon free ink.
9. **Test Methods** – Unless otherwise specified, when tested in accordance with the relevant methods of the IEC: 60641-2 : Pressboard and presspaper for electrical purposes – Method of tests, the test sample shall follow the properties as per table A of this document.

   For drying of test specimens, air drying for 96 hours to method B of IEC:60763-2, may be carried out as an alternative.
10. **Test samples** – Four boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.
11. **Properties** – The pressboard supplied against this spec. to confirm the requirement as per table A.
12. **Test certificates** - Unless otherwise stated, 3 copies of test certificates shall be supplied alongwith each consignment. In addition, the supplier shall ensure to send one copy of test certificates alongwith their dispatch documents to facilitate quick clearance of the material. The test certificates shall bear the information indicated in clause 13 and test results of clause 4,5,6,7 &Table A.
13. **Packing & marking** – Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS:335 or IEC:60296. The boards shall be sealed in high density polyethylene sheets, which shall then be covered all around with water proof bituminised brown paper to prevent entry of rain water. These boards then shall be packed in a wooden case to avoid damage during transit. Packing shall be marked legibly with the following information -

    TRE-184 : Solid Precompressed Pressboard
    BHEL Order No.

Manufacturer's/ Supplier's name
Grade / trade mark, if any
Batch/ Lot no.
Thickness, Length & Width of the board
Quantity of boards / Net weight/ Gross weight (kg)
Date of manufacturer
No. of boards

14. **Preferred standards** (Latest publications including amendment)
1. IS:335/ IEC:60296 2. IEC-60641-2 3. IEC: 60641-3-1 4. IEC: 60763-2

Table A

	Thickness → Properties ↓	**Up to 1.6mm**	**Above 1.6mm-Up to 3.0mm**	**Above 3.0mm-Up to 6.0mm**	**Above 6.0mm-Up to 8.0mm**
1.	Tolerance on thickness	±7.5%	±5%	±5%	±5%
2.	**Physical properties**				
2.1	Apparent density [g/cm^3]	1.0 to 1.2	1.1 to 1.25	1.15 to 1.3	1.15 to 1.3
2.2	Oil absorption	11% Min.	9% Min.	7% Min.	6% Min.
2.3	Moisture content	6% Max.			
2.4	Shrinkage in air	MD – 0.5% Max. XD - 0.7% Max. Thickness – 6.0% Max.			
3.	**Mechanical properties**				
3.1	Tensile strength [N/mm^2]	MD – 100 Min. XD – 75 Min.	MD – 105 Min. XD – 80 Min.	MD – 110 Min. XD – 85 Min.	MD – 110 Min. XD – 85 Min.
3.2	Elongation [Type test]	MD – 2.5% Min. XD – 3.5% Min.			
3.3	Compressibility in air **C**	10% Max.	7.5% Max.	5% Max.	4.5% Max.
3.4	Reverse Compressibility in air C_{rev}	45% Min.	50% Min.	50% Min.	50% Min.
4.	**Electrical properties**				
4.1	Electrical strength [1] [kV/mm]	45 Min.	35 Min.	35 Min.	35 Min.
5.	**Chemical properties**				
5.1	Ash content	0.7% Max.			
5.2	PH of 5% aqueous extract	6.0 to 9.0			
5.3	Conductivity of 5% aqueous extract [mS/m]	5 Max.	6 Max.	8 Max.	10 Max.

MD- Machine Direction, XD – Cross Machine Direction

1) Electrical strength in oil at room temp., short time (Rapid rise) test. Thickness of test piece shall be thickness of sheet under test, except that where it exceeds 2mm, the thickness at electrode contact area may be reduced to 3.0 ± 0.2mm by machining from one side, keeping the other side intact. When it is necessary to avoid flashover or because of limitation of available equipment, specimens may be prepared by reducing at electrode contact area to 2.0 ± 0.1mm.

LAMINATED PRECOMPRESSED PRESSBOARD

1. **General** - This specification governs the quality requirements of a very hard and rigid laminated precompressed pressboard made by 100% sulphate wood pulp board characterised by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears mash marks. The laminates are manufactured by building up laminate of solid precompressed pressboard complying with TRE-184 by hot pressing with casein based adhesive or non-aqueous adhesive, free from extraneous matter in the solid plastic state. The material shall be free from soluble electrolyte such as chlorides, sulphates and carbonates and also from conducting particles. The material in insulating oil shall have temperature index of atleast 105^0C.
2. **Applications** - The material can be used as coil spacers, flat washers, edge blocks and clamping rings etc. in transformers, reactors etc.
3. **Compliance with International Standard** – The material shall comply, in general with the requirements of the latest edition of IEC: 60763-3-1 TYPE LB 3.1 A.1 or LB 3.1 A.2.
4. **Dimensions and Tolerances** – Thickness, width and length of the pressboard shall be stated on the order. The sheet shall be rectangular in shape with the two diagonals being equal. Sheet shall not form parallelogram. Two diagonals of the sheet shall be within ±5 mm.
5. **Preferred Thickness** – 8, 12, 16, 20, 25, 30, 40, 50mm and above in multiple of 10mm
6. **Preferred size** – 1800 x 3000mm or bigger (With a tolerance of ±0.5% on length & width)
7. **Bow (Edge camber)** – Lateral departure of the four edges of the sheet from the straight line forming a cord shall not be more than 2 mm.
8. **Finish** – Shall have matt finish with no irregularities except regular indentations due to wire mesh used during pressing operation. Each board should be printed with brand name/ mark along the length or width with carbon free ink.
9. **Test Methods** – Unless otherwise specified, when tested in accordance with the relevant methods of the IEC: 60763-2 : Laminated pressboard – Method of tests, the test sample shall follow the properties as per table A of this document.
10. **Test samples** – Three boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.
11. **Properties** – The pressboard supplied against this spec. to confirm the requirement as per table A.
12. **Test certificates** - Unless otherwise stated, 3 copies of test certificates shall be supplied alongwith each consignment. In addition, the supplier shall ensure to send one copy of test certificates alongwith their dispatch documents to facilitate quick clearance of the material. The test certificates shall bear the information indicated in clause 13 and test results of clause 4,5,6,7 &Table A.
13. **Packing & marking** – Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS:335 or IEC:60296. The boards shall be sealed in high density polyethylene sheets, which shall then be covered all around with water proof bituminised brown paper to prevent entry of rain water. These boards then shall be packed in a wooden case to avoid damage during transit. Packing shall be marked legibly with the following information -

    TRE-185 : Laminated Precompressed Pressboard
    BHEL Order No.
    Manufacturer's/ Supplier's name

Grade / trade mark, if any
Batch/ Lot no.
Thickness, Length & Width of the board
Quantity of boards / Net weight/ Gross weight (kg)
Date of manufacturer

14. **Preferred standards** (Latest publications including amendment)
1. IS:335/ IEC:60296 2. IEC-60763-2 3. IEC: 60763-3-1

Table A

	Properties	**Limits**
1.	Tolerance on thickness	±5% for ≤12mm ±4% for >12mm
2.	**Physical properties**	
2.1	Apparent density [g/cm^3]	1.15 to 1.35
2.2	Oil absorption	5% Min.
2.3	Moisture content	8% Max.
2.4	Shrinkage in air	Machine Direction - 0.4% Max. Cross Machine Direction - 0.6% Max. Thickness - 6.0% Max.
3.	**Mechanical properties**	
3.1	Flexural strength [MPa]	Machine Direction - 100 Min. Cross Machine Direction - 85 Min.
3.2	Compressibility in air **C**	3% Max.
3.3	Reverse Compressibility in air $\mathbf{C_{rev}}$	60% Min.
4.	**Electrical properties**	
4.1	Electrical strength [1)] [kV/mm]	8 Min.
5.	**Chemical properties**	
5.1	PH of 5% aqueous extract	5 to 8
5.2	Conductivity of 5% aqueous extract [mS/m]	15 Max.

1) Electrical strength parallel to layers, Method 1, Fig. 2 of IEC: 60763-2, for all thickness.

PRECOMPRESSED PRESSBOARD - SOLID

1.0 GENERAL :-

This specification governs the quality requirements of a very hard and rigid solid pressboard characterised by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears cloth mesh marks. It is manufactured by hot pressing 100% sulphate wood pulp board without the addition of any additive/adhesive into the solid plastic state. The material shall be free from soluble electrolytes such as chlorides, sulphates and carbonates and also from conducting particles. The material in insulating oil shall has temperature index of at least 105.

2.0 APPLICATION :

Used as insulating blocks, spacer strips, cylinders & other insulating components, barriers etc. in transformers, reactors and capacitors etc.

3.0 COMPLIANCE WITH NATIONAL STANDARDS :

The material shall comply, ingeneral, with the requirements of the following International Standard and also meet the requirements of this specification.

IEC : 60641-3-1, Type B 3.1; (First edition 1992-04)	Specification for Pressboard and Presspaper for electrical Purposes.

4.0 DIMENSIONS AND TOLERANCES :

Thickness, Width and Length of the pressboard shall be as stated on the order.

The sheet shall be rectangular in shape with the two diagonals being equal. Sheet shall not form parallelogram. Two diagonals of the sheet shall be within ± 3 mm.

4.1 Preferred Thickness :

1, 1.5, 2, 3, 4, 5, 6 and 8 mm

4.1.1 Tolerance On Thickness :

Thickness, mm	Tolerance, ± %
Upto and including 1.6	7.5
Over 1.6	5

4.2 Preferred Length And Width And Tolerance :

2100 X 3200, 2000 X 3000, 2250 X 2250 and 2500 X 2500 mm with a tolerance of ±0.5%

4.3 Bow (Edge Camber) :

Lateral departure of the four edges of the sheet from a straight line forming a cord shall not be more than 1 mm.

5.0 FINISH

Shall have matt finish with no irregularities except regular indentations due to wire mesh used during pressing operation.

6.0 TEST METHODS :

Unless otherwise specified, when tested in accordance with the relevant methods of IEC 60641-2 : Specification For Pressboard And Presspaper For Electrical Purposes - Methods of Test, the test samples shall show the following properties.

For drying of test specimens, air drying for 96 hours to method B of IEC 763 Part II,, may be carried out as an alternative.

7.0 TEST SAMPLES :

Three boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.

8.0 PHYSICAL PROPERTIES :

8.1 Apparent Density :

Thickness, mm		g/cm³
Above	Upto & incld.	
-	1.6	1.0 to 1.2
1.6	3	1.10 to 1.25
3	6	1.15 to 1.3
6	8	1.2 to 1.3

8.2 Oil Absorption

Thickness, mm		Oil Absorption, % Max
Above	Upto & incld.	
-	1.6	11
1.6	3.0	9
3.0	8.0	7

8.3 Moisture Content :

6% Maximum

8.4 Shrinkage in Air :

Direction	Shrinkage, % Max.
Machine (MD)	0.5
Cross (XD)	0.7
Thickness (TK)	5.0

8.5 Cohesion Between Plies - Visual Test :

The split shall show a rupture one or more plies and have a distinctly ragged or hairy appearance.

9.0 MECHANICAL PROPERTIES :

9.1 Tensile Strength :

Thickness, mm		Tensile strength, N/mm2	
Above	Upto & incld.	Machine Direction	Cross machine Direction
	1.6	100	75
1.6	3.0	105	80
3.0	6.0	110	85
6.0	8.0	110	85

9.2 Elongation :

Machine Direction (MD) 3% minimum

Cross Machine Direction (MD) 4% minimum

9.3 Compressibility In Air :

Thickness, mm		Compressibility C % max	Reversible Compressibility C Rev % min
Above	Upto & incld.		
	1.6	10	45
1.6	3.0	7.5	50
3.0	6.0	5	50
6.0	8.0	4	50

10.0 ELECTRICAL PROPERTIES :

10.1 Electric Strength in oil at room temp. short time (Rapid ~~Rix~~ Rise) Test :

Thickness, mm		KV / mm, Min
Over	Upto & incld.	Oil
-	1.6	40
1.6	3.0	35
3.0	6.0	30
6.0	8.0	30

Note : Thickness of test piece shall be thickness of sheet under test except that where it exceeds 2 mm, the thickness at electrode contact area may be reduced to 2.0 ± 0.1 mm by machining from one side only keeping the other side intact. In this option required value shall be 35kv/mm min irrespective of nominal thickness of pre compressed press board sheet under test.

