



**EVERY PART MATTERS**

# Material Properties Guide



Advanced Composite Manufacturing for Your Critical Applications

Collaborative Engineering

Automated Thermoplastic Composite Processing

Injection Molding of High Temperature Thermoplastics

In-House Mold Design & Tool Making

Bonding & Assembly

Multi-Axis Machining

ISO 9100 / AS9100 / NADCAP

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|                                 | SUPPLIER AND TRADENAME    | DESIGNATION | FILLER                                 | MECHANICAL PROPERTIES            |   |   |  |   |  |  |  |  |  |  |  |  |   |   |   | RELATIVE WEAR CHARACTERISTICS, DRY <sup>(3)</sup><br>(1 = EXCEPTIONAL; 5 = POOR)  | RESISTANCE TO OILS, FUELS,<br>AND SOLVENTS TO 300°F <sup>(3)</sup><br>(1 = EXCEPTIONAL; 5 = POOR) |
|---------------------------------|---------------------------|-------------|--|----------------------------------|---|---|--|---|--|--|--|--|--|--|--|--|---|---|---|---|---|
|                                 |                           |             |  | SPECIFIC GRAVITY <sup>(12)</sup> | TENSILE STRENGTH <sup>(14)</sup><br>(73°F) (P.S.I.) | TENSILE STRENGTH AT<br>HIGH TEMPERATURE <sup>(15)</sup><br>(P.S.I.) | TENSILE ELONGATION <sup>(14)</sup><br>(73°F) (%) | TENSILE MODULUS <sup>(16)</sup><br>(73°F) (P.S.I. x 10 <sup>3</sup> ) | COMPRESSIVE STRENGTH <sup>(18)</sup><br>(P.S.I.) | COMPRESSIVE MODULUS <sup>(19)</sup><br>(P.S.I. x 10 <sup>3</sup> ) | FLEXURAL STRENGTH <sup>(16)</sup><br>(73°F) (P.S.I.) | FLEXURAL MODULUS <sup>(16)</sup><br>(73°F) (P.S.I. x 10 <sup>3</sup> ) | NOTCHED IZOD IMPACT<br>STRENGTH <sup>(17)</sup><br>(ft-lb/in.) | UNNOTCHED IZOD IMPACT<br>STRENGTH <sup>(17)</sup><br>(ft-lb/in.) | HEAT DEFLACEMENT <sup>(18)</sup><br>TEMPERATURE <sup>(19)</sup><br>@ 264 P.S.I. (°F) | COEFFICIENT OF LINEAR<br>THERMAL EXPANSION <sup>(18)</sup><br>(10 <sup>6</sup> IN./IN. x °F) | HIGHEST CONTINUOUS USE<br>TEMPERATURE <sup>(19)</sup><br>(°F) | HIGHEST CONTINUOUS USE<br>TEMPERATURE <sup>(19)</sup><br>(°F) |   |   |   |
| Polyimide<br>(PI)               | DUPONT (1)<br>VESPEL®     | SP-1        | NONE                                   | 1.36                             | 10,500  | 5,300<br>(500°F)  | 8.0  | —   | 19,000   | .35  | 14,000   | 0.36   | 1.5  | 30.0   | 680  | 28   | 500-550   | 2   | 1 | HIGHEST CONTINUOUS USE<br>TEMPERATURE RANGE;<br>EXCELLENT BEARING RESISTANCE<br>POOR STEAM RESISTANCE                     |   |
|                                 | DUPONT (1)<br>VESPEL®     | SP-21       | 15% GRAPHITE<br>POWDER                 | 1.43                             | 9,000   | 4,400<br>(500°F)  | 6.0  | —   | 16,000   | .33  | 13,000   | 0.46   | .8   | 8.0  | 680  | 23   | 500-550   | 1   | 1 |   |   |
|                                 | DUPONT (1)<br>VESPEL®     | SP-22       | 40% GRAPHITE<br>POWDER                 | 1.46                             | 7,000   | 3,800<br>(500°F)  | 2.5  | —   | 14,000   | .38  | 10,000   | 0.70   | —  | —  | —  | 15   | 500-550   | 1   | 1 |   |   |
