

Sheet Products - Property Comparison

|   |  |                        | NP600           | NP602           | NP605           | NP610           |
|---|--|------------------------|-----------------|-----------------|-----------------|-----------------|
|   |  |                        | Paper           |                 |                 |                 |
|   |  |                        | Phenolic        |                 |                 |                 |
| PHYSICAL PROPERTIES                       |  |                        |                 |                 |                 |                 |
| Specific Gravity (0.500")                 |  | -                      | 1.38            | 1.30            | 1.30            | 1.40            |
| Rockwell Hardness (0.250" Build-up)       |  | M Scale                | 90              | 90              | 90              | 90              |
| Moisture Absorption (0.062")              | Condition D <sub>1</sub> -24/23                  | %                      | 8.00            | 8.00            | 8.00            | 1.80            |
| Flexural Strength (0.062")                | Condition A<br>Lengthwise / Crosswise            | psi                    | 25,000 / 25,000 | 25,000 / 22,000 | 25,000 / 25,000 | 34,000 / 28,000 |
|   | Condition E-1/150 T150<br>Lengthwise / Crosswise |                        | -- / --         | -- / --         | -- / --         | -- / --         |
| Flexural Modulus (0.062")                 | Lengthwise / Crosswise                           | kpsi                   | -- / --         | -- / --         | -- / --         | 1,900 / 1,400   |
| Tensile Strength (0.125")                 | Lengthwise / Crosswise                           | psi                    | 17,000 / 13,000 | 17,000 / 13,000 | 17,000 / 13,000 | 17,000 / 13,000 |
| Izod Impact Strength (0.500")             | Condition E-48/50<br>Lengthwise / Crosswise      | ft-lb/in (notched)     | 0.55 / 0.50     | 0.55 / 0.50     | 0.55 / 0.50     | 0.82 / 0.76     |
| Compressive Strength (0.500")             | Flatwise   | psi                    | 35,000          | 35,000          | 35,000          | 35,000          |
| Bonding Strength (0.500")                 | Condition A                                      | lb                     | --              | --              | --              | 1,000           |
|   | Condition D-48/50                                |                        | --              | --              | --              | --              |
| Shear Strength (0.062")                   | Perpendicular                                    | psi                    | --              | --              | --              | 15,000          |
| THERMAL PROPERTIES                        |  |                        |                 |                 |                 |                 |
| Temperature Index <sup>1</sup>            | Electrical / Mechanical                          | °C                     | 150 / 150       | 150 / 150       | 150 / 150       | 130 / 130       |
| Coefficient of Thermal Expansion (0.125") | X-axis / Y-axis                                  | "/"°Cx10 <sup>-6</sup> | -- / --         | -- / --         | -- / --         | 13.0 / 17.0     |
| Flammability Rating U.L. 94 (0.062")      | Condition A                                      | Class                  | HB              | HB              | HB              | HB              |
| ELECTRICAL PROPERTIES                     |  |                        |                 |                 |                 |                 |
| Dissipation Factor (0.062")               | Condition D <sub>1</sub> -24/23                  | -                      | --              | --              | --              | --              |
| Permittivity (0.062")                     | Condition D <sub>1</sub> -24/23                  | -                      | --              | --              | --              | --              |
| Breakdown Voltage (0.062")                | Condition A                                      | kV                     | 60              | 60              | --              | 40              |
|   | Condition D-48/50                                |                        | 3               | 3               | --              | --              |
| Electric Strength (0.062")                | Condition A                                      | V/mil                  | --              | --              | --              | 600             |
|   | Condition D-48/50                                |                        | --              | --              | --              | --              |
| Arc Resistance D495 (0.125")              | Condition A                                      | sec                    | --              | --              | --              | 90              |
| Comparative Tracking Index D3638 (0.125") |  | V                      | --              | --              | --              | --              |

NOTE a: A double dash (--) indicates that the value has not been determined or is not applicable to the product.

NOTE b: All testing per ASTM D348 unless otherwise noted.