11.0 CHEMICAL PROPERTIES :

11.1 Ash Content :

1.0%, Max.

11.2 pH of 5% Aqueous Extract :

6.0 to 9.0

11.3 Conductivity of 5% Aqueous Extract :

Thickness, mm		mS / m, Max.
Over	Upto & incl.	
-	1.6	5
1.6	3.0	6
3.0	7.0	8
7.0	8.0	10

12.0 TEST CERTIFICATES :

Unless and otherwise stated, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to send one copy of test certificates along with their despatch documents to facilitate quick clearance of the material.

The test certificates shall bear the following information.

AA 21108 (Rev. No. 04) : Precompressed Pressboard - Solid

BHEL order no.

Manufacturer's / supplier's name.

Trade mark, if any.

Batch / lot no.

Size and quantity supplied.

Date of manufacture.

Test results of clause 4 and 7.

13.0 PACKING AND MARKING :

Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS : 335 / IEC 296. The boards shall be sealed in high density polyethylene sheets which shall then be covered all around with water proof bituminised brown paper to prevent entry of rain water. These boards then shall be packed in a wooden case to avoid damage during transit.

The packing shall be marked legibly with the following information :

AA 21108 : Precompressed pressboard - Solid

BHEL : Order No.

Manufacturer's / Supplier's name.

Grades / Trade mark, if any.

Batch / lot No.

Thickness, Length and width of boards

Quantity of boards (kg)

Date of manufacture.

No of boards

11.0 REFERRED STANDARDS (Latest Publications Including Amendments)

1. IS : 335 / IEC 296
2. IEC 60641 - Part II-

POLYAMIDE (ARAMID) CALENDER PAPER

1.0 GENERAL:

This specification governs with the quality requirements calender polyamide (Aramid) paper made from specially formulated polyamide fibres with a high degree of thermal stability. The material is used upto a maximum operating temperature of 220^0C.

2.0 APPLICATION:

Used as inter-turn insulation, slot liner of electrical machines.

3.0 COMPLIANCE WITH NATIONAL STANDARDS:

There is no national standard covering this type of material.

4.0 DIMENSIONS AND TOLERANCES:

4.1 Sizes:

Thickness, width and length of the sheet / tape shall be as specified in BHEL order.

4.1.1 Preferred thickness and Tolerances:

0.05, 0.08, 0.13, 0.18, 0.2, 0.25, 0.3, 0.4, 0.5 and 0.8 mm with tolerances as per Annexure I.

4.1.2 Preferred Width and Tolerances:

Sheet: 600mm and 900mm with tolerance of ± 15 mm.

Tape: 20, 25 and 30 mm with tolerance of ± 0.5 mm.

5.0 FINISH:

The material shall be free from surface or edge defects, inclusions, voids, pin-holes and cracks which may affect its suitability for use. Visual properties shall be consistent from lot to lot.

6.0 TEST SAMPLES:

A roll of at least 50 metres length for tape or 2 m^2 sample from inner portion of sheet roll of ordered thickness from the same batch shall be supplied for testing and approval.

7.0 PROPERTIES:

When tested in accordance with the relevant clauses of the test methods mentioned against each, the test samples shall show the following values.

7.1 Physical properties:

7.1.1 Moisture absorption: 8%, maximum

A sample of 75 ± 1 mm x 75 ± 1mm is kept at 90% RH and room temperature ($27^0 \pm 2^{0-}$C) for 72 hours.

8.0 TYPE TESTS:

8.1 Mechanical properties :

Breaking strength : As per Annexure I

Elongation at break : As per Annexure I

8.2 Electrical Properties:

Electrical strength (BDV) in air at 27 ± 2^0 C : As per Annexure I

Volume Resistivity (ASTM D –257) : 1 x 10^{16} ohm-cm, minimum.

9.0 ACCEPTANCE CRITERIA:

Material shall be accepted on the basis of the following:

a) Compliance certificate furnished by the supplier
b) Test certificate furnished by the supplier and / or testing carried out at BHEL end.

10.0 TEST CERTIFICATES:

Unless otherwise stated, three copies of test certificates shall be supplied along with each consignment giving following information:

In addition, the supplier shall ensure to send one copy of test certificate along with the dispatch documents to facilitate quick clearance of the materials.

AA 229 01, Rev 05: Polyamide (Aramid) calender paper.
BHEL order No.
Manufacturers/suppliers Name:
Trade name/mark, if any:
Batch/Lot No.
Quantity supplied
Test results of clauses 4.0, 7.0 and 8.0

11.0 PACKING AND MARKING:

Rolls shall be suitably packed to prevent damage during transit and storage.
Each consignment shall be legibly marked or labeled with the following information:

AA 229 01: Polyamide (Aramid) calender paper
BHEL order No.
Manufacturers/suppliers Name:
Batch/Lot No.
Trade mark, if any
Sizes and Quantity supplied

12.0 REFRRED STANDARDS (Latest Publications Including Amendments):

1) ASTM D 257

ANNEXURE I - CLAUSE 8.0

Nominal Thick-ness, mm	Tolerance ± mm	Substance g/m^2 Tolerance of ±10%	Breaking strength , N/cm width, minimum		Elongation, percent, minimum		Tear strength, N, minimum		Dissipation factor, maximum	Electric strength (BDV) in air at 27±2°C kV/mm, min.
			Machine direction (MD)	Cross machine direction (XD	Machine direction (MD)	Cross machine direction (XD)	Machine direction (MD)	Cross machine direction (XD)		
0.05	0.01	40	44	19	11	8	0.7	1.6	0.004	19
0.08	0.01	63	70	35	11	9	1.2	2.3	0.005	24
0.13	0.02	120	140	68	16	13	2.4	5.1	0.006	27
0.18 0.2	0.02	170	230	120	19	15	3.6	7.1	0.006	35
0.25	0.03	250	320	160	20	16	5.2	9.8	0.006	33
0.3	0.03	310	390	210	23	19	6.5	12	0.007	34
0.4	0.05	410	490	260	21	17	8.1	15	0.007	33
0.5	0.06	540	670	390	22	17	12	19	0.007	33
0.8	0.10	850	910	610	20	16	--	--	0.007	28

SEASONED HARD WOOD FOR ELECTRICAL PURPOSES

1.0 GENERAL :

This specification governs the quality requirements of a seasoned hard wood for electrical purposes supplied in the form of planks, beams, round rods and components.

2.0 APPLICATION :

Suitable for use in Transformers, Switchgear, and other electrical machines.

3.0 COMPLIANCE WITH NATIONAL STANDARDS :

The is no Indian Standard covering this grade of wood.

4.0 TERMINOLOGY:

For the purpose of this specification, the definitions given in IS : 707 Glossary of Terms applicable to timber technology and utilisation shall apply.

5.0 Species :

Standard trade name shall be stated on the order from the following.

Sl.No.	Botanical Name	Standard Trade Name	Local Names in Regional languages of India
1.	Terminalia tomentosa wight et Arn	Laurel	Banappu, Karumarudu, karimarudu, asna, sain, aisan, asan, hatana saj, pucca saj, sahaja, ain, sadar, matti, karimatti, sajad, nallamaddi.
2.	Adina cardifokia Hook	Haldu	haldwan, heddi, yetagal, hedu, haldu yettaga, bimbu, Kadambari, manja kadambai, bandaru taraksopa rangkat, karam, kumbha, kuruma, haladwar
3.	Tectono grandis linn.	Teak	Sagoon, shegun, sagwan saguan, saguvain, thega, thekinamara, theku, teku, sag, tegu
4.	Dysoxylum malabaricum bedd.	White cedar	Biliderdari, vella-gil

Sl.No.	Botanical Name	Standard Trade Name	Local Names in Regional languages of India
5.	Lagerstrocmia lanceolata wall.	Benteak	bendeku, nandi, venteak, bethekku, venthekhu, nana
6.	Terminalia paniculata Roth	Kindal	honagalu, honal, hunal, pillamarudu, nallapulaga.
7.	Shorea Robusta	Sal	Sakhu, sal, sarjam, Raigala, sargi

6.0 FINISH :

Unless otherwise specified, the planks / beams shall have sawn finish and the components shall have planner finish.

7.0 DIMENSIONS AND TOLERANCES :

7.1 Sizes :

Thickness, Width and length of timber shall be stated on the order from the following standard dimensions :

Thickness (mm)	Width x Length
25, 50, 75, 100	250 - 300 X 2400 - 2800

However, any other size can also be ordered. Dimensions of components shall be in accordance with the relevant drawing.

7.2 Tolerances :

7.2.1 Width and Thickness :

Over (mm)	Upto & incl. (mm)	Tolerance (mm)
-	25	± 2
25	75	± 3
75	125	± 4
125	-	± 5

7.2.2 Length

Standard Length, m	Tolerance
1, 1.5, 2, 2.5, 3.5 and 4	± 2 Percent or ± 50 mm whichever is less

Note : 1. Minus tolerances shall not be permitted in more than 25 percent of timber supplied.

2. Minus tolerance shall be permissible in one dimension only.

8.0 TEST METHODS :

Unless otherwise specified, the tests shall be conducted in accordance with the relevant methods of IS : 1708.

9.0 SAMPLE FOR TESTS :

A set of test samples as per Annexure I shall be supplied for testing and approval.

10.0 FREEDOM FROM DEFECTS :

Timber shall be free from the following defects :
Brashness, splits across the grain, shakes, cup, bow, wane, spring, twist, insect attack, any kind of decay (rot), any sign of infection, open centre heart, centre heart on planks upto a thickness of 75 mm and any other defect.
Defects to the extent specified below are permissible. These defects shall be measured in accordance with IS : 3364,

10.1 Centre Heart :

Shall be permissible on planks above 75 mm thick only and on sleepers when it is not farther than 25 mm from the nearest edge and is sound and boxed.

10.2 End Splits :

The longest end split at each end shall be measured and the lengths added together.
The added lengths of these shall not exceed 6mm per metre run of the piece.

10.3 Live Knots upto 25mm diameter :

A maximum of 3 knots / metre length are permissible, However, the knots shall not be so grouped or located as to affect the strength of the piece.
Live knots above 25mm diameter are not permissible.

10.4 Dead knots upto 10 mm diameter :

One knot/metre length shall be permissible provided the knot does not move across thickness with a moderate pressure.
Dead knots above 10 mm diameter are not permissible.

10.5 Surface Cracks :

Surface cracks with a maximum depth of 5 mm are permissible. A continuous crack of any depth, all along the length, is not permissible.

10.6 Sap Wood :

Shall be permissible upto a maximum of 10 percent of the cross-sectional area but not in more than 10 percent of the total supply.

11.0 SEASONING & MOISTURE CONTENT :

The timber shall be seasoned to a moisture content of 10% maximum at the time of inspection, within a depth of 15 mm from the surface excluding a length of 300 mm from each end.

12.0 MECHANICAL PROPERTIES :

12.1 Compressive Strength (Perpendicular to grain) :

14 MPa, Min.

12.2 Machinability :

Shall be free from tendency to warp, crack, split at any stage of machining.

13.0 ELECTRICAL PROPERTIES :

13.1 Electric Strength (Proof for 5 minutes) :

13.1.1 Parallel to grain : 25 kV

13.1.2 Perpendicular to grain : 16 kV

Two specimens of size 100 X 25 X 25 mm shall be prepared in parallel to grain as well as perpendicular to grain directions. The specimens shall be predried at 105 $\pm$ 2 deg C for 48 $\pm$ 0.5 hours and the voltage shall be applied for 5 minutes along 100 mm length, using two pieces of 25 mm square aluminium foil as electrodes.

14.0 CHEMICAL PROPERTIES :

14.1 pH of 5% Aqueous extract :

5.5 to 9.0

14.2 Effect of wood on insulating oil (Annexure II) :

14.2.1 Increase in Acidity :

0.1 mg KOH / g. Max

14.2.2 Increase in sludge content :

0.05 % Max.

