



An ISO 9001 Company

Permawood is a non-impregnated improved wood laminate using Beech Veneers developed especially for transformer construction for 400 kV and above. Material conforms to IEC-61061; it is supplied in various densities to suit the application. Its grain arrangement can be varied to develop its high mechanical strength directionally and it has good dimensional stability and dielectric properties. The superior qualities of Permawood allow highly economical solutions to many transformer design problems.

Colour	Natural	
Sheet Size	2400 X 1200MM	For Type 4
	1700 X 900MM	
	2400 X 210 X MM	For Type 5
	1700 X 210MM	
Thickness	2500 x 1300MM	For Type 6
	2400 X 1200MM	
	1700 X 900MM	
Thickness	10 - 100MM	Type 4
	6 - 50MM	Type 5
	6 to 120MM	Type 6

## Applications

**Type 4:** Material has veneers to the extent of 80 to 90 % with parallel grain in direction of the axis of load and balance veneer are placed across the grain direction; recommended for application as mentioned in type-5 but especially suitable where the holes are made for taking load in the direction of the axis.

**Type 5:** Material with all parallel grain in direction of axis of load, recommended for cleat bars, tie rods, cylinder, spacer, sticks, wedges, key-strip and parts predominantly stressed in tension or bending etc.

**Type 6:** Material with equal proportion of grain parallel to each axis; recommended for panels, blocks, platforms, clamping rings, parts under heavy compression load etc. solutions to many transformer design problems.

\*Test applicable for 'A' direction only

Type Test - # (Once in 2 years), ## (Once in 3 years)

NOTE 1:

We have conducted additional tests to provide detailed information on the product, which are not covered under IEC-61061.

They are namely:-

- I. Partial Discharge
- II. Thermal Conductivity
- III. Dissipation Factor
- IV. Dielectric Constant

NOTE 2:

i. Test values given indicate general characteristics of material but no liability should be assumed or implied while considering the stated values. Values stated above in table are on standard data L-90 basis.

ii. Dimensions/Size/Thickness, etc. can be varied to suit specific requirements.

iii. All the above properties are dependent on actual density of the product whereas the properties indicated are based on central value of apparent density. If the density is increased to the limiting value, the mechanical values will be improved by about 10 to 15 %, without affecting the electrical properties.

iv. In case, the test specimen has an equal proportion of veneers in both the directions, the lower limiting values of flexural strength indicated will increase by 10 to 15%.

	Properties	Test Method IEC 61061-2 Subclause	Unit	Values		
				Grade		
				MD LV Type 4	MD LV Type 5	MD LV Type 6
PHYSICAL PROPERTIES	Apparent Density	9.1	G/cm <sup>3</sup>	1.1-1.2	1.1-1.2	1.1-1.2
	Oil Absorption	9.5	% Min.	7	8	10
	Moisture Content	9.3	% Max.	6	6	6
	Shrinkage after drying					
	Direction 'A'	9.4	% Max.	0.3	0.3	0.3
	Direction 'B'	9.4	% Max.	0.3	0.5	0.3
	Thickness	9.4	% Max.	3.0	3.0	3.0
	Contamination of liquid dielectrics (Type Test #)	9.7	Max.	0.1	0.1	0.1
	Operating temp. continuous	DIN 7707	°C	105	105	105
	Metal Detector Test	-	--	No metallic particle detected		
MECHANICAL PROPERTIES	Flexural Strength - A Direction	6.1	MPa (Min.)	150*	160*	105
	Flexural Strength – B Direction	6.1	MPa (Min.)	--	--	92
	Apparent Modulus of Elasticity in Flexure, Perpendicular to the lamina (Type Test #)	6.2	GPa (Min.)	10*	12*	8.5*
	Compressive Strength Flat wise (Proof)	6.4	MPa	105	35	180
	Compressive Strength End wise (Proof)	DIN 53454	MPa	--	--	70
	Compressibility					
	Perpendicular to the lamina					
	C	6.4	% Max.	2.8	3	3
	C <sub>rev</sub> (Type Test #)	6.4	% Min.	65	70	70
	Impact Strength-A Direction (Type Test #)	6.5	KJ/m <sup>2</sup>	30*	35*	20
Impact Strength-B direction (Type Test #)	6.5	KJ/m <sup>2</sup>	--	--	22	
Shearing Strength for glue line bond	6.6	MPa (min.)	8	8	8	
ELECTRICAL PROPERTIES	Electrical Strength, perpendicular to the laminations on 3mm thk. sample	7.1	kV/mm (Min.)	11	11	11
	Breakdown Voltage, parallel to the laminations	7.1	kV (Min.)	50	50	50
	Partial Discharge at 5.1 kv/mm (Type Test ##)	IEC 60270	pc	< 1		
	Thermal Conductivity (Type Test ##)	Lee Disk	w/m.k	0.20 (Typical value)		
	Dielectric Constant at 500V/50Hz/25°C (Type Test ##)	ASTM D150- 92	-	3.5 (Typical value)		
	Dissipation Factor at 500V/50Hz/25°C (Type Test ##)	ASTM D 150- 92	-	0.009 (Typical value)		