

EPOXY GLASS PHENOLICS

Glass cloth impregnated with synthetic thermosetting resins. When heat and pressure are applied to the layers, a chemical reaction (polymerization) transforms the separate layers into a single laminated material with a "set" shape that cannot be softened again -- therefore, these materials are called "Thermosets". A variety of resin types and cloth materials can be used to manufacture thermoset laminates with a range of mechanical, thermal, and electrical properties.

GENERAL PROPERTIES

Physical strength, resiliency, ease and versatility of fabrication, and excellent electrical properties make Phenolic Laminates useful as support components in a wide range of mechanical and electrical applications. Phenolic Laminates are strong, stiff, and have high impact and compressive strengths. And, they do not soften upon re-heating, so they are easy to saw, drill, tap, and machine with ordinary tools. "FR" grades are flame retardant. Glass-based grades have the highest dimensional stability and mechanical strength, as well as low moisture absorption. However, they are not as easily machined as paper or cotton fabric laminates.

GLASS-BASED PHENOLIC GRADES -- G-10 and G-11 (Glass Cloth / Epoxy Resin)

These glass-epoxy laminates are specified for their extremely high strength and high dimensional stability over temperature. G-10 and G-11 are used for high humidity applications, electrical and electronic test equipment and electric rotor insulation. G-10 is slightly stronger while G-11 is a better insulator and can take higher temperatures. FR-4 is a fire-retardant G-10 glass-epoxy laminate that is used primarily in the printed circuit board industry.

TYPICAL PROPERTIES of GLASS LAMINATES (SHEET FORM)

(mechanical properties of rod and tube forms may differ)

ASTM or UL test	Property	G-3	G-5/G-9	G-7	G-10	G-11
PHYSICAL						
D792	Density (lb/in ³)	0.065	0.067	0.065	0.065	0.065
	(g/cm ³)	1.8	1.85	1.8	1.8	1.8
D570	Water Absorption, 24 hrs (%)	2.65	0.6	0.1	0.1	0.2
MECHANICAL						
D638	Tensile Strength (psi)					
	-lengthwise	42,000	61,600	20,000	45,000	43,000
	-crosswise	34,000	51,100	-	38,000	37,000
D790	Flexural Strength (psi)					
	-lengthwise	40,500	61,600	30,000	75,000	80,000
	-crosswise	34,000	51,100	-	65,000	70,000
D790	Flexural Modulus (Kpsi)					
	-lengthwise	1,800	2,000	1,600	2,700	3,000
	-crosswise	1,400	1,700	-	2,400	2,700
D256	lb/in)					
	-lengthwise	12.0	12.5	13.0	14.0	12.0
	-crosswise	11.0	8.5	-	12.0	9.0
D695	Compressive Strength (psi)	55,000	65,000	50,000	65,000	63,000
D785	Hardness, Rockwell M	M110	M115	M105	M110	M112
THERMAL						
D696	Expansion	0.83	0.83	0.72	0.55	0.72
	(x 10 ⁻⁵ in./in./°F)	1.00	1.00	0.90	0.66	0.83
	-lengthwise					
	-crosswise					
-	°C)	340 / 170	285 / 140	430 / 220	284 / 140	329 / 165
C177	Thermal Conductivity					
	(BTU-in/ft ² -hr-°F)	2.0	2.0	2.0	2.0	2.0
	(x 10 ⁻⁴ cal/cm-sec-°C)	7.0	7.0	7.0	7.0	7.0
UL94	Flammability Rating	H-B	V-0	H-B	H-B	H-B
ELECTRICAL						
D149	short time, 1/8" thick	460	300	350	800	900
D150	Dielectric Constant at 1 MHz	7.3	6.3	4.5	5.0	4.5
D150	Dissipation Factor at 1 MHz	0.023	0.019	0.018	0.019	0.020
D495	Arc Resistance (sec)	180	180	240	100	120

NOTE: The information contained herein are typical values intended for reference and comparison purposes only. They should NOT be used as a basis for design specifications or quality control. Contact us for manufacturers' complete material property datasheets.

All values at 73°F (23°C) unless otherwise noted.