15.0 END COATING :

Timber shall be coated after inspection with any of the following compositions, upto a distance of 80 mm from each end.

15.1 Thick coal tar or bituminous paint.

15.2 Resin and lamp black (10:1) melted, mixed and applied hot.

15.3 Hardened gloss oil

15.4 Paraffin wax

15.5 Molassess and lime (3:1)

16.0 TEST CERTIFICATE :

Unless otherwise stated, three copies of test certificates shall be supplied along with each consignment.

In addition, the supplier shall ensure to send one copy of test certificates along with despatch documents to facilitate quick clearance of the material .

The test certificates shall bear the following information :

AA 211 51 (Rev 01) : Seasoned Hard Wood for Electrical Purposes

BHEL Order No.

Batch / Lot No.

Thickness, Width and Length

No. of Boards / Components

Net Volume (cubic metre)

Test Values obtained and certificate for compliance with clauses 5 to 7 and 10 to 15.

17.0 PACKING AND MARKING :

Components shall be suitably packed in a wooden crate. The crate and plank / Beam shall be marked with the following information :

AA 21151 : Seasoned Hard Wood for Electrical Purposes

BHEL Order No.

Batch / Lot No.

Manufacturer's Name & Grade

Thickness, Width and Lengths

No. of Boards / Components

Net Volume

ANNEXURE - I

SIZE OF TEST SAMPLES

1. 25 X 25 X 100 mm - 4 Nos, parallel to the grain & 4 Nos. perpendicular to the grain.
2. 50 X 50 X 200 mm - 3 Nos. along the grain.
3. 25 X 25 X 25 mm - 2 Nos
4. 25 X 25 X Thickness mm - 4 Nos.
5. 7.5 X 12.5 X 9.0 mm Thick - 4 Nos.
6. Chips - 50 gms.

ANNEXURE - II

Sludge and Oil Acidity :

Conditioning : Condition the test piece for 168 ± 2 hours in controlled atmosphere of 65 ± 5% RH and 27 ± 2 C.

Test Specimen : Cut the specimen to dimension of 75 mm X 12.5 mm X thickness.

Note: Thickness above 9 mm shall be machined to 9 mm. Both the surfaces shall be machined evenly to achieve thickness of 9 mm.

Procedure : Into a 150 mm X 25 mm test tube weigh 25 g of transformer oil. Transformer oil complying with the requirements of IS 335 is suitable. Prepare the test specimen, weigh it to the nearest 0.01 g and introduce it into the oil. Lightly plug the mouth of the tube with cotton wool and place it in a constant temperature bath maintained at 100 ± 0.5 deg. C for 164 ± 1 hour.

Place a similar quantity of the same oil in a second tube and maintain this under the same conditions as "Blank" sample.

At the end of the specified heating period, remove the tubes from the bath and allow them to cool to room temperature. If it can be seen that delamination has occurred, the specimen has failed. If there is no visible delamination, determine the sludge content of the oil in which the pressboard has been immersed as follows.

Pour the oil into a 600 ml beaker and wash the test tube and pressboard sample with n-heptane until oil-free, adding the washings to the oil in the beaker. Make the contents of the beaker upto approximately 300 ml with n-heptane. Cover the beaker with a watch glass and allow to stand in the dark for 24 ± 0.5 hrs. at room temperature.

Filter the solution through a tared, dried, sintered glass filter, of no. 4 filter transferring all the sediment to the filter with the aid of n-heptane from a wash-bottle. Dry the filter at 105 ± 2 deg. C to constant mass. Express the amount of sediment as a percentage of the original sample mass.

Make the filtrate up to 500 ml in a measuring cylinder with n-heptane. Make the "Blank" sample upto 500 ml a second cylinder. Determine the acid values of the heptane solutions as follows.

Place 60 ml toluene and 40 ml industrial methylated spirit (66 over proof) in a 600 ml conical flask. Add 2 to 3 ml Alkali blue 6B indicator solution (2% by mass in industrial methylated spirit and one drop of 0.1N hydrochloric acid). Neutralize this mixture, with 0.1N alcoholic potassium hydroxide (KOH), to give a red colour which persists for 15 s.

Add 100 ml of the above filtrate to the neutralized solvents and titrate to the same end point with the 0.1N alcoholic KOH. Repeat the titration on 100 ml of the "Blank" solution.

Results : Calculate the increase in the acid value of the oil per gram of Wood in mg KOH/g from the expression :

$$\text{Increase in Acid Value} = \frac{(t_2 - t_1) \times 5.61 \times 5}{W}$$

Where

t_1 is the number of milliliters of 0.1N KOH required to neutralize 100 ml n-heptane in blank solution;

t_2 is the number of milliliters of 0.1N KOH required to neutralize 100 ml of filtrate; and

W is the sample mass of Wood (grams).

Report the acid value of the "blank" oil together with the increase in acid value due to the sample as calculated from the above equation. Report also the percentage sludge produced by the sample.

GLASS FILAMENT WOUND EPOXY BONDED CYLINDERS/EDGE BLOCK FOR TRANSFORMER

1. GENERAL:-

This specification governs the requirement of glass filament wound epoxy bonded cylinders manufactured by a special thread winding process. Specially formulated Epoxy resin system impregnated glass fibres are wound in exact spirals crosswise on to a cylindrical mandrel. First few inside layers (2 to 3mm radial thickness) can be cut to a sufficient length to remove the weaker cross over build up of winding. The cylinders must have excellent mechanical characteristics attained by winding the filament at a suitable angle approx 45^0 to the mandrel axis. The cylinder's shall have no deterious effect on the properties of transformer oil and are capable of withstanding high degree of mechanical, electrical & thermal stresses . Cylinders should have temperature index of at least 120.

2. APPLICATION :

Used in manufacture of (a) Base cylinder for transformer winding

(b) Edge blocks for end supports.

3. COMPLIANCE WITH NATIONAL STANDARDS :

There is no Indian standard for this type of material.

4. DIMENSIONS & TOLERANCES :

Dimensions & tolerances (if any) of base cylinders and edge blocks shall be stated on the order/drawing .It is mostly required in the form of finished components as per drawings. The acceptable limit of tolerance on thickness of cylinder/ edge block is ±0.25 mm.

5. FINISH :

5.1. The cylinders shall have a uniform and smooth finish at I/D and be free from splits, inclusion of foreign bodies, visible defects and voids. Cylinders to be machined on outer surface.

5.2. The machined O/D surface shall be uniformly finished with an arc resisting varnish with suitable temperature index, which shall not affect the properties of transformer oil.

5.3. Edge trimming to be done to avoid any sharp corners.

6. TEST METHODS :-

Unless otherwise specified the tests shall be conducted in accordance with the relevant methods AA0851701.

7. PHYSICAL PROPERTIES :

7.1. Apparent Density 1.7 g/cc (Min.) when tested on a sample of 38mm length & 38mm width by any conventional method.

7.2. Water absorption after 4 days of water immersion at room temperature 0.2% max when tested on a cured sample of 38mm length & 38mm width.

7.3. Shrinkage after 4 days at 120+/-4^0 C.

0.5% max. When tested on a cured sample of 38mm length & 38mm width.

7.4. Bond content :

30 to 40% shall be determined by burning the bond at 600-620^0 C for sufficient time.

7.5. Texture of glass:

Test shall be carried out on 50mm long (curved) and 25mm wide sample by burning the bond at 600-620^0 C for sufficient time.

Glass fibres shall not have cross weave orientation.

7.6. Mechanical strength :

Compression strength axial: 85 N/mm^2 (min.)

Compression strength circumferential: 250 N/mm (min.)

8. ELECTRICAL PROPERTIES : (Test to be conducted on a sample test piece and separate test certificate to be submitted)

8.1. Electrical Strength in oil at 90+/-2^0 C : 10kv /mm for 5 minutes.

8.2. Comparative Tracking Index: (400 Min.)

8.3. Dielectric loss factor tan delta at 90^0 C and 50 Hz: 0.005 (Max.)

9. TEST CERTIFICATE :

Material shall be tested for each batch of consignment for physical properties at clause 7. Three copies of test certificates shall be supplied with each consignment giving the following information.

Our Order No.

Supplier's reference No.

Batch No.

10. PACKING AND MARKING :

The cylinder/edge block shall be suitable packed to prevent damage during transit.

Each packing shall bear the following information.

JS 22299 REV01 Glass Filament Epoxy bonded edge-block /Cylinder

Our Order No.

Manufacturer's and / or supplier's Name and Grade

Batch No.

ID x OD x Length/ Drawing No.

No. of Edge block / Cylinder.

PRESSPAPER FOR ELECTRICAL PURPOSES

1. GENERAL:

This specification governs the quality requirements of dense calendered multi-layered paper made by continuous process from 100% sulphate wood pulp and of high chemical purity and in natural colour without any dye. It is free from conducting particles and other extraneous matter. The paper in insulating oil has temperature index of atleast 105.

2. APPLICATION:

Used for the insulation in Transformers and turbogenerators.

3. COMPLIANCE WITH NATIONAL STANDARDS:

The material is technically identical to Type D of IS: 8570-1977 (Reaffirmed 1990), "Specification for Press paper for electrical purposes" with additional property of Flexibility.

4. DIMENSIONS AND TOLERANCES:

Thickness, width and length shall be as stated on the order.

4.1 Thickness:

Standard thickness and tolerances are given in Table 1. of annexure 1.

4.2 Width:

Standard widths are 1000, 1500, 1800 and 2000 mm. However, any other widths can also be ordered.

5. FINISH:

The presspaper shall have a smooth calendered but unglazed finish.

6. **TEST METHODS:**

Unless otherwise specified, the tests shall be conducted in accordance with IS: 8570.

7. **SAMPLE FOR TEST:**

20 sheets of size 300 x 300 mm of required thickness suitably packed shall be sent for test and approval.

8. **PHYSICAL PROPERTIES:**

8.1 **Density:**

1.0 g/cm^3, Min.

8.2 **Moisture Centent:**

8% Max.

8.3 **Oil Absorption:**

Density (g/cm^3)	Oil Absorption, Min percent.
1	21
1.05	17
1.1	13
1.15	10
1.2	7
1.25	5
1.3	3

8.4 **Flexibility:**

When tested as per IS: 1576, the presspaper shall withstand one 360° fold without any sign of splitting or cracking of either surface or delamination along the plies.

9. **MECHANICAL PROPERTIES:**

9.1 **Tensile Strength:**

As per table 1 of Annexure I.

9.2 **Heat ageing in air:**

Decrease in Bursting Strength: 60% Max.

10. ELECTRICAL PROPERTIES:

10.1 Electric Strength (BDV) in air at 90 ± 2°C:

As per table 1 of Annexure - I.

11. CHEMICAL PROPERTIES:

11.1 Ash Content:

2.0% Max.

11.2 Conductivity of 1% aqueous extract:

3.0 mS/m, Max.

11.3 p^H Value:

5.0 to 8.5

12. TEST CERTIFICATE:

Unless otherwise stated, three copies of test certificates shall be sent along with each consignment.

In addition, the supplier shall ensure to send one copy of test certificates along with the despatch documents to facilitate quick clearance of the material.

The test certificates shall bear the following information:

AA 21103 : Presspaper for Electrical Purposes
(Rev.No. 02)
BHEL Order No.
Batch No.
Net Weight/No of Rolls
Thickness, Width
Gross weight
Test values obtained and certificate for compliance with claus 4,5 and 8 to 11.

13. PACKING AND MARKING:

The presspaper shall be supplied in rolls or sheets as specified on the order. The material shall be packed in moisture-proof wrappers, boxes or cartons, as applicable, so constructed as to prevent damage and contamination in transit.

Each package shall be marked with the following information:

AA 21103: Presspaper for Electrical Purposes.
BHEL Order No.
Manufacturer's Name and Grade
Batch No.
Thickness, Width
Net Weight/No of Rolls.

