



CK Composites, Inc.

Wood laminates data sheet

A WORLD OF PRODUCTS FOR INDUSTRY

High-Strength Phenolic Laminate

Combines the dielectric properties and stability of thermosetting resins with the strength and toughness of wood fibers.

Insulam is a long-established, high-voltage insulating material widely used in the electrical industry because of its dielectric properties, high tensile strength and excellent machinability. To designers of electrical equipment, Insulam wood-base laminates add structure and critical alignment.



Insulam EH High-Strength Phenolic Laminate

Fabrication and Quality Control

Insulam EH is made of selected beechwood veneers, impregnated under vacuum with synthetic resins and densified under heat and pressure. The result is a uniform material that combines the dielectric properties and excellent stability of the most advanced thermosetting resins with the great strength and toughness of wood fibers.

In a continuing pursuit of excellence, all Insulam EH is processed under strict controls that include daily tests and constant checks on processing operations. The electrical, mechanical and physical properties detailed on page 4 are averaged from tests conducted on production-run materials over a period of four decades.

Advantages

Insulam EH is generally less expensive than NEMA-grade canvas-base phenolic laminates. It is superior mechanically and equal electrically.

Insulam EH costs only about 40% as much as NEMA-grade glass laminates, is easier to machine and normally costs 50% less to fabricate.

Insulam EH can be fabricated to put strength where needed. By varying the arrangement of the wood veneers, and thereby the collective disposition of their grain structure, Insulam can develop mechanical strength in any required direction, to suit a specific application.

Insulam EH has a higher modulus of elasticity than other phenolic laminates. Designers and fabricators of large insulating structures can therefore use reduced cross-sections, or can provide greater rigidity with the same cross-sections.

Properties

While Insulam EH structural dielectric material is preferred by manufacturers of high voltage electrical equipment, other manufacturers have benefited from its engineered properties in their products.

Dielectric Strength—Excellent dielectric ratings are obtained in all lamination orientations. Under ASTM D-229 at 60 Hz, Insulam EH is rated at 4.5.

Completely Non-Magnetic—Naval Ordnance Laboratory tests indicate magnetic permeability less than 1.004. In another test, after being subjected to a 1.4 kilogauss field, a Insulam EH sample recorded a residual field of less than .01 gamma on a Varian Assoc. Rubidium Vapor Magnetometer. Motion in the magnetic field of a coil wrapped on a Insulam EH frame will not produce eddy currents.

Strength/Weight Ratio Equal to High-Tensile Steel—With a specific gravity of 1.3, Insulam EH has a tensile strength of 28,000 psi.

Dimensionally Stable—Because Insulam EH is fully resin-impregnated and densified, water absorption is low and dimensional stability is good.

Resists Abrasion—Insulam EH is used for cams, gears, wear strips, etc. because its rate of wear is lower than that of many metals.

Resists Heat and Weather—Suitable for prolonged use in all climates and weather, continuously at 105°C and intermittently to 150°C.

Resists Many Chemicals—Unaffected by continuous immersion in oils and fats. Resists attack of mild acids and alkalis.

Can be Used in Cryogenic Applications—Insulam EH retains approximately 80% of mechanical strength at -192°C (-314°F). Its compressive strength (perpendicular to the face) actually doubles at cryogenic temperatures.

Highly Efficient Structural Material For Neutron Shielding—Can be fabricated to close tolerances and operated at relatively high temperatures without deformation or loss of shielding properties.

Types of Insulam EH

Six symbols completely describe any type of Insulam EH, as follows:

Grade	E for most applications
Species of wood	H is Beech
Type	Laminar orientation (see p. 3)
Veneer thickness	5 is $\frac{1}{16}$ " (1.5 mm) 7 is $\frac{1}{8}$ " (2.5 mm)
P	Surface as pressed
M	Surface machined for closer tolerances
Surface finish	—Unvarnished 0 Edges varnished (special cases only) 1 Transformer oil finish (threaded parts) 4 Standard air drying electrical varnish. Excellent anti-tracking properties
Example:	EH65P4 Electrical grade Insulam made from cross laminated beech veneers, 1/16" (1.55 mm) thick, press finish, with standard electrical varnish coating.

APPLICATIONS

Lift rods, lift rod guides and splitter plates of high voltage circuit breakers all made of Type 5, splitter plates of Type 6.

