

CLOTH / PAPER PHENOLIC LAMINATED SHEETS & ROD



DESCRIPTION : This are Paper Based Laminates suitable for fixture parts and machining, under high humid appication These laminates have good electrical properties. And moisture resistance low cold flow with good dimensional stability

GLASS EPOXY LAMINATED SHEET & ROD



G10 & FR 4 Applications

- Appliance Lines
- Bearings
- Computer Electronics
- Electron Lines
- Electronic Boards
- Gaskets
- Gears
- Industrial Laminates
- Industrial Electronics
- Machine Components
- Mechanical Lines
- Wave Soldering Pallet
- Switches
- Terminal Boards
- Thick Parts
- Transformers
- Washers
- Wear Strips

NEMA Grade	X	X	XP	XX	C	XXX	FR-1	C	C	CE	L	LE	—	—	G-3	G-5	G-7	G-9	G-10	G-11	FR-4	
Grade Designation	X-116	XN-152	XP-240	XX-324	C-590	XXX-409	X-123FR	C-592	C-501	CE-578	L-610	LE-675	CEF-586	PAR-785	G-3-810	G-5-813	G-7-838	G-9-818	EG-864	G-11-861	EG-873	
Mechanical (Typical Values)																						
Density, GM/CC	1.35	1.39	1.33	1.34	1.34	1.30	1.39	1.34	1.35	1.32	1.34	1.32	1.32	1.40	1.88	1.90	1.85	1.95	1.85	1.85	1.95	
Specific Volume, CUIN/LB	20.5	20.0	20.8	20.6	20.6	21.3	20.7	20.6	20.5	21.0	20.6	21.0	21.0	20.0	14.8	14.6	15.0	14.3	15.0	15.0	14.3	
Lbs. per Sq. Ft., 1/8" Thick	.87	.91	.86	.87	.87	.84	.91	.87	.88	.86	.87	.86	.86	.91	1.22	1.23	1.20	1.26	1.20	1.20	1.26	
Tensile Strength, PSI, Lengthwise	20,000	18,000	11,000	16,000	12,000	15,000	18,000	12,000	11,200	12,000	14,000	13,500	14,000	19,000	38,000	37,000	23,000	41,000	48,000	48,000	48,000	
Tensile Strength, PSI, Crosswise	16,000	14,000	8,500	13,000	9,000	12,000	14,000	9,000	9,500	9,000	10,000	9,500	10,000	18,000	32,000	30,000	19,000	32,000	44,000	44,000	44,000	
Comprehensive Strength, PSI, Flatwise	36,000	31,000	20,000	34,000	35,000	32,000	30,000	40,000	37,000	39,000	35,000	37,000	35,000	55,000	60,000	70,000	43,000	70,000	60,000	75,000	60,000	
Flexural Strength, PSI, Lengthwise	28,000	23,700	18,000	18,000	20,000	18,000	25,000	20,000	22,000	22,000	23,000	18,000	20,000	27,000	61,000	65,000	25,000	82,000	72,000	70,000	79,000	
Flexural Strength, PSI, Crosswise	23,000	17,000	15,000	14,000	19,000	14,000	23,000	25,000	18,000	17,000	18,000	15,000	19,000	26,000	59,000	50,000	22,000	58,000	63,800	62,000	65,000	
Modulus of Elasticity in Flexure x 10 ⁵																						
Lengthwise	18	14	9	14	10	13	14	10	10	9	11	10	11	12	17	17	9	16	15	17	15	
Crosswise	13	11	7	11	9	10	11	9	9	8	8	8	9	10	15	15	8	13	12	15	12	
Impact Strength, IZOD Edgewise																						