14.0 ***REFERRED STANDARDS (Latest Publications Including Amendments):***

1. IS: 8570

TABLE - 1 Annexure - I

Nom.Tkns. (mm)	Tolerance (mm)	Tensile Strength per 15mm width, Min at 90 + 2°C, Min.		Elec. Strength (BDV) In Air (KV)
		M/c Direction	Cross Direction	
		N	N	
0.10	±0.01	105	35	1.00
0.15	+0.02 -0.01	135	45	1.40
0.20	±0.02	160	55	1.75
0.25	±0.02	190	70	2.05
0.30	+0.03 -0.02	215	80	2.25
0.40	+0.04 -0.03	275	102	2.70
0.50	±0.04	335	122	3.00

Note: For the thickness other than the nominal thickness, the corresponding values shall be that given for the next higher thickness.

LAMINATED PRECOMPRESSED PRESSBOARD BONDED WITH NON - AQUEOUS AGENT

1.0 GENERAL :

This specification governs the quality requirements of a very hard and rigid laminated Pre-compressed pressboard made from 100% sulphate wood pulp characterized by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears cloth/mesh marks The laminates are manufactured by building up laminae of the solid precompressed pressboard complying with CPS No AA 21108 by hot pressing with appropriate non aqueous adhesive free from extraneous matter in the solid plastic state. The material shall also be free from soluble electrolytes such as chlorides, sulphates and carbonates and conducting particles. The material in insulating oil shall have temperature index of at least 105.

2.0 APPLICATION :

Used in transformers, as coil spacers, flat-washers, edge blocks and clamping rings etc.

3.0 COMPLIANCE WITH NATIONAL STANDARDS :

The material shall comply, in general, with the requirements of the following Inter National Standard and also meet the requirements of this specification.

IEC : 60673-3-1 (l992-09)-first edition : Specification for Laminated press board
Type : LB 3.1.2

4.0 DIMENSIONS AND TOLERANCES :

Thickness, width and length of the board shall be as stated on our order.
The sheets shall be rectangular in shape and shall not form a parallelogram. The variation in length of the two diagonals of a sheet shall be within + 5 mm.

4.1 Preferred Thickness :

12, 16, 20, 25, 30, 40 & 50 mm

4.2 Tolerance on thickness :

Upto and including 12 mm : ± 5 %

Above 12 mm :± 4 %

4.3 Length nnd Width

1000 X 3000; 2000 X 3000; 2250 X 2250 and 2500 X 2500 mm and 3100 X 4100mm with a tolerance of ± 0.5 %.

However, any other size can also be ordered

4.4 Bow (Edge Camber):

Lateral departure of the four edges of a sheet from a straight line forming a cord shall not be more than 2 mm

5.0 FINISH :

Shall have matt finish with no irregulaties except regular indentations due to wire mesh used during pressing operation

6.0 TEST METHOD :

Unless otherwise stated, when tested in accordance with the relevant methods of IEC 60763-2; "Laminates Pressboard' -Method of test" the test sample shall show the following properties.

7.0 TEST SAMPLE :

Two boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.

8.0 PHYSICAL PROPERTIES :

When tested in accordance with the relevant methods of IEC : 763-2 : Laminated Press Board –
Method of Test. The test samples shall show tiie following properties.

8.1 Apparent Density : 1.15 to 1.50 g/cni^{J}

8.2 Oil Absorption : 5% minimum

8.3 Moisture Content : 5 % maximum

8.4 Shrinkage In Air :

Machine Du tion (MP)	:	0 4 % maximum
Cross Direction (XD)	:	0 6 % maximum
Thickness (TK)	:	4.0 % maximum

9.0 MECHANICAL PROPERTIES

9.1 Flexural Strength
(Cross-Breaking Strength)- Perpendicular To Layers

Machine Direction (MD)	:	100 MPa, minimum
Cross Machine Direction (CMD)	:	85 Mpa. minimum
Thickness (TK)	:	4.0 % maximum

9.2 Compressibility In Air :

Compressibility (C) : 3% maximum
Reverse Compressibility (C_{Krv}) : 60% minimum

10.0 ELECTRICAL PROPERTIES

10.1 Electric Strength Parallel To Layer,, Method-1, Fig 2 of IEC : 60763-2 for all Thickness:

8 kv/mm, minimum

11.0 CHEMICAL PROPERTIES

11.1 PH of Aqueous Extract:

5 to 8

11.2 Conductivity of Aqueous Extract: 10 mS/m, maximum

12.0 TEST CERTIFICATES:

Unless otherwise stated, three copies of test certificates shall be supplied along each consignment

In addition the supplier shall ensure to send one copy of test certificates along with despatch documents/shipping or packing test to facilitate quick clearance of the material.

The test certificates shall bear the following information:

AA 211 09 (Rev. No.04) . Laminated precompressed press board bonded with non Aqueous Agent.

BHEL Order No.
Manufacturer's / Supplier's name.
Batch/Lot No.
Grade/Trade mark, if any
Thickness, width and length of the board
No. of Boards
Quantity supplied (kg)
Test results for clause 4,5 and 8 & 11

CORPORATE PURCHASING SPECIFICATIONS

13.0 PACKING AND MARKING:

Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS : 335/1EC : 296 The boards shall be sealed in polythene sheet which sh: !1 then be covered all round with water proof bituminised brown paper and packed m a wooden crate to prevent damage during transit

Each packing case shall be marked with the following information

AA 21109: Laminated Precompressed Pressboard - Bonded with non-Aqueous Agent

BHEL Order No

Manufacturers/Suppliers Name and Grade
Batch/Lot No.
Grade/Trade Mark, if any
Thickness, Width and Length of Board
No. of boards
Quantity supplied (kg)

14.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1) EC: 60763-2 2) IS 335 3) IEC 296

SOLID PRECOMPRESSED PRESSBOARD

1. **General** - This specification governs the quality requirements of a very hard and rigid solid pressboard characterised by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears mash marks. It is manufactured by hot pressing 100% sulphate wood pulp without the addition of any additive/ adhesive into the solid plastic state. The material shall be free from soluble electrolyte such as chlorides, sulphates and carbonates and also from conducting particles. The material in insulating oil shall have temperature index of atleast 105^0C.
2. **Applications** - The material can be used as insulating blocks, spacer strips, cylinders & other insulating components, barriers etc. in transformers, reactors and capacitors etc.
3. **Compliance with International Standard** – The material shall comply, in general with the requirements of the latest edition of IEC: 60641-3-1(2008) TYPE B 3.1A.
4. **Dimensions and Tolerances** – Thickness, width and length of the pressboard shall be stated on the order. The sheet shall be rectangular in shape with the two diagonals being equal. Sheet shall not form parallelogram. Two diagonals of the sheet shall be within ±3 mm.
5. **Preferred Thickness** – 1, 1.5, 2, 3, 4, 5, 6 and 8mm
6. **Preferred size** – 1800 x 3000mm or bigger (With a tolerance of ±0.5% on length & width)
7. **Bow (Edge camber)** – Lateral departure of the four edges of the sheet from the straight line forming a cord shall not be more than 1 mm.
8. **Finish** – Shall have matt finish with no irregularities except regular indentations due to wire mesh used during pressing operation and welt marks/ waves within thickness. Each board should be printed with brand name/ mark along the length or width with carbon free ink.
9. **Test Methods** – Unless otherwise specified, when tested in accordance with the relevant methods of the IEC: 60641-2 : Pressboard and presspaper for electrical purposes – Method of tests, the test sample shall follow the properties as per table A of this document.

   For drying of test specimens, air drying for 96 hours to method B of IEC:60763-2, may be carried out as an alternative.
10. **Test samples** – Four boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.
11. **Properties** – The pressboard supplied against this spec. to confirm the requirement as per table A.
12. **Test certificates** - Unless otherwise stated, 3 copies of test certificates shall be supplied alongwith each consignment. In addition, the supplier shall ensure to send one copy of test certificates alongwith their dispatch documents to facilitate quick clearance of the material. The test certificates shall bear the information indicated in clause 13 and test results of clause 4,5,6,7 &Table A.
13. **Packing & marking** – Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS:335 or IEC:60296. The boards shall be sealed in high density polyethylene sheets, which shall then be covered all around with water proof bituminised brown paper to prevent entry of rain water. These boards then shall be packed in a wooden case to avoid damage during transit. Packing shall be marked legibly with the following information -

    TRE-184 : Solid Precompressed Pressboard
    BHEL Order No.

Manufacturer's/ Supplier's name
Grade / trade mark, if any
Batch/ Lot no.
Thickness, Length & Width of the board
Quantity of boards / Net weight/ Gross weight (kg)
Date of manufacturer
No. of boards

14. **Preferred standards** (Latest publications including amendment)
1. IS:335/ IEC:60296 2. IEC-60641-2 3. IEC: 60641-3-1 4. IEC: 60763-2

Table A

	Thickness → Properties ↓	**Up to 1.6mm**	**Above 1.6mm-Up to 3.0mm**	**Above 3.0mm-Up to 6.0mm**	**Above 6.0mm-Up to 8.0mm**
1.	Tolerance on thickness	±7.5%	±5%	±5%	±5%
2.	**Physical properties**				
2.1	Apparent density [g/cm^3]	1.0 to 1.2	1.1 to 1.25	1.15 to 1.3	1.15 to 1.3
2.2	Oil absorption	11% Min.	9% Min.	7% Min.	6% Min.
2.3	Moisture content	6% Max.			
2.4	Shrinkage in air	MD – 0.5% Max. XD - 0.7% Max. Thickness – 6.0% Max.			
3.	**Mechanical properties**				
3.1	Tensile strength [N/mm^2]	MD – 100 Min. XD – 75 Min.	MD – 105 Min. XD – 80 Min.	MD – 110 Min. XD – 85 Min.	MD – 110 Min. XD – 85 Min.
3.2	Elongation [Type test]	MD – 2.5% Min. XD – 3.5% Min.			
3.3	Compressibility in air **C**	10% Max.	7.5% Max.	5% Max.	4.5% Max.
3.4	Reverse Compressibility in air C_{rev}	45% Min.	50% Min.	50% Min.	50% Min.
4.	**Electrical properties**				
4.1	Electrical strength [1] [kV/mm]	45 Min.	35 Min.	35 Min.	35 Min.
5.	**Chemical properties**				
5.1	Ash content	0.7% Max.			
5.2	PH of 5% aqueous extract	6.0 to 9.0			
5.3	Conductivity of 5% aqueous extract [mS/m]	5 Max.	6 Max.	8 Max.	10 Max.

MD- Machine Direction, XD – Cross Machine Direction

1) Electrical strength in oil at room temp., short time (Rapid rise) test. Thickness of test piece shall be thickness of sheet under test, except that where it exceeds 2mm, the thickness at electrode contact area may be reduced to 3.0 ± 0.2mm by machining from one side, keeping the other side intact. When it is necessary to avoid flashover or because of limitation of available equipment, specimens may be prepared by reducing at electrode contact area to 2.0 ± 0.1mm.