<sup>1</sup> NEMA LI-6: This temperature is a recommendation only and is based upon experience in various applications. The maximum operating temperature is dependent upon the application and should be investigated prior to use.

Sheet Products - Property Comparison

|   |  |                        | NP611           | NP611R          | NP612           | NP613           |
|---|--|------------------------|-----------------|-----------------|-----------------|-----------------|
|   |  |                        | Paper           |                 |                 |                 |
|   |  |                        | Phenolic        |                 |                 | Epoxy           |
| <b>PHYSICAL PROPERTIES</b>                |  |                        |                 |                 |                 |                 |
| Specific Gravity (0.500")                 |  | -                      | 1.35            | 1.35            | 1.38            | 1.35            |
| Rockwell Hardness (0.250" Build-up)       |  | M Scale                | 100             | 100             | 84              | 90              |
| Moisture Absorption (0.062")              | Condition D <sub>1</sub> -24/23                  | %                      | 1.50            | 1.50            | 3.20            | 2.80            |
| Flexural Strength (0.062")                | Condition A<br>Lengthwise / Crosswise            | psi                    | 29,000 / 22,000 | 29,000 / 22,000 | 19,300 / 17,600 | 34,000 / 26,000 |
|   | Condition E-1/150 T150<br>Lengthwise / Crosswise |                        | -- / --         | -- / --         | -- / --         | -- / --         |
| Flexural Modulus (0.062")                 | Lengthwise / Crosswise                           | kpsi                   | 1,200 / 900     | 1,200 / 900     | 1,000 / 850     | 2,000 / 1,500   |
| Tensile Strength (0.125")                 | Lengthwise / Crosswise                           | psi                    | 18,000 / 13,500 | 18,000 / 13,500 | 12,500 / 8,400  | -- / --         |
| Izod Impact Strength (0.500")             | Condition E-48/50<br>Lengthwise / Crosswise      | ft-lb/in (notched)     | 0.70 / 0.60     | 0.70 / 0.60     | 0.76 / 0.66     | 1.25 / 1.00     |
| Compressive Strength (0.500")             | Flatwise   | psi                    | 45,000          | 45,000          | 27,000          | 40,000          |
| Bonding Strength (0.500")                 | Condition A                                      | lb                     | 1,100           | 1,100           | 1,400           | 1,000           |
|   | Condition D-48/50                                |                        | --              | --              | --              | 770             |
| Shear Strength (0.062")                   | Perpendicular                                    | psi                    | 12,200          | 12,200          | 9,500           | --              |
| <b>THERMAL PROPERTIES</b>                 |  |                        |                 |                 |                 |                 |
| Temperature Index <sup>1</sup>            | Electrical / Mechanical                          | °C                     | 130 / 130       | 130 / 130       | 130 / 130       | 140 / 140       |
| Coefficient of Thermal Expansion (0.125") | X-axis / Y-axis                                  | "/"°Cx10 <sup>-6</sup> | 13.0 / 17.0     | 13.0 / 17.0     | 15.0 / 19.0     | -- / --         |
| Flammability Rating U.L. 94 (0.062")      | Condition A                                      | Class                  | HB              | HB              | HB              | HB              |
| <b>ELECTRICAL PROPERTIES</b>              |  |                        |                 |                 |                 |                 |
| Dissipation Factor (0.062")               | Condition D <sub>1</sub> -24/23                  | -                      | --              | --              | 0.060           | 0.040           |
| Permittivity (0.062")                     | Condition D <sub>1</sub> -24/23                  | -                      | --              | --              | 5.50            | 5.13            |
| Breakdown Voltage (0.062")                | Condition A                                      | kV                     | 50              | 50              | 55              | 80              |
|   | Condition D-48/50                                |                        | 4               | 4               | 10              | 4               |
| Electric Strength (0.062")                | Condition A                                      | V/mil                  | 600             | 600             | 700             | --              |
|   | Condition D-48/50                                |                        | --              | --              | --              | --              |
| Arc Resistance D495 (0.125")              | Condition A                                      | sec                    | 75              | 75              | 110             | --              |
| Comparative Tracking Index D3638 (0.125") |  | V                      | 180             | 180             | 500             | --              |