ft lbs./in notch, Lengthwise	0.9	0.6	1.1	0.5	2.3	0.5	0.9	2.5	2.3	1.6	1.3	1.3	1.8	11	20	12	15	16	14	13	12	
Crosswise	0.7	0.5	0.9	0.5	2.2	0.5	0.8	2.3	2.2	1.4	1.2	1.2	1.8	9	15	9	12	9	11	10	8	
Rockwell Hardness, M Scale	110	101	81	105	105	110	100	105	103	105	105	105	105	105	100	120	100	120	109	110	110	
Bond Strength, lbs.	900	950	—	1,100	2,000	1,200	—	2,000	2,000	2,200	1,700	1,800	2,200	2,000	1,800	1,700	800	2,000	2,500	2,100	2,300	
Electrical (Typical Values)																						
Dielectric strength — Perpendicular to laminations short time, volts/mil, 1/16" 1/8"	700	—	800	700	—	700	600	—	—	500	—	500	500	—	—	600	300	695	810	710	670	
	500	—	500	500	—	500	400	—	—	360	—	360	360	—	—	500	250	550	570	530	525	
Dielectric strength — Parallel to laminations kilovolts, step by step 1/8" cond. A	50	33	60	50	45	65	60	—	—	45	—	50	50	—	—	35	60	87	55	43	60	
Cond. D 48/50	5	5	11	10	25	15	—	—	—	5	—	6	6	—	—	12	50	78	60	45	50	
Dissipation Factor; 10 ⁶ cycles — condition A	.045	.058	—	.040	—	.034	.058	—	—	.055	—	.048	.055	—	—	0.16	.001	.012	.012	.015	.015	
Cond. D 24/23	.05	.068	—	.046	—	.038	.068	—	—	.070	—	.058	.070	—	—	.03	.009	.012	.013	.015	.016	
Dielectric Constant, 10 ⁶ cycles — condition A	6.0	6.0	—	5.3	—	4.7	6.0	—	—	5.3	—	5.3	5.3	—	—	6.8	3.70	6.5	4.8	4.9	4.8	
Insulation Resistance, Megohms, Cond. C96/35/90	—	—	—	60	—	1,000	—	—	—	—	—	30	30	—	100,000	10,000	200,000	10,000	100,000	100,000	100,000	
Arc Resistance, seconds	—	—	—	—	—	—	—	—	—	—	—	—	—	—	130	190	220	190	100	127	120	
Physical (Typical Values)																						
Thermal Conductivity, CAL/SEC/CM ² /°C/CM	7.0 x 10 ⁻⁴													—	—	12.0x10 ⁻⁴	7.0x10 ⁻⁴	12.0x10 ⁻⁴	7.0 x 10 ⁻⁴			
Specific Heat CAL/GM/°C	.35 to 0.40													—	—	.026	0.25	0.26	.35 to 0.40			
Heat Resistance °F, Short Time	275	250	275	300	320	300	250	320	275	300	275	300	300	500	500	425	500	425	350	400	350	
Continuous	250	200	250	250	300	250	200	300	225	250	225	250	250	350	400	300	400	300	250	300	250	
Thermal Expansion in/in/°F x 10 ⁻⁵																						
Lengthwise	1.1	0.7	0.8	0.9	1.0	0.9	0.7	1.0	1.0	1.0	.8	1.0	1.0	0.5	0.8	0.6	—	0.6	0.8	0.9	0.9	
Crosswise	1.4	1.2	1.2	1.3	1.2	1.3	1.2	1.2	1.2	1.2	1.0	1.4	1.1	0.5	0.6	0.6	—	0.6	0.6	0.7	0.7	
Water Absorptuib % 24 hours 1/16"	4.0	1.7	3.6	1.3	1.2	0.8	4.0	1.2	2.7	1.3	2.0	1.3	1.3	4.0	0.3	1.0	.10	.28	.09	.15	.10	
1/8"	2.3	1.0	2.2	0.9	0.8	0.5	2.3	0.8	1.6	0.9	1.4	0.8	0.9	2.8	0.2	1.0	.10	.28	.09	.15	.10	
1/2"	0.9	0.8	—	0.5	0.5	0.3	—	0.5	1.0	0.5	0.8	0.5	0.5	1.5	0.1	0.4	.05	.10	.03	.05	.03	