LAMINATED PRECOMPRESSED PRESSBOARD

1. **General** - This specification governs the quality requirements of a very hard and rigid laminated precompressed pressboard made by 100% sulphate wood pulp board characterised by high purity and mechanical strength and capable of being sheared without showing ragged edges. Its surface bears mash marks. The laminates are manufactured by building up laminate of solid precompressed pressboard complying with TRE-184 by hot pressing with casein based adhesive or non-aqueous adhesive, free from extraneous matter in the solid plastic state. The material shall be free from soluble electrolyte such as chlorides, sulphates and carbonates and also from conducting particles. The material in insulating oil shall have temperature index of atleast 105^0C.
2. **Applications** - The material can be used as coil spacers, flat washers, edge blocks and clamping rings etc. in transformers, reactors etc.
3. **Compliance with International Standard** – The material shall comply, in general with the requirements of the latest edition of IEC: 60763-3-1 TYPE LB 3.1 A.1 or LB 3.1 A.2.
4. **Dimensions and Tolerances** – Thickness, width and length of the pressboard shall be stated on the order. The sheet shall be rectangular in shape with the two diagonals being equal. Sheet shall not form parallelogram. Two diagonals of the sheet shall be within ±5 mm.
5. **Preferred Thickness** – 8, 12, 16, 20, 25, 30, 40, 50mm and above in multiple of 10mm
6. **Preferred size** – 1800 x 3000mm or bigger (With a tolerance of ±0.5% on length & width)
7. **Bow (Edge camber)** – Lateral departure of the four edges of the sheet from the straight line forming a cord shall not be more than 2 mm.
8. **Finish** – Shall have matt finish with no irregularities except regular indentations due to wire mesh used during pressing operation. Each board should be printed with brand name/ mark along the length or width with carbon free ink.
9. **Test Methods** – Unless otherwise specified, when tested in accordance with the relevant methods of the IEC: 60763-2 : Laminated pressboard – Method of tests, the test sample shall follow the properties as per table A of this document.
10. **Test samples** – Three boards of ordered thickness in 500 x 500 mm size shall be supplied for testing and approval.
11. **Properties** – The pressboard supplied against this spec. to confirm the requirement as per table A.
12. **Test certificates** - Unless otherwise stated, 3 copies of test certificates shall be supplied alongwith each consignment. In addition, the supplier shall ensure to send one copy of test certificates alongwith their dispatch documents to facilitate quick clearance of the material. The test certificates shall bear the information indicated in clause 13 and test results of clause 4,5,6,7 &Table A.
13. **Packing & marking** – Manufacturer's name or identification slips shall be given on each board which shall be compatible with insulating oil to IS:335 or IEC:60296. The boards shall be sealed in high density polyethylene sheets, which shall then be covered all around with water proof bituminised brown paper to prevent entry of rain water. These boards then shall be packed in a wooden case to avoid damage during transit. Packing shall be marked legibly with the following information -

    TRE-185 : Laminated Precompressed Pressboard
    BHEL Order No.
    Manufacturer's/ Supplier's name

Grade / trade mark, if any
Batch/ Lot no.
Thickness, Length & Width of the board
Quantity of boards / Net weight/ Gross weight (kg)
Date of manufacturer

14. **Preferred standards** (Latest publications including amendment)
1. IS:335/ IEC:60296 2. IEC-60763-2 3. IEC: 60763-3-1

Table A

	Properties	**Limits**
1.	Tolerance on thickness	±5% for ≤12mm ±4% for >12mm
2.	**Physical properties**	
2.1	Apparent density [g/cm^3]	1.15 to 1.35
2.2	Oil absorption	5% Min.
2.3	Moisture content	8% Max.
2.4	Shrinkage in air	Machine Direction - 0.4% Max. Cross Machine Direction - 0.6% Max. Thickness - 6.0% Max.
3.	**Mechanical properties**	
3.1	Flexural strength [MPa]	Machine Direction - 100 Min. Cross Machine Direction - 85 Min.
3.2	Compressibility in air **C**	3% Max.
3.3	Reverse Compressibility in air $\mathbf{C_{rev}}$	60% Min.
4.	**Electrical properties**	
4.1	Electrical strength [1)] [kV/mm]	8 Min.
5.	**Chemical properties**	
5.1	PH of 5% aqueous extract	5 to 8
5.2	Conductivity of 5% aqueous extract [mS/m]	15 Max.

1) Electrical strength parallel to layers, Method 1, Fig. 2 of IEC: 60763-2, for all thickness.

SN	Description
1	**General:**
A	These general terms & conditions shall apply to all enquiries, notice inviting tenders, request for quotations concerning the supply of goods and / or rendering of services to Bharat Heavy Electricals Ltd., Jhansi (hereinafter referred to as BHEL or the Purchaser) or its Projects / Customers.
B	Special / supplementary enquiry conditions& Mandatory Sheet requirements, if any, covered in the respective enquiry, will override the relevant conditions mentioned in this document.
C	Commercial Conditions quoted by the vendor in any place including as stated in bidder's 'General Terms and Conditions' if any, shall not be binding on the Purchaser. Only the conditions contained in this document, including special conditions, if any, for this enquiry shall prevail.
2	**General Instructions - Common for Indigenous & Foreign enquiries**
A	Sealed bids are invited for scope of Supply / Services as detailed in the enquiry. The quotation should be neatly typed and free from over writing/ erasures. Any correction or addition must be authenticated.. Relevant enclosures, supporting documents, catalogue, samples, if any, as required as per Notice Inviting Tender (NIT) conditions shall be sent along with technical offer. Rate should be quoted in the units asked for in the enquiry. The rates should be quoted both in figures and words. In case of discrepancy in figures and words, the rates quoted in words shall be considered.
B	Bids shall be submitted in a Sealed cover with Enquiry No., Due date and Bidder's name indicated on the Cover. The Cover should contain both **Part-I** and **Part –II** bids, as the case may be. **Part – I bid** In case of Two part Bid, **Part – I** bid i.e. **Technical bid** containing (i) technical offer, (ii) Mandatory Sheet, (iii) **un-priced copy** of the Price Bid, (iv) EMD (if called in NIT),and (v) Relevant documents of PQR (if called in NIT), all duly filled-in & signed; should be kept in one envelope. The Part – I bid Cover items should have Enquiry No., Part I Bid, Due date, and Bidder's name indicated on the Cover **Part –II Bid wherever Reverse Auction is not called for** **Part – II** bid i.e. **Price Bid** containing only the price (as called for in the price format where required), duly filled-in & signed; should be kept in a **separate envelope**. The Price bid Cover items should have Enquiry No., Part II Bid, and Bidder's name indicated on the Cover **Part –II Bid wherever Reverse Auction is called for** **Part – II** bid i.e. **Price Bid** containing only the price (as called for in the price format where required), duly filled-in & signed; should be kept in a **separate envelope**. Wherever, BHEL informs that it proposes to conduct Reverse Auction for many items in the tender and where evaluation of the tender is on individual item basis, separate Part – II bids are to be submitted for each of the item. The Price bid Cover for each of the items should have Enquiry No., Part II Bid, Item no of Enquiry, and Bidder's name indicated on the Cover The envelopes indicating Part –I or Part-II, as the case may be, to be put in a bigger envelope, which should be addressed to In-charge, Tender Room, Bharat Heavy Electricals Ltd., Administration Building, Jhansi 284120. Enquiry No., due date and bidder's name must be mentioned on the bigger envelope. Offer must reach tender room of BHEL Jhansi latest by 13.15 hrs of the enquiry due date. In case, the bids are not submitted in the manner stated above, the offer of the bidder(s) are liable to be rejected. It is preferred that offers are sent in sealed envelope. However, if the bidder choses to send the offer through E-mail, offers received through E-mail shall be considered only when such offers are complete in all respects.. In cases of offers through E-mail, the offers shall be sent totenderbox.jhs@bhel.in. , wherein the Subject of the Email should mention the Enquiry Number. E mail offers sent to any other E mail ID shall not be entertained. BHEL shall not take any responsibility if the offers are incomplete or if the Enquiry number is not mentioned in the subject of the E-mail.
C	Wherever BHEL proposes to issue tender through e –procurement, the same philosophy as mentioned in 2B above is ensured through suitable system locks.
D	Offer received after 13.15 hrs of the due date will be termed as "Late" and shall not be considered

E	BHEL reserves the right to go for Reverse Auction (RA) (as per Guidelines available on www.bhel.com) instead of opening the sealed envelope price bid, submitted by the bidder. This will be decided after techno-commercial evaluation. Bidders to give their acceptance with the offer for participation in RA. Non-acceptance to participate in RA may result in non consideration of their bids, in case BHEL decides to go for RA. Those bidders who have given their acceptance to participate in Reverse Auction will have to necessarily submit 'Process compliance form' (to the designated service provider) as well as 'Online sealed bid' in the Reverse Auction. Non-submission of 'Process compliance form' or 'Online sealed bid' by the agreed bidder(s) will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on www.bhel.com). The bidders have to necessarily submit online sealed bid less than or equal to their envelope sealed price bid already submitted to BHEL along with the offer. The envelope sealed price bid of successful L1 bidder in RA, if conducted, shall also be opened after RA and the order will be processed on lower of the two bids (RA closing price & envelope sealed price) thus obtained. The bidder having submitted this offer specifically agrees to this condition and undertakes to execute the contract on thus awarded rates. If it is found that L1 bidder has quoted higher in online sealed bid in comparison to envelope sealed bid for any item(s), the bidder will be issued a warning letter to this effect. However, if the same bidder again defaults on this count in any subsequent tender in the unit, it will be considered as fraud and will invite action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on www.bhel.com)
F	The goods offered shall conform to BHEL specifications / drawings and / or Indian / International standards as mentioned in the Enquiry and the bidder is required to confirm his unconditional acceptance to the same. Vendors, seeking deviations from the specifications and any other conditions, may indicate the same clearly on a separate sheet, with reasons for such deviations. BHEL reserves the right to reject the offer with deviations or load the deviations suitably for evaluation.
G	Offers shall be submitted directly by vendor or his authorized agent/representative only. Offers from any other sources shall be considered as unsolicited and shall be summarily rejected.
H	Bid in single part or techno-commercial bid in **two** part system (as the case may be) will be opened on the due date. In case of two part bid, price bids of techno-commercially acceptable bidder(s) only shall be opened on the assigned date, for which separate intimation will be sent to the acceptable bidders.
I	The bidder whose bid is technically not accepted will be informed & EMD wherever submitted shall be returned along with his price bid within *30 days* of contract finalization date. No interest will be payable on EMD amount. EMD shall however be forfeited in the event of bidder backing out after submission of the bid.
J	1. Any discount / revised offer submitted by a bidder on its own shall be considered, provided it is received on or before the due date and time of offer submission (Part-I). Conditional discounts shall not be considered for evaluation of tenders. 2. Unsolicited discounts / revised offers given after Part-I bid opening shall not be accepted. No change in price will be permitted within the validity period asked for in the enquiry. 3. In case of changes in scope and / or technical specification and / or commercial terms & conditions, having price implication, techno-commercially acceptable bidders shall be asked by BHEL to submit the impact of such changes on their price bids. A suitable cut-off date and time shall be given to all the techno-commercially acceptable bidders to submit the impact on their price bids. In case a bidder opts to submit revised price bid instead of impact called for, then their original price (i.e. previous bid) shall be necessarily opened to know the price impact. .
K	The bidders will submit Integrity Pact, duly signed by its authorized signatory, if called for in the enquiry.
L	Wherever the enquiry is issued to unregistered vendor referred by BHEL Customer, the bidder shall submit the Supplier Registration Form (SRF) online at www.bhel.com and submit the signed copy of the duly filled-in SRF along with the bid. Price bids of such vendors, will be opened only on techno-commercial acceptance of bid and if allotted permanent code before the date of price bid opening.
M	BHEL expects that the bidder must respond to the enquiry. Regret letter, with valid reasons for not participating in the tender will be submitted where the bidder is unable to submit offer. Repeated lack of response on the part of vendor may lead to his deletion from BHEL's approved vendor list.
N	Goods shall be properly packed to avoid transit damage. Suitable markings shall be provided to identify the goods with that of the PO No, Item no. and the consignee details.
O	Goods shall be consigned to Manager , Stores (CRX), BHEL, Jhansi - 284120, India, unless otherwise specified in the PO.
P	Offers of the Bidders who are under HOLD or are under Interim Suspension or are on the banned list (as on date of Price bid opening) and / or those bidders who engage services of such suspended / banned firms, shall be rejected. The list of firms banned by BHEL is available on BHEL web site www.bhel.com. The list of firms suspended by BHEL, Jhansi is available on www.bheljhs.co.in. The " Guidelines for suspension of business dealings with Suppliers / Contractors" is uploaded on BHEL website http://www.bhel.com/vender registration/vender.php

