

# Phenolics

## DESCRIPTIONS

### Paper Phenolic Grades X, XX, XXX

Paper based phenolic have high tensile, flexural and compression strength. Good electrical insulation in dry or humid conditions. Often used for washers, spacers and punched parts for electrical equipment.

### Linen Phenolic Grades L, LE

Because of its fine weave, linen grade is good for machined parts requiring many operations and good finish. LE has lower moisture pick up, excellent electrical properties and low dissipation factor. Used in relay bases, terminal boards and radio parts.

### Canvas Phenolic Grades C, CE

Canvas based phenolic have good mechanical properties with especially high impact strength. Low-voltage, low-frequency electrical performance. Good mechanical performance in moderately humid conditions. Often used in switchboard panels, gears and pinions.

### Glass Epoxy Grades G-10/FR 4, G-11

Glass epoxy grades have very low moisture absorption, excellent electrical insulating capability and great dimensional stability. Extremely high mechanical strength and good dielectric loss properties in wet or dry conditions. G-11 has similar qualities with the addition of a higher operating temperature. Used for terminal boards or sealing applications.

### Glass Silicone Grade G-7

Glass silicone laminates exhibit excellent heat and arc resistance. Good dielectric loss properties under dry conditions and good electrical properties under humid conditions. Not as strong as epoxy grades. Used in high temperature electronic applications requiring low electrical losses.

### Glass Melamine Grade G-9

Melamine resin is the hardest, most rigid and abrasion resistant laminate material. Exhibits good dimensional stability and arc resistance. Used in wet conditions where good mechanical properties are needed.

**TYPICAL PROPERTY VALUES**

Properties	Condi- tions/Units	Paper Phenolic XX	Paper Phenolic XXX	Canvas Phenolic C	Canvas Phenolic CE	Linen Phenolic L	Linen Phenolic LE	Glass Melamine G-9	Glass Epoxy G-10/FR4	Glass Epoxy G-11	Glass Silicone G-7
Specific Gravity		1.35	1.38	1.35	1.37	1.34	1.34	1.85	1.85	1.82	1.78
Tensile Strength	PSI	17,000	13,000	11,200	10,000	14,000	13,000	39,000	38,000	37,000	18,000
Compressive Strength	PSI	35,000	35,000	37,000	36,000	35,000	36,000	70,000	66,000	63,000	45,000
Flexural Strength	PSI	34,000	22,000	22,000	17,000	23,000	18,000	55,000	60,000	75,000	25,000
Hardness	M Scale	120	101	103	100	105	100	115	115	112	105
Bond Strength	PSI	1,500	1,200	2,000	1,900	1,700	1,900	1,900	2,300	2,200	900
Shear Strength	PSI	11,500	12,800	14,000	14,000	13,500	13,500	18,000	21,500	22,000	17,000
Dissipation Factor	10 <sup>6</sup> cycles	0.040	0.035		0.048		0.065	0.015	0.032	0.020	0.003
Dielectric Constant	10 <sup>6</sup> cycles	5.30	5.10		5.50		5.70	7.00	4.80	5.00	4.20
Electric Strength	V/mil	750	700		550		625	450	800	900	400
Flammability Rating		94HB	94HB	94HB	94HB	94HB	94HB	94V-O	94V-O	94HB	94V-O
Max. Operating Temp.	°C	140	140	125	125	125	125	140	140	180	220
Thermal Expansion (CLTE)	in/in/°C x 10 <sup>5</sup>	1.20	1.50	1.10	2.00	1.04	1.80	1.50	1.00	1.10	1.00
Water Absorption	% - 24 hrs	2.00	0.57	1.60	2.00	1.40	1.90	0.60	0.10	0.20	0.20
Military/Fed Spec	MIL-H-	24768/11	24768/10	24768/16	24768/14	24768/15	24768/13	24768/1	24768/27	24768/3	24768/17
Military/Fed Spec	PBG	PBE	FBM	FBG	FBI	FBG	GME	GEE-F	GEB	GSG	

- The data stated above are typical values intended for reference and comparison purposes only.
- The data should not be used as a basis for design specifications or quality control.
- The information is provided as a guide to the best of our knowledge and given without obligation or liability.
- Testing under individual application circumstances is recommended