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## THERMOSETS MATERIALS

|                  |                      |   | G10, FR4          | G5, G9           | G7                           | X                               | XX                              | XXX            | C, CE          | L, LE          | Composite Bearing Grade TL | Composite Bearing Grade TX | Composite Bearing Grade HT | Composite Bearing Grade HX |              |                   |
|------------------|----------------------|---|-------------------|------------------|------------------------------|---------------------------------|---------------------------------|----------------|----------------|----------------|----------------------------|----------------------------|----------------------------|----------------------------|--------------|-------------------|
|                  |                      |   | Units             | ASTM Test Method | Glass cloth Reinforced Epoxy | Glass cloth Reinforced Melamine | Glass cloth Reinforced Silicone | Paper Phenolic | Paper Phenolic | Paper Phenolic | Canvas Phenolic            | Linen Phenolic             | Polyester Cloth            | Polyester PTFE Cloth       | Aramid Cloth | Aramid PTFE Cloth |
| MECHANICAL       | 1                    | Strength to Weight Ratio                            | ksi               | -                |                              |                                 |                                 |                |                |                |                            |                            |                            |                            |              |                   |
|                  | 2                    | Specific Gravity @ 73 F                             | -                 | D792             | 1.82                         | 1.90                            | 1.68                            | 1.36           | 1.34           | 1.32           | 1.35                       | 1.34                       | 1.25                       | 1.25                       | 1.20         | 1.20              |
|                  | 3                    | Tensile Strength @ 73 F, (ult)/(yld)                | psi               | D638             | 40000                        | 37000                           | 23000                           | 20000          | 16000          | 15000          | 9500                       | 12500                      | 8000                       | 8000                       | 8700         | 8700              |
|                  | 4                    | Tensile Modulus of Elasticity @ 73 F                | psi               | D638             | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | 470000                     | 470000                     | 630000       | 630000            |
|                  | 5                    | Tensile Elongation at Break @ 73 F                  | %                 | D638             | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | -                          | -                          | -            | -                 |
|                  | 6                    | Flexural Strength @ 73 F                            | psi               | D790             | 55000                        | 55000                           | 23000                           | 25000          | 15000          | 13500          | 17000                      | 15000                      | -                          | -                          | -            | -                 |
|                  | 7                    | Flexural Modulus of Elasticity @ 73 F               | psi               | D790             | 2700000                      | 2500000                         | 1400000                         | 1800000        | 1400000        | 1300000        | 950000                     | 1050000                    | 280000                     | 280000                     | -            | -                 |
|                  | 8                    | Shear Strength @ 73 F                               | psi               | D732             | 19000                        | 20000                           | 17000                           | 12000          | 11000          | 10000          | 11500                      | 11750                      | 12000                      | 12000                      | -            | -                 |
|                  | 9                    | Compressive Strength, (% Deformation) @73 F         | psi               | D695             | 60000 (10)                   | 70000 (10)                      | 45000 (10)                      | 36000 (10)     | 34000 (10)     | 32000 (10)     | 37000 (10)                 | 37000 (10)                 | 17400 (10)                 | 17400 (10)                 | 23500 (10)   | 23500 (10)        |
|                  | 10                   | Compressive Modulus of Elasticity @73 F             | psi               | D695             | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | -                          | -                          | -            | -                 |
|                  | 11                   | Hardness, Rockwell, Scale as noted @73 F            | -                 | D785             | M110                         | M120                            | M100                            | M110           | M105           | M110           | M104                       | M105                       | M100                       | M100                       | M105         | M105              |
|                  | 12                   | Hardness, Durometer, Shore D @73 F                  | -                 | D2240            | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | -                          | -                          | -            | -                 |
|                  | 13                   | Izod Impact, (Notched) @73 F                        | ft-lb/in of notch | D256 TypeA       | 7.0                          | 12.0                            | 8.5                             | 4.0            | 1.3            | 1.0            | 3.2/2.3                    | 2.5/1.8                    | >10                        | >10                        | >10          | >10               |
|                  | 14                   | Coefficient of Friction, (Dry vs. Steel) Dynamic    | -                 | -                | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | 0.10                       | .03-.05                    | .12-.18      | .09-.12           |
|                  | 15                   | Limiting PV, (with 4 to 1 factor of safety applied) | psi-ft/min        | -                | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | -                          | -                          | -            | -                 |
| THERMAL          | 16                   | Coefficient of Linear Thermal Expansion @73 F       | in/in/F           | E-831 (TMA)      | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | 2.5E-05                    | 2.5E-05                    | 1.5E-05      | 1.5E-05           |
|                  | 17                   | Heat Deflection Temperature @ 264 psi               | F                 | D648             | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | -                          | -                          | -            | -                 |
|                  | 18                   | Tg-Glass transition temperature, (Amorphous)        | F                 | D3418            | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | -                          | -                          | -            | -                 |
|                  | 19                   | Melting Point, (VS=Vicat Softening Temp.)           | F                 | D3418            | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | -                          | -                          | -            | -                 |
|                  | 20                   | Continuous Service Temperature in Air, (Max.)       | F                 | -                | 285                          | 285                             | 465                             | 285            | 285            | 285            | 265                        | 265                        | 266                        | 266                        | 482          | 482               |
| 21               | Thermal Conductivity | BTU-in/hr-ft2-F                                     | -                 | -                | -                            | -                               | -                               | -              | -              | -              | -                          | 1.20                       | -                          | 0.70                       | -            |                   |
| ELECTRICAL       | 22                   | Dielectric Strength, Short Term                     | Volts/mil         | D149             | 400                          | 350                             | 350                             | 500            | 500            | 470            | 150/360                    | 150/360                    | -                          | -                          | -            | -                 |
|                  | 23                   | Volume Resistivity                                  | ohm-cm            | D257             | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | -                          | -                          | -            | -                 |
|                  | 24                   | Dielectric Constant @ 10E6 Hz                       | -                 | D150             | 5.2                          | 7.1                             | 4.2                             | 6.0            | 5.5            | 5.3            | -,5.8                      | -,5.8                      | -                          | -                          | -            | -                 |
|                  | 25                   | Dissipation Factor @ 10E6 Hz                        | -                 | D150             | 0.025                        | 0.017                           | 0.003                           | 0.060          | 0.045          | 0.038          | .1,.055                    | .1,.055                    | -                          | -                          | -            | -                 |
|                  | 26                   | Flammability @ 3.1 mm unless noted                  | -                 | UL94             | V-O                          | V-O                             | V-O                             | HB             | HB             | HB             | HB                         | HB                         | -                          | -                          | -            | -                 |
| H <sub>2</sub> O | 27                   | Water Absorbtion, Immersion, 24 Hrs                 | % by wt.          | D570(7)          | 0.10                         | 0.40                            | 0.15                            | 1.10           | 0.55           | 0.45           | 1.2,.75                    | .9,.7                      | <.1                        | <.1                        | <.1          | <.1               |
|                  | 28                   | Water Absorbtion, Saturation                        | % by wt.          | D570(7)          | -                            | -                               | -                               | -              | -              | -              | -                          | -                          | <.1                        | <.1                        | <.1          | <.1               |