Q	In case of press tenders (i.e. those published in newspapers) all corrigenda, addenda, amendments, time extensions, clarifications etc. to the tender will be hosted on BHEL website. (www.bhel.com &www.bhejhs.co.in) only. Bidders responding to press tender should regularly visit website(s) to keep themselves updated.
R	In case the bidder decides to sub-contract part of his activity / work to some of his vendors, details of such intended subcontracting shall be mentioned in the bid. This will however not absolve the bidder from his contractual obligations and responsibilities.
S	In the course of evaluation, if more than one bidder happen to occupy L-1 status and the order is to be placed on a single vendor, effective L-1 will be decided by soliciting discounts from the respective L1 bidders.. In case more than one bidder happen to occupy the L1 status even after soliciting discounts, the L1 bidder shall be decided by, a toss / draw of lots, in the presence of the respective L1 bidder(s). BHEL's decision in such situations shall be final and binding.
T	Wherever the minimum reserved capacity is called for in the tender, the offers of such bidders, who do not quote for the minimum reserved capacity, are liable to be rejected.
U	Due to large qty. requirement, we may finalize the tendered quantities among more than one bidder (after acceptance of L1 price by the other bidders), but limited to the capacity quoted by the bidder. Indicate your committed capacity for the item(s) tendered and confirm that capacity offered by you against our tender shall be available for us during the entire period of the Purchase Order / Contract. Where the number of qualified responses (N) are three or more, the distribution shall be limited to (N-1) responses. The manner and proportion of distribution shall be mentioned in the specific enquiry. Normally, the quantity distribution shall be generally as per quantities allocated to the bidder, but limited to the capacity quoted by the bidder. While the manner of distribution is mentioned in the enquiry, the absolute values of the unit of measurement shall be rounded off . For eg : If an allocation of 40% quantity results in 23.5 units, the quantity allocated shall be 24 units. If an allocation of 40% quantity results in 23.3 units, the quantity allocated shall be 23 units The distribution shall be based on the acceptance given by bidders to the L1 price counter offered to them. In case any or all of the bidders do not accept the counter offer, and a situation arises wherein bidder(s) who have agreed to the counter offer may have to be allotted more quantity than what has been proposed earlier, then the same shall be done , but limited to the capacity quoted by the bidder (s). Wherever, the number of techno commercially qualified responses (N) is two, BHEL reserves the right on whether or not to distribute the quantity on more than one bidder While the above pattern shall also be followed in long term framework agreements (FA), performance of the suppliers shall be monitored periodically, and the loading in FA will also be subject to factors like (a) Customer approval of suppliers in specific projects, (b) quality surveillance at Supplier works, (c) Suppliers delivery and quality performance during execution of FA, (c) Pendency of orders on the supplier and (d) responsiveness in addressing post order completion issues at BHEL. In view of these factors, the loading during execution of FA may vary with respect to allocated quantity. During execution of FA, if the performance of supplier is not upto the mark in respect of delivery / quality performance / quoted capacity of the bidder, BHEL reserves the right to either reduce further loading or stop loading till the execution of overdue orders. In such cases, action shall be taken against the defaulting supplier(s) as per guidelines of the Company, and the balance allocated full or part quantity of the defaulting supplier(s) may be re-distributed amongst other performing and willing vendors of the FA..
V	The bidder shall submit price bid strictly in the price format, wherever provided for, in the enquiry. Any attempt on the part of the bidder to alter the contents of the price bid format in any manner, which in the opinion of BHEL can vitiate the tendering process, will lead to rejection of the bid, *besides BHEL taking appropriate punitive action as deemed fit.*
3	**Vendor's particulars & logistics information**
	Bidder to provide contact details and all logistical information as called for in the Mandatory Sheet enclosed to this enquiry
4	**Delivery Schedule & Completion date**
A	• Instead of writing specific date against delivery offered, Bidder shall commit delivery period in number of days / weeks/ months to suit the delivery period indicated in the enquiry. • Commencement of delivery period shall be reckoned from the date of PO / LOI or any other agreed milestone. • Seller shall deliver the goods in the manner and schedule agreed under the Purchase order. • Goods shall be delivered within contractual period or any extension thereof, if any, granted by the Purchaser.

B.	In case of foreign supplies, bidders are to quote for CIF/CFR delivery terms .For CIF / CFR delivery terms, the date of bill of lading (BL) shall be taken as actual date of delivery.
C.	In case of Indigenous bidders, the date of delivery at named destination in India shall be taken as contractual delivery completion date where delivery terms are FOR destination. In case of 'Ex-works' delivery terms, the date of LR / RR shall be the contractual delivery completion date.
D	In case of unreasonable delivery quoted by the bidders, BHEL reserves the right to reject such offers.
5	**Transit Insurance**
	Except where delivery terms are agreed on CIF basis for Imports & FOR destination basis for indigenous purchases, transit insurance will be covered by BHEL under its open Marine Insurance Policy. Seller shall inform dispatch particulars with value of consignment to the Purchaser within 07 days of dispatch for BHEL to arrange insurance coverage in its policy. Failure on the part of seller to inform dispatch particulars will make him liable to pay for any transit damages / losses suffered by the Purchaser.
6	**Delivery Terms**
A	**Indigenous Purchase**
	Goods shall be delivered on 'FOR Destination' basis (with freight and insurance in bidder scope) to the named destination unless otherwise called for in the enquiry. In case the bidder quotes on Ex-Works, the offer of such bidder(s) is/are liable to be rejected. Wherever the PO terms mentions delivery terms as FOR Destination basis, and In the event of supplier having supplied the material by BHEL Truck / Vehicles as per BHEL transportation rate contract, thus causing BHEL to bear the freight charges, the corresponding amount ,incurred / estimated, shall be deducted from the bills of the Supplier.
B	**Foreign Purchase – Imports**
	1. Goods shall be dispatched by sea on CIF/CFR basis, unless stated otherwise in the enquiry or purchase order. The destination shall at Navsheva, Mumbai for LCL/Breakbulk Cargo and ICD, Mandideep, Madhya Pradesh for FCL Cargo 2. If air freight is called for in the enquiry, the goods shall be delivered on FCA basis to the named Airport 3. Please visit BHEL Jhansi web site www.bheljhs.co.infor details of named Airports. . Name of the airport so chosen by the Seller shall be indicated by the Bidder in his offer. 4. Goods shall be handled for air freight by BHEL's freight forwarder only, under FCA contracts and HAWB issued by BHEL appointed forwarder or his authorized agent(s) shall only be accepted for negotiation.
C	• In the event of bidder offering CFR or CIF delivery terms for delivery in FCL(Full Container Load), the Bidder shall provide **14 days' time free of detention** from the date of delivery at delivery port. Wherever the detention free period offered is less than 14 days, the bids shall be **loaded** for the period short of 14 days period. • *Port congestion charges or any additional charges claimed by shipping line till delivery at destination port shall be to theSeller's account.* •
7	**Force Majeure**
	Notwithstanding anything contained in the contract, neither the Seller nor the Purchaser shall be held responsible for total or partial non-execution of any of the contractual obligations, should the obligation become unreasonably onerous or impossible due to occurrence of a 'Force Majeure' which directly affects the obligations to be performed by the Purchaser or the Seller; Such events include war, military operations of any nature, blockages, revolutions, insurrections, riots, civil commotions, insurgency, sabotage, acts of public enemy, fires, explosion, epidemics, quarantine restrictions, floods, earthquake, or acts of God, restrictions by Govt. authorities; over which the Seller or the Purchaser has no control. The party claiming to be affected by force majeure shall notify the other party in writing without delay, within two weeks on the intervention and on the cessation of such circumstance. Extension of time sought by the Seller along with supporting evidence and so granted by the Purchaser for the supply/ work affected, if any, shall not be construed as waiver in respect of remaining deliveries. Rescheduling of deliveries on account of force majeure conditions, if so agreed by the Purchaser, will not entail the Seller to claim any increase in the price on whatsoever account.

	Notwithstanding above provisions, Purchaser shall reserve the right to cancel the order/ Contract, wholly or partly, in order to meet the overall project schedule and make alternative arrangements. If deemed necessary, Purchaser may takeover partly processed material at a mutually agreed price.
8	**LD / Penalty for delayed performance.**
A	I. Subject to force majeure conditions, LD shall be 0.5% of the total order value per week of delay or part thereof, subject a maximum of 10% of the total order value. II. In case of staggered delivery schedule, LD shall be 0.5% of the undelivered portion per week or part thereof subject to a maximum of 10% of the undelivered portion . III. However in case of Capital Machine / BOP where staggered deliveries may be applicable, the LD cap will be levied on total order value inclusive of E&C charges. (15%) IV. Wherever Erection & Commissioning (E& C) is called for, the vendor is provided a stipulated period from date of site readiness. LD shall be applicable for any delay beyond the stipulated period mentioned in the PO. V. In case of any amendment / revision, the LD shall be linked to the amended / revised PO value. VI. Any loading on LD clause shall be to the extent to which it is not agreed to by the bidder (at offered value) For the sake of clarity – Total order value means purchase order value (exclusive of taxes), Undelivered portion means , the delayed portion for the given lot. In case a supply is rejected and the same is replaced at a later date, the date of replacement of accepted supply shall be reckoned for calculation of LD
B	In case the contractually agreed delivery date falls on a holiday in BHEL Jhansi, the next working day shall be taken as contractual delivery date for compliance and applicability of LD / penalty.
C	In case of Ex works Delivery terms for Indigenous supplies, the date LR shall be reckoned for LD deduction. In case of FOR Delivery terms, the date of entry in BHEL Jhansi (CISF date) shall be reckoned for LD deduction. In case of FCA Delivery terms / Ex Works Delivery terms of Foreign supplies , the date Invoice / Packing List / Test Certificate, whichever date is later, shall be reckoned for LD deduction. In case of FOB / CIF / CFR / CIP Delivery terms, the date of Bill of Lading , shall be reckoned for LD deduction.
	Risk Purchase.
C	If the material is not supplied within the agreed delivery period, BHEL reserves the right to cancel the order and purchase the material(of the undelivered portion) from alternate source(s) at the Risk and Cost of the Seller. In such an event, it shall be obligatory on the part of seller to make good any loss suffered by the purchaser. In such cases, BHEL shall withhold bills, bank guarantees, etc of the Supplier, which are pending either at BHEL, Jhansi or any other Unit of BHEL . Wherever Risk purchase is invoked attracting action as per guidelines of the Company, action shall be initiated to suspend business dealings with the Supplier. To know the implications of suspension, the bidder may see the " Guidelines for suspension of business dealings with Suppliers / Contractors" which is uploaded on BHEL website http://www.bhel.com/vender registration/vender.php
9	**Indian Agents and Agency commission**
A	BHEL prefers to deal directly with Foreign vendor, wherever required, for procurement of Goods. However if the Foreign Principal desires to avail services of an Indian Agent, then the Principal should ensure compliance to "regulatory guidelines" which will require submission of an agency agreement. The agency agreement should specify the precise relationship between the foreign OEM / foreign Principal and their Indian Agent. Any payment which the Indian agent receives in India or abroad from the OEM, whether as commission or as a general retainer fee, should be brought on record in the agency agreement.
B	The CIF price quoted will be deemed to be inclusive of Indian Agency commission. Agency commission as disclosed by the bidder in his quoted CIF price will be paid in Indian Rupees on receipt & acceptance of Materials or it's installation at destination, as the case may be. The lower of the TT selling rate prevailing on the date of (a_ technical bid opening, or (b) price bid opening, or (c) date of invoice, shall be considered for computation of Agency commission.
C	Be it a case of a Foreign / Indigenous Principal or OEM, in a tender either the Indian Agent on behalf of Principal / OEM or the Principal / OEM itself can bid, but both cannot bid simultaneously for same item / product in the same Tender. In case both submit a bid in the tender, then the bid of OEM only shall be opened

D	Be it a case of a Foreign / Indigenous Principal or OEM, If an agent submits Bid on behalf of the Principal / OEM, the same agent shall not submit bid on behalf of another Principal / OEM in the Tender, for the same Item / Product.
10	**Documentation:**
A	**Indigenous Purchase**

Immediately on despatch of Goods, the following documents shall be necessarily sent by the Seller to the respective address(es) mentioned below

(a).	**Addressed to:** Addl General Manager (Stores) Main Store Building BHEL Jhansi PIN-284120 Telephone . 0510-2412230	**Documents to be sent:** (i) GST compliance Invoice – Duplicate for Transporter (ii) Challan/Despatch Advice note / Packing List etc. + 1 Photo copy (iii) Test Certificate, Guarantee / Warrantee Certificate (iv) LR/RR Duplicate for Transporter copy (v) O&M Manuals, wherever applicable
(b)	**Addressed to:** Dy. General Manager (Finance) Administrative Building BHEL Jhansi PIN-284120	**Documents to be sent:** (i) GST compliance Invoice – Original for Buyer (ii) Copy of LR/RR (iii) Copy of Test Certificate (iv) PVC Calculation sheet, if any, with supporting documents. (v) MOM with BHEL Customer (if called for in the PO) in case of installation & commissioning at Customer Site (vi) Capitalization Certificate, if called for in the PO
(c)	**Addressed to:** Dy. General Manager (MM) Administrative Building BHEL Jhansi PIN-284120	**Documents to be sent:** (i) GST compliance Invoice – Extra copy / Photo copy (ii) Challan/Despatch Advice note (iii) Test Certificate, Guarantee / Warrantee Certificate (iv) Copy of LR/RR

In case any other documents are required, the distribution of such documents will be specified in the Purchase order.