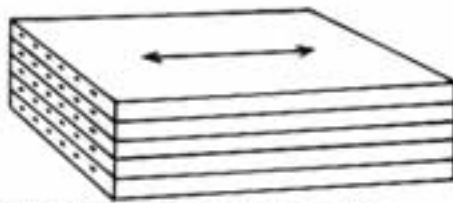
Transformer coil clamp ring using Type 6.

Tuning coil for very low frequency radio transmitter.

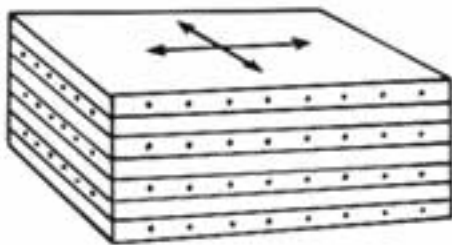
Large test generator with end coil supports.



General Application



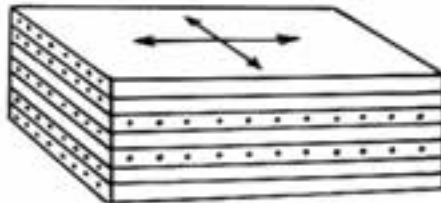
TYPE 5—Uni-directional laminae
For components stressed in tension, flexure or torsion
Lengths to 156"
Widths to 10"
Thickness Type 55 $\frac{3}{16}$ " to $\frac{1}{2}$ "
Type 57 $\frac{1}{2}$ " to 3"



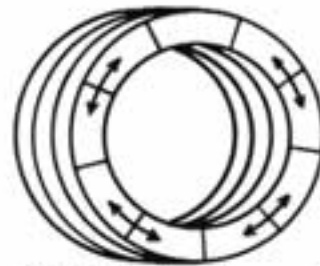
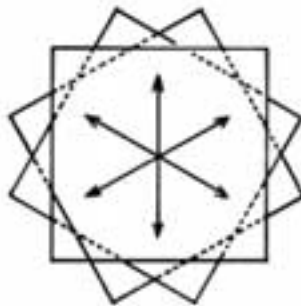
TYPE 6—Cross laminated
For panels and components in compression or for parts stressed in more than one direction
Sizes to suit most applications
Thickness Type 65 $\frac{3}{16}$ " to 1"
Type 67 $\frac{1}{2}$ " to 6"

Special Application

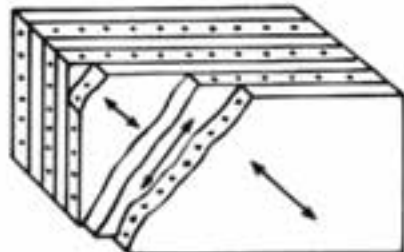
TYPE 2—25% Cross laminated
For tensile applications requiring higher shear strength along the major axis
Lengths to 170"
Widths to 20"
Thickness Type 25 $\frac{3}{8}$ " to $\frac{1}{2}$ "
Type 27 $\frac{1}{2}$ " to 4"



TYPE 3—Radially disposed laminae
For making silent gears. This arrangement achieves uniform tooth strength.
Maximum diameter: 18"
Thickness Type 35 $\frac{3}{8}$ " to 1"
Type 37 1" to 4"

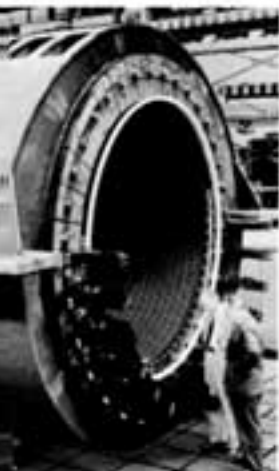


TYPE 7—Laminae tangential to periphery
For non-impregnated transformer clamping rings
Minimum I.D.—12"
Maximum O.D.—110"
Minimum Radial Wall—1 $\frac{1}{2}$ "
Maximum Radial Wall—14"
Ratio of Wall to Thickness—12:1
Maximum
Thickness— $\frac{3}{4}$ " to 2 $\frac{1}{2}$ "



TYPE 8—Laminae 45° to major axis
For increasing the electrical strength of components along the major axis where mechanical requirements are not critical
Sizes restricted
Thickness Type 85 $\frac{1}{2}$ " to 1"
Type 87 1" to 3"