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Sheet Products - Property Comparison

|   |  |                        | NP625           | NP629           | NP630           | NP631           |
|---|--|------------------------|-----------------|-----------------|-----------------|-----------------|
|   |  |                        | Paper           |                 |                 |                 |
|   |  |                        | Phenolic        |                 |                 |                 |
| PHYSICAL PROPERTIES                       |  |                        |                 |                 |                 |                 |
| Specific Gravity (0.500")                 |  | -                      | 1.39            | 1.39            | 1.36            | 1.38            |
| Rockwell Hardness (0.250" Build-up)       |  | M Scale                | 85              | 95              | 96              | 115             |
| Moisture Absorption (0.062")              | Condition D <sub>1</sub> -24/23                  | %                      | 1.60            | 2.00            | 1.60            | 1.00            |
| Flexural Strength (0.062")                | Condition A<br>Lengthwise / Crosswise            | psi                    | 19,000 / 17,000 | 22,000 / 17,000 | 22,000 / 18,000 | 16,000 / 13,200 |
|   | Condition E-1/150 T150<br>Lengthwise / Crosswise |                        | -- / --         | -- / --         | -- / --         | -- / --         |
| Flexural Modulus (0.062")                 | Lengthwise / Crosswise                           | kpsi                   | 1,000 / 850     | -- / --         | 1,400 / 1,200   | 1,100 / 900     |
| Tensile Strength (0.125")                 | Lengthwise / Crosswise                           | psi                    | 12,400 / 10,400 | 13,500 / 11,500 | 14,000 / 11,000 | 15,000 / 12,000 |
| Izod Impact Strength (0.500")             | Condition E-48/50<br>Lengthwise / Crosswise      | ft-lb/in (notched)     | 0.75 / 0.70     | 0.50 / 0.40     | 0.90 / 0.80     | 0.65 / 0.60     |
| Compressive Strength (0.500")             | Flatwise   | psi                    | 29,500          | 25,000          | 45,000          | 32,000          |
| Bonding Strength (0.500")                 | Condition A                                      | lb                     | 1,100           | 900             | 1,100           | 1,000           |
|   | Condition D-48/50                                |                        | --              | --              | --              | --              |
| Shear Strength (0.062")                   | Perpendicular                                    | psi                    | 10,500          | 11,500          | 12,800          | 11,500          |
| THERMAL PROPERTIES                        |  |                        |                 |                 |                 |                 |
| Temperature Index <sup>1</sup>            | Electrical / Mechanical                          | °C                     | 130 / 130       | 130 / 130       | 130 / 130       | 125 / 125       |
| Coefficient of Thermal Expansion (0.125") | X-axis / Y-axis                                  | "/"°Cx10 <sup>-6</sup> | 15.0 / 19.0     | -- / --         | 15.0 / 19.0     | 16.0 / 20.0     |
| Flammability Rating U.L. 94 (0.062")      | Condition A                                      | Class                  | HB              | HB              | HB              | HB              |
| ELECTRICAL PROPERTIES                     |  |                        |                 |                 |                 |                 |
| Dissipation Factor (0.062")               | Condition D <sub>1</sub> -24/23                  | -                      | 0.060           | 0.052           | 0.080           | 0.035           |
| Permittivity (0.062")                     | Condition D <sub>1</sub> -24/23                  | -                      | 6.05            | 6.20            | 6.10            | 4.80            |
| Breakdown Voltage (0.062")                | Condition A                                      | kV                     | 50              | 40              | 33              | 60              |
|   | Condition D-48/50                                |                        | --              | 5               | 5               | 15              |
| Electric Strength (0.062")                | Condition A                                      | V/mil                  | 700             | --              | 310             | 750             |
|   | Condition D-48/50                                |                        | --              | --              | 85              | 600             |
| Arc Resistance D495 (0.125")              | Condition A                                      | sec                    | 90              | --              | 130             | 124             |
| Comparative Tracking Index D3638 (0.125") |  | V                      | 180             | --              | 200             | 200             |