Further, if specified in the Purchase order, all the details and copies of documents have to be uploaded by Supplier on BHEL portal before despatch of Goods

B **Foreign Purchase – Imports**

Seller shall send 1 set of following documents, in English, within 7 days of BL date by courier to the Purchaser

1. Original Clean on board Bill of lading.
2. One set of Commercial Invoice, Packing list indicating container-wise Gross weight, net weight, CBM (cubic metre) volume, No. of packages with Dimensions of each package.
3. Original certificate of Country of Origin issued by Chamber of Commerce
4. One set of Original test certificates and O&M manual where called for.
5. Fumigation certificate wherever cargo is packed in wooden packing or packing of Plant origin material is used.

In case the Seller decides to negotiate all 3 originals of BL through negotiating Bank, non-negotiable documents (NND) consisting of copy of BL / HAWB & all originals at sl.no. 10-B2 to B5 will be couriered to Purchaser. Soft Copy of documents at sl. 10-B1 to B5 will also be sent by e-mail to the Purchaser at the e-mail address given in the PO. Other documents, as required, will be separately indicated in the Purchase Order. Additional expenditure, if any, incurred by the Purchaser by way of detention / demurrage, resulting out of delay attributable to the Seller in providing negotiable documents, will be recovered from the Seller.

C	In case of incomplete documentation, the communication shall be provided to supplier. The delays in submission of documentation by the supplier shall be reckoned while releasing payments to the Supplier
11	**Pricing Terms**

Prices once quoted shall remain firm within the validity or any extension thereof for placement of order, till complete execution of the order, without any escalation/increase for any reason, whatsoever, unless specifically provided for in the Enquiry & PO. In case of foreign vendors, the quoted price shall be taken as inclusive of Third Party Inspection and testing charges as called for in the NIT.

12	**Price Validity** :
	Unless stated otherwise in the enquiry, offer shall be valid for a period of 120 days from the date of Techno- commercial (Part-I) bid opening date. The prices quoted for spare parts of the main equipment shall be kept valid for a period of 180 days from the date of placement of PO for the main equipment.
13	**Taxes & Duties - Indigenous Purchase**
A	The Taxes and duties as applicable shall be payable extra which may include GSTagainst Gate pass. The Seller shall clearly indicate extent of taxes as applicable in his techno commercial bid. In the event of vendor failing to furnish valid GST invoices with appropriate HSN Code , amount corresponding to GST will be disallowed by BHEL while making payments. Bidders to ensure applicability of IGST / CGST/SGST based on the Inter / Intrastate movement of goods. GST Registration Number (GSTIN) should be clearly mentioned on the vendor's quotation. Please quote our IGST registration number 09AAACB4146P2ZC in all invoices raised for supply of goods and services under GST regime and also ensure filing of timely return and payment of tax and compliance of other applicable provisions on supplier under GST regime. In the event of any disallowance of input credit or applicability of interest or any other financial liability arises on BHEL-Jhansi due to any default of supplier under GST such implication shall be to supplier's account. GST shall be levied on LD and the relevant tax invoice shall be provided to vendors for availing credit. In case of directly despatchable items to Customer's Site, Supplier to bill to BHEL Jhansi at its GST Account number 09AAACB4146P2ZC and ship to the respective Customer Since, input credit of GST will be available to BHEL-Jhansi only after correct filing of return and payment of applicable GST by supplier, reimbursement of GST shall be made by BHEL-Jhansi on matching of vendor inputs at GST portal and after ensuring availability of input credit to BHEL-Jhansi. Payment of tax shall be done only after availing matching ITC, in all cases where bills are submitted directly to BHEL-Jhansi or through bank or under LC or through any other mode. Other statutory declaration forms are also to be submitted in time, as mentioned in the relevant Laws. BHEL reserves the right to withhold the payment due to the vendor equivalent to BHEL's tax and related liability thereon. In case of any changes in statutory laws w.r.t. taxes and duties, the same shall be applicable at the given point of time.
B	*Wherever GST is not applicable, the tax and duty structure , as applicable, is to be complied by the seller.*
14	**Taxes & Duties - Foreign Purchase – Imports**
A	The offered prices shall be inclusive of all the Taxes and duties as applicable in the country of bidder / country of dispatch for the quoted FCA / CFR/CIF price.
15	**Payment Terms-**
A	**Indigenous:** 100 % payment within 90 days (45 days for MSE / NSIC registered suppliers as per relevant act in force) from the date of receipt of material and submission of clear and admissible bill, subject to acceptance of material at BHEL , on direct presentation of the documents.. Payments to vendors who are seeking benefits under MSME act shall not be entertained if the Udhyog Aadhar Memorandum (UAM) submitted by them is not valid on the date of Purchase Order and date of supply (SRV Date of BHEL) . It is hence in the interest of the vendor that they validate the status of UAM regularly with BHEL. In case of despatch of material to site directly, site certification for receipt of materials is required unless otherwise provided for in the PO. Any deviation from the above payment terms, if accepted (by BHEL), shall be loaded @ SBI base rate(as on date of Part I bid opening) + 6%, for the purpose of bid evaluation.

	All documents as called for in the PO have to be submitted by the Supplier at the time of receipt of material and this should include the Invoice of the Supplier - Original copy of the Buyer and Duplicate for Transporter. On receipt of Invoice, the same shall be acknowledged by BHEL. Any clarifications on the bill submitted by the supplier shall be sought generally within 30 days (15 days for MSE / NSIC registered suppliers as per relevant act in force) of receipt of bill at BHEL. While it would be in the interest of the Supplier to provide the reply immediately to the clarifications sought , the Supplier is to respond at least within 7 days from the date of clarifications sought by BHEL. Wherever clarifications are sought by BHEL, the date of receipt of clarifications from the supplier shall be considered as date of submission of clear and admissible bill.
B	**Foreign:** 100% against irrevocable, unconfirmed LC, payable within 120 days of the bill of lading (BL) date. In case BHEL considers any deviation in payment terms i.e. early payment based on vendor's request, then bids shall be evaluated with loading of State bank of India Base rate (as on date of Part I bid opening) plus 6%, for the credit period short of 120 days. The LC shall be established 2 month prior to shipment date, valid for period of 120 days, unless agreed otherwise. Payment terms of CAD payable on 120th day of BL / HAWB date shall be preferred.
C	While there could be exceptional situations wherein the payment may be delayed beyond the stipulated time mentioned above, it is clarified that BHEL shall not pay any interest on such delays
D	In case of any disagreement between BHEL and the Supplier on any part of the bill, such part shall be severed from the rest and payment against agreed and admissible part shall be processed as per laid down procedure, while the disputed part shall be dealt as per contract provisions viz. conciliation, dispute resolution, arbitration, etc
16	**Inspection of Goods**
A	The Seller shall give adequate notice, of 1 week or as mutually agreed period, in writing to the Purchaser about the date and place at which the goods will be ready for inspection/ testing, as provided for in the contract.
B	Purchaser or his authorized representative shall be entitled to carry out inspection of material and workmanship at Seller's premises or at his sub-contractor's premises at all reasonable times during execution of contract; Such inspection, examination and testing, if made, shall not absolve the Seller from his obligations under the contract.
C	All costs related to inspections and re-inspections shall be borne by the Seller. In case of foreign vendors, the cost of third party inspection, where called for, shall be deemed to be included in the quoted price. Seller shall be responsible to provide assistance such as labour, materials, electricity, fuels, stores, apparatus, instruments at his cost, as may be required and as may be reasonably demanded to carry out such tests effectively.
D	**Undertaking to be provided by Suppliers before despatch** : The suppliers , before despatching the jobs, shall provide an undertaking on their letterhead, that the jobs have been made as per BHEL Specification / Drawings, that the test results meet the specified parameters of the drawing / specification, that the supplies have been inspected as per Quality Plan (if called for in the Purchase Order), that on receipt of supplies at BHEL, Jhansi; BHEL reserves the right to reject any supplies which are non compliant, that in case the material is accepted with deviationst wherever rectifications / rework is observed, that the Supplier shall be given seven days notice to attend to the work and if the Supplier does not attend the rectifications in the said period, BHEL shall reserve the right for suitable deductions. Despatch clearance shall be given when the Supplier provides the above undertaking (as per Annexure I) to BHEL
E	**Uploading despatch information on BHEL SIP** The supplier has to upload despatch information details by logging in at **'Supplier Information Portal'** of BHEL Jhansi website using their User name (Vendor Code) and Password. Subsequently, the supplier has to click at the link**'Update Consignment details'** provided therein.Submitting **'Despatch Intimation' is mandatory**. All supplies arriving (reaching BHEL Jhansi) will be allowed inside CISF Material gate of BHEL Jhansi only if the supplier has submitted online Despatch Intimation. The **following documents are necessary before entry of material at our Material Gate**:

1	GST Invoice **OR** Delivery Challan (as per rule 55) **OR** Bill of entry for imports **OR** Excise Duty Invoice for Petroleum supplies
2	Lorry Receipt (LR) **OR** Railway Receipt (RR) **OR** Door Delivery (Courier Docket..).
3	'Despatch Intimation' (Printout required).

The following documents are additionally required for **SRV clearance** if they are called for in the Purchase Order (PO):

4	Complete Test certificates/Inspection reports
5	Guarantee certificates
6	Any other document as called for

Following may be required for **SRV preparation** depending on the nature of material being supplied:

7	Packing lists, wherever applicable.
8	Weighment slip.

A cost of one percent of the transaction value (not more than Rs 5000 per transaction but not less than Rs 500 per transaction) shall be deducted from supplier bills in case supplier has failed to upload the despatch information on Supplier Information Portal

E Material despatched one month prior to the date of despatch shall not be permitted inside BHEL, unless there are instructions otherwise from BHEL. In all such cases, material will be allowed inside only if approved by Head MM

Material despatched 10 weeks after date of despatch shall not be permitted inside BHEL, unless there are instructions otherwise from BHEL. In all such cases, material will be allowed inside only if approved by Head MM

17 Warranty , Corresponding Repairs / Replacement of Goods, and Deductions

A

Goods shall comply with the specifications for material, workmanship and performance.

The warranty shall be for a period of 24 months from the date of receipt at BHEL, Jhansi

However, **wherever erection & commissioning also is in the scope of the bidder**, the warranty shall be for a period of 24 months from the date of supply or 18 months from the date of commissioning, whichever is later.

In case any other terms are to be specified for warranty, the same shall be specified in the specific enquiry
Normally deviation shall not be accepted for the criteria of warranty period. The offers of bidders, who offer deviation to the warranty terms mentioned in the NIT, are liable to be rejected.
If the item supplied is found non-compliant during the warranty period, leading to rejection, the Seller shall arrange free replacement / repair of goods, within one month from the date of intimation or any mutually agreed period. The rejected goods shall be taken away by the Seller at his cost and replaced on Delivered Duty Paid (DDP) (FOR - BHEL Stores/ designated destination basis) within such period. In the event of the Seller's failure to comply, Purchaser may take action as appropriate, including Repair / Replenish rejected goods & disposal of rejections, at the risk & cost of the Seller.