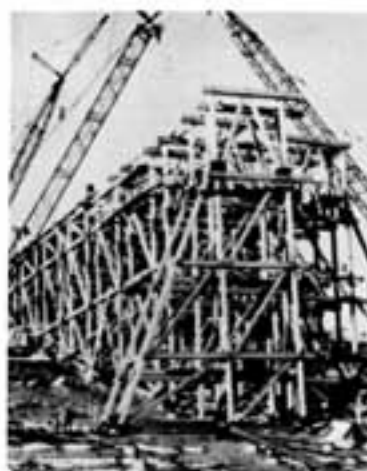
Type 6 Insulam EH



Large power transformer showing Insulam EH lead supports and pressure rings.



The "Trestle"—Electromagnetic Pulse Simulator Platform.



Blocks of Insulam EH help to keep things cool at new LNG Terminal.



Mechanical Properties

	TYPE 5	TYPE 6
Tensile Strength, psi, Lengthwise (ASTM D-638)	28,000	15,000
Compressive Strength, psi (ASTM D-695)		
Perpendicular to laminations	17,000	30,000
Parallel to laminations and grain	17,000	22,000
Flexural Strength, psi (flatwise) (ASTM D-790)		
Lengthwise	32,500	18,000
Crosswise	—	15,000
Shear Strength, psi		
Parallel to grain and laminations	3,500	3,500
Perpendicular to laminations parallel to grain	4,800	7,200
Perpendicular to grain and laminations	9,500	7,200
Bonding Strength, lbs., Cond. A Impact Strength, Izod, ft lb/in of notch (ASTM D-256)	1,500	1,400
Perpendicular to face, lengthwise	5.4	3.4
Perpendicular to edge, lengthwise	5.0	1.6
Modulus of Elasticity, psi (ASTM D-790)	2.5x10 ⁶	2.0x10 ⁶

Physical Properties

Water Absorption—%—24 hr (ASTM D-570)	
Thickness ½"	1.00
Thickness 1"	0.75
Intermittent operating temperature	150°C (302°F)
Continuous operating temperatures	
In Oil	105°C (221°F)
In Air	105°C (221°F)
Specific Gravity (ASTM D-792)	1.30
Hardness (Rockwell H Scale) (ASTM D-735)	90-100
Specific Heat	0.4
Coefficient of thermal expansion—celsius units (ASTM D-696)	
Type 5 Lengthwise	8 x 10 ⁻⁶
Crosswise	69 x 10 ⁻⁶
Perpendicular to laminations	113 x 10 ⁻⁶
Type 6 Parallel to laminations	15 x 10 ⁻⁶
Perpendicular to laminations	113 x 10 ⁻⁶
Thermal Conductivity—cal/cm/°C/sec (ASTM C-177)	
in plane of laminations—lengthwise	5.6 x 10 ⁻⁴
in plane of laminations—crosswise	3.6 x 10 ⁻⁴
perpendicular to laminations	3.4 x 10 ⁻⁴

Electrical Properties

Dielectric Strength (step-by-step @ 25°C—ASTM D-229)			
Perpendicular to laminations V/M (kV)	½"	360 (45)	
	¼"	250 (63)	
	½"	175 (88)	
Parallel to laminations V/M (kV)		87 (65)	
Power Factor—%—60 Hz (ASTM D-229)		1.9	
	10 ³ Hz	3.0	
	10 ⁶ Hz	5.0	
Dielectric Constant—60 Hz (ASTM D-229)		4.5	
Specific Resistance—ohms/cm ³ (ASTM D-257)		2 x 10 ¹²	
IMPULSE STRENGTH— Typical Values for Flashover in Air, 1.2 x 50 Wave Form			
Distance Between Electrodes	Negative Wave	Positive Wave	
12"	210 kV	150 kV	
24"	435 kV	380 kV	
36"	620 kV	560 kV	
All data are based on applicable NEMA/ASTM test standards			

Technical Help

Customers can rely on technical and economic advantages when using the design and fabrication services of C-K Composites. Our design and development engineers are prepared to offer maximum technical assistance in translating customer ideas and needs into practical, efficient Insulam

EH components. They recommend the exact materials for new applications and, by supervising fabrication, make sure that customer components and assemblies are completed on time and according to specifications.