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Global Thermoset Composite Solutions

Sheet Products - Property Comparison

|   |  |                         | NP643           | NP660           | NP664           | NP843           |
|---|--|-------------------------|-----------------|-----------------|-----------------|-----------------|
|   |  |                         | Paper           |                 |                 |                 |
|   |  |                         | Epoxy           | Phenolic        |                 |                 |
| <b>PHYSICAL PROPERTIES</b>                |  |                         |                 |                 |                 |                 |
| Specific Gravity (0.500")                 |  | -                       | 1.40            | 1.35            | 1.37            | 1.40            |
| Rockwell Hardness (0.250" Build-up)       |  | M Scale                 | 115             | 100             | 90              | 100             |
| Moisture Absorption (0.062")              | Condition D <sub>1</sub> -24/23                  | %                       | --              | 3.50            | 5.50            | --              |
| Flexural Strength (0.062")                | Condition A<br>Lengthwise / Crosswise            | psi                     | 27,700 / 20,800 | 33,000 / 30,000 | 26,000 / 24,000 | -- / --         |
|   | Condition E-1/150 T150<br>Lengthwise / Crosswise |                         | -- / --         | -- / --         | -- / --         | -- / --         |
| Flexural Modulus (0.062")                 | Lengthwise / Crosswise                           | kpsi                    | -- / --         | 1,900 / 1,400   | 1,200 1,000     | -- / --         |
| Tensile Strength (0.125")                 | Lengthwise / Crosswise                           | psi                     | 16,900 / 13,900 | 20,000 / 16,000 | 22,500 / 12,500 | 22,000 / 15,000 |
| Izod Impact Strength (0.500")             | Condition E-48/50<br>Lengthwise / Crosswise      | ft-lb/in (notched)      | 0.65 0.56       | 0.75 / 0.70     | 0.67 / 0.62     | 0.70 / 0.50     |
| Compressive Strength (0.500")             | Flatwise   | psi                     | 44,100          | 49,000          | 30,000          | 44,000          |
| Bonding Strength (0.500")                 | Condition A                                      | lb                      | 900             | 1,100           | 1,100           | 1,000           |
|   | Condition D-48/50                                |                         | --              | --              | --              | --              |
| Shear Strength (0.062")                   | Perpendicular                                    | psi                     | --              | 14,000          | 11,000          | --              |
| <b>THERMAL PROPERTIES</b>                 |  |                         |                 |                 |                 |                 |
| Temperature Index <sup>1</sup>            | Electrical / Mechanical                          | °C                      | 140 / 140       | 130 / 130       | 130 / 130       | 125 / 125       |
| Coefficient of Thermal Expansion (0.125") | X-axis / Y-axis                                  | "/"/°Cx10 <sup>-6</sup> | -- / --         | 13.0 / 17.0     | 18.0 / 20.0     | 10.0 / 12.0     |
| Flammability Rating U.L. 94 (0.062")      | Condition A                                      | Class                   | HB              | HB              | HB              | HB              |
| <b>ELECTRICAL PROPERTIES</b>              |  |                         |                 |                 |                 |                 |
| Dissipation Factor (0.062")               | Condition D <sub>1</sub> -24/23                  | -                       | 0.057           | 0.045           | --              | --              |
| Permittivity (0.062")                     | Condition D <sub>1</sub> -24/23                  | -                       | 4.50            | 5.45            | --              | --              |
| Breakdown Voltage (0.062")                | Condition A                                      | kV                      | > 65            | 47              | 60              | --              |
|   | Condition D-48/50                                |                         | 6               | --              | 10              | --              |
| Electric Strength (0.062")                | Condition A                                      | V/mil                   | 170             | 500             | 500             | --              |
|   | Condition D-48/50                                |                         | --              | 300             | 300             | --              |
| Arc Resistance D495 (0.125")              | Condition A                                      | sec                     | 120             | 60              | 110             | --              |
| Comparative Tracking Index D3638 (0.125") |  | V                       | 150             | 150             | 180             | --              |

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