In case the defects attributable to Seller are detected during processing of the goods at purchaser's/ his subcontractor's works, the Seller shall be responsible for free replacement/ repair of the goods as required by the purchaser.

18 Evaluation and Loading Criteria:

Evaluation of the tender shall be on the basis of delivered cost, i.e. 'total cost to BHEL' w.r.t the finalized technical scope and commercial conditions (after considering, inter alia, Customs Duty and CENVAT/ VAT/ CST/Service Tax/Entry Tax or any other tax as applicable). Exchange rate (TT selling rate of State Bank of India) applicable on the date of Part-I bid opening shall be considered for evaluation of foreign bids. If the relevant day happens to be a bank holiday in India, then the FOREX rate as on the previous bank working day shall be taken for evaluation.

Foreign suppliers shall ensure that the benefits as applicable under Free Trade Agreement (FTA) with Government of India are disclosed in the bid & relevant documents such as Certificate of Country of Origin, issued by the appropriate authority in the country of Export, is provided by the vendor along with dispatch documents. Bids shall be evaluated with such applicable benefits. In the event of Seller failing to provide appropriate documents for Purchaser to avail disclosed

	concessional duty benefits in India, the cost incurred owing to consequent delays, detention and demurrage thereof, will be to the Seller's account. To arrive at the Delivered Cost, the quoted price shall be suitably loaded, the details of which are mentioned in this annexure / special remarks of the enquiry. In case of any additional techno commercial deviations, for which the loading criterion is required to be framed after opening of techno commercial bid, such criterial shall be communicated to all qualified bidders before price bid opening.
19	**Non-Disclosure Agreement**
	All Drawing and technical documents relating to the product or it's manufacture submitted by one party to the other, prior or subsequent to the formation of contract, shall remain property of the submitting party. Drawing, technical documents or other technical information received by one party, shall not without the consent of the other party, be used for any other purpose than that, for which they were provided. Such technical information shall not without the consent of the submitting party, otherwise be used or copied, reproduced, transmitted or communicated to a third party. Patterns supplied by BHEL will remain BHEL's property which shall be returned by the bidder on demand to BHEL. Bidder shall in no way share or use such intellectual property of BHEL to promote his own business with others. *BHEL reserves the right to claim damages from the bidder, or takeappropriate penal action as deemed fit against the bidder, for any infringement of the provisions contained herein.*
20	**RIGHT OF REJECTION /NON- PLACEMENT OF PO/ SHORTCLOSURE OF PO:** BHEL reserves the right to accept the offers in part or in full, or cancel the Tender enquiry without assigning any reason whatsoever / non placement of PO or contract / short closure of PO or contract.
21	**Performance Bank Guarantee (PBG)/ Security Deposit (SD):**
A	Bank Guarantee wherever called for, shall be in the BHEL prescribed format. In case the order is to be placed in foreign currency, the BG must normally be in Indian Currency from the Consortium Banks of BHEL / as specified in the specific Enquiry
B	Wherever the contract is for supply of Goods processed on labour basis from BHEL supplied materials, the materials shall be issued against a suitable security, preferably Bank guarantee.
22	**Benefits earmarked for Purchase from Micro & Small Enterprises (MSEs) – Indigenous Purchase**
A	MSE suppliers who are registered by bodies like MSMED, NSIC & DIC specified by Ministry of Micro, Small and Medium Enterprises (MoMSME) can avail the intended benefits only if they submit along with the offer, relevant documents including valid certificate as mentioned in " Format for Supplier MSME Status' on Supplier Information Portal of BHEL, Jhansi. In case the valid MSE registration of the bidder is already updated in SDC records of BHEL, Jhansi, it may not submit the details again. It is hence in the interest of the supplier that they validate the status of UAM regularly with BHEL, if they would like to avail intended benefits under MSME Act.
B	Tenders to MSE suppliers shall be issued free of cost & no EMD wherever called for will be insisted upon. Such MSE bidders shall submit along with bid, relevant documents including valid certificate. Date to be reckoned for determining the deemed validity will be the date of bid opening (Part I in case of two part bid). Non- submission of such document will lead to consideration of their bid, at par with other bidders. No benefit shall be applicable for this enquiry if any deficiency in the above required documents are not submitted before price bid opening. If the tender is to be submitted through e-procurement portal, then the above required documents are to be uploaded on the portal. Documents should be notarized or attested by a Gazetted Officer.
C	In tender, participating MSEs quoting price within price band of L1 (on total cost to BHEL) +15% shall also be allowed to supply a portion of requirement by bringing down their price to L1 price **in a situation where L1 price is from someone other than a MSE** and such MSE shall be allowed to supply up to 20% of total tendered quantity. In case of more than one such MSE within price band of L1 (on total cost to BHEL) +15%, the supply shall be shared proportionately (to tendered quantity, as per their tender ranking of the bidders and also their SC/ST status). However if there are more than one MSE vendor at the same price level, then the quantity shall be distributed equally. A quantum of 4% out of 20% quantity, so earmarked, will be reserved for MSE's owned by SC / ST entrepreneurs who submit their bid with relevant documents. However, such distribution shall be subject to the tender requirement in terms of Customer approval of vendors, divisibility of quantity, etc. While all efforts shall be made to ensure compliance to the stated distribution, the decision of BHEL in distribution stated in this clause shall be binding on all bidders.

	The above distribution is not applicable (a) where L1 vendor is MSE vendor and minimum 20% share is assured to the L1 bidder in the tender, or (b) where the MSE bidders qualified for distribution as per ' manner of splitting' clause in NIT already cater to 20% share in the tendered load.
D	In case it comes to notice that the bidder is found responsible for misconducts like, having submitted fake/false/forged documents/ certificates, has misrepresented the facts, has wilfully suppressed the facts, has resorted to unethical/ illegal means, etc., action shall be initiated against such bidders as per the extant guidelines of the Company for suspension of business dealings.
23	**Benefits earmarked to suppliers for Purchase under ' MAKE IN INDIA'**
	As part of minimizing import content, Government of India , vide order no P-45021/2/2017-B.E.-II dated 15.06.2017, under the subject – Public Procurement (Preference to Make in India) -- has set the initiatives to encourage and promote indigenously manufactured goods within India and services provided by sources within India. . In line with this, bidders who manufacture the goods and provide services within India (otherwise referred as local suppliers) are given purchase preference and are entitled to benefits in the tender
A	**Definitions**
(i)	**Local content** means the amount of value added in India which shall, unless otherwise prescribed by the Nodal Ministry, be the total value of item procured (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value , in percent . Presently, the minimum local content required is 50%. The nodal ministry may prescribe a higher or lower percentage in respect of any particular item and may also prescribe the manner of calculation of local content.
(ii)	**Local supplier** means a supplier or service provider whose product or service offered for procurement meets the minimum local content as prescribed
(iii)	Margin of Purchase Preference means the maximum extent to which the price quoted by a local supplier may be above the L1 for the purpose of purchase preference. Presently the margin of Purchase preference is 20%.
B	**Conditions under which preference is given**
(i)	In procurement of goods in respect of which the Nodal ministry has communicated that there is sufficient local capacity and local competition, and where the estimated value of procurement is Rs 50 lakhs or less, only local suppliers shall be eligible. If the estimated value of procurement of such goods is more that Rs 50 lakhs, provisions of 23(B) (ii) and 23(B)(iii) shall apply.
(ii)	If the procurement of goods are not covered by 23(B)(i) and are divisible in nature, the following procedure shall be followed :
a	If L1 is a local supplier, the order for full quantity shall be awarded to local supplier
b	If L1 bid is not from a local supplier, 50% of the order quantity shall be awarded to L1. Thereafter, the lowest bidder among the local suppliers, shall be invited to match the L1 price for the remaining 50% quantity , subject to the local supplier's quoted price falling within the margin of purchase preference, and the order for that quantity shall be awarded to such local supplier subject to matching the L1 price. In case such lowest eligible local supplier fails to match the L1 price or accepts less than offered quantity, the next higher local supplier within the margin of purchase preference shall be invited to match the L1 price for remaining quantity and so on, and the order shall be awarded accordingly. In case some quantity is still left uncovered on local suppliers, then such balance quantity may also be ordered on the L1 bidder.
iii	If the procurement of goods are not covered by 23(B)(ii) and are not divisible in nature, and in procurement of services where the bid is evaluated on the price alone, the following procedure shall be followed :
a	If L1 is a local supplier, the order shall be awarded to local supplier
b	If L1 bid is not from a local supplier, then the lowest bidder among the local suppliers, will be invited to match the L1 price, subject to the local supplier's quoted price falling within the margin of purchase preference, and the order shall be awarded to such local supplier subject to matching the L1 price. In case such lowest eligible local supplier fails to match the L1 price, the local supplier with the next higher bid within the margin of purchase preference shall be invited to match the L1 price and so on, and the order shall be awarded accordingly. In case none of the local suppliers within the margin of preference match the L1 price, then the order may be awarded to the L1 bidder.
C	**Exemption of small purchases**
	Notwithstanding anything contained at clause 23B above, procurements where the estimated value of procurement is less than Rs 5 lakhs are exempt and purchase preference shall not be accorded in such cases.

D	**Verification of local content**
(i)	The local supplier, at the time of tender, bidding or solicitation, shall be required to provide self certification that the item offered meets the minimum local content and shall give details of the location(s) at which the local value addition is made.
(ii)	In cases of procurement for a value in excess of Rs 10 crores, the local supplier shall be required to provide a certificate from the statutory auditor or cost auditor of the company (in case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content.
(iii)	False declarations shall be in breach of code of integrity and shall invite action as per guidelines for Suspension of Business dealings with Suppliers
E	In case of any disputes / clarifications, the extant guidelines of Government of India shall prevail.
24	**Fraud Prevention**
	The Bidder along with its associate/ collaborators/ sub-contractors/ sub-vendors/ consultants/ service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website http://www.bhel.com and shall immediately bring to the notice of BHEL Management about any fraud or suspected fraud as soon as it comes to their notice
25	**Settlement of Disputes & Arbitration**
A	All questions/interpretations regarding subject matter of the Contract shall be decided by the Purchaser on the request of the Seller and the decision of the Purchaser shall be final.
B	In case of dispute, steps shall be taken by the parties to the contract to settle the same through negotiations.
C	In case, dispute is not settled in negotiations, it shall be referred to Conciliator appointed by the competent authority of the Purchaser.
D	In case dispute is not settled in conciliation proceedings, the same shall be referred to Arbitration as per Corporate Guidelines of the Purchaser and the arbitration proceeding shall be conducted as per provisions of the Arbitration and Conciliation Act, 1996 read with Corporate guideline as amended from time to time.
E	The Seller shall continue to perform the contract, pending settlement of dispute(s).
26	**Applicable Laws and Jurisdiction of Courts**
	Indian laws both substantive and procedural, for the time being in force, including modifications thereto, shall govern the Contract including Arbitration proceedings. The competent Courts at Jhansi in the State of Uttar Pradesh, India shall have sole jurisdiction.
27	**Conciliation**
	BHEL and bidder agree that if at any time (whether before, during or after the arbitral or judicial proceedings), any Disputes (which term shall mean and include any dispute, difference, question or disagreement arising in connection with construction, meaning, operation, effect, interpretation or breach of the terms and conditions of order, which the Parties are unable to settle mutually), arise inter-se the Parties, the same may, be referred by either party to Conciliation to be conducted through Independent Experts Committee to be appointed by competent authority of BHEL from the BHEL Panel of Conciliators. **Notes:** **1.** No serving or a retired employee of BHEL/Administrative Ministry of BHEL shall be included in the BHEL Panel of Conciliators. **2.** Any other person(s) can be appointed as Conciliator(s) who is/are mutually agreeable to both the parties from outside the BHEL Panel of Conciliators. The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof. The details of Conciliations shall be governed by the BHEL Conciliation scheme 2018.
28	**General**
	The Bidder shall keep a track of any changes by visiting the Supplier Information Portal of BHEL, Jhansi at https://www.bheljhs.co.in/apps/sip/index.php