

# PHENOLICS

## DESCRIPTIONS

### **Paper Phenolic Grades X, XX, XXX, XXP**

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.

### **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 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.

### **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.

### **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 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                  | Condition/<br>Units                 | Paper<br>Phenolic<br>XX | Paper<br>Phenolic<br>XXX | Canvas<br>Phenolic<br>C | Canvas<br>Phenolic<br>CE | Linen<br>Phenolic<br>L | Linen<br>Phenolic<br>LE | Glass<br>Melamine<br>G-9 | Glass<br>Epoxy<br>G-10/FR4 | Glass<br>Epoxy<br>G-11 | Glass<br>Silicone<br>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<br>Condition | 0.040                   | 0.035                    |                         | 0.048                    |                        | 0.065                   | 0.015                    | 0.032                      | 0.020                  | 0.003                    |
| Dielectric Constant         | 10 <sup>6</sup> cycles<br>Condition | 5.30                    | 5.10                     |                         | 5.50                     |                        | 5.70                    | 7.00                     | 4.80                       | 5.00                   | 4.20                     |
| Electric Strength           | V/mil<br>Condition                  | 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<br>(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-I-                              | 24768/11                | 24768/10                 | 24768/16                | 24768/14                 | 24768/15               | 24768/13                | 24768/1                  | 24768/27                   | 24768/3                | 24768/17                 |
| Military/Fed Type           |                                     | PBC                     | PBE                      | FBM                     | FBG                      | FBI                    | FBG                     | GME                      | GEE-F                      | GEB                    | GSC                      |

\*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.