|                                 | MITSUI (21)<br>AURUM®     | PL-450      | NONE                                   | 1.33                             | 13,442  | 2,418<br>(482°F)  | 90.0   | —   | 17,446   | .31  | 20,200   | .43  | 1.6  | —  | 460  | —  | 445-480   | 5   | 1 |   |   |
|                                 | MITSUI (21)<br>AURUM®     | JCN3030     | CARBON<br>FIBER                        | 1.43                             | 33,319  | —   | 2.0  | —   | 30,173   | .57  | 46,618   | .33  | 1.9  | —  | 478  | —  | 445-480   | 3   | 1 |   |   |
|                                 | MITSUI (21)<br>AURUM®     | JRF3025     | PTFE<br>GRAPHITE                       | 1.40                             | 13,156  | —   | 6.0  | —   | —  | —  | 14,157   | .50  | 1.1  | —  | 460  | —  | 445-480   | 3   | 1 |   |   |
| Polybenzimidazole<br>(PBI)      | HOECHST (22)<br>CELAZOLE® | U-60        | NONE                                   | 1.3                              | 23,000  | 13,000<br>(600°F)   | 3.0  | .95   | 58,000   | .90  | 32,000   | .95  | .5   | 11   | 815  | 13   | 450-500   | 2   | 1 | VERY HIGH TEMPERATURE<br>RESISTANCE   |   |
|                                 | HOECHST (22)<br>CELAZOLE® | TU-60       | NONE                                   | 1.3                              | 16,000  | —   | 2.8  | .70   | 30,000   | .43  | 24,500   | .81  | —  | —  | 491  | 19.1   | 450-500   | 2   | 1 |   |   |
|                                 | HOECHST (22)<br>CELAZOLE® | TF-60V      | GLASS<br>FIBER                         | 1.5                              | 26,300  | —   | 1.9  | 1.9   | 32,000   | .53  | 35,100   | 1.85   | —  | —  | 597  | 9.6  | 450-500   | —   | 1 |   |   |
|                                 | HOECHST (22)<br>CELAZOLE® | TF-60C      | CARBON<br>FIBER                        | 1.4                              | 29,000  | —   | 1.7  | 3.1   | 32,000   | .55  | 46,000   | 2.90   | —  | —  | 619  | 14.7   | 450-500   | —   | 1 |   |   |
|                                 | HOECHST (22)<br>CELAZOLE® | TL-60       | —                                      | 1.4                              | 16,300  | —   | 1.2  | 2.3   | 32,000   | .45  | 26,400   | 2.11   | —  | —  | 600  | 14.7   | 450-500   | —   | 1 |   |   |
| Polyamide-imide<br>(PAI)        | AMOCO (2)<br>TORLON®      | 4203L       | NONE                                   | 1.42                             | 27,800  | 9,500<br>(450°F)  | 15.0   | .70   | 32,100   | —  | 34,900   | 0.73   | 2.7  | 20.0   | 532  | 17   | 430-480   | 3   | 1 | HIGHEST STRENGTH AT 500°F;<br>GOOD MOLDABILITY; LONG POST<br>CURING REQUIRED TO ACHIEVE<br>OPTIMAL PROPERTIES             |   |
|                                 | AMOCO (2)<br>TORLON®      | 4301        | 12% GRAPHITE<br>POWDER +3%<br>P.T.F.E. | 1.46                             | 23,700  | 10,600<br>(450°F)   | 7.0  | .95   | 24,100   | .77  | 31,200   | 1.00   | 1.2  | 7.6  | 534  | 14   | 430-480   | 2   | 1 |   |   |
|                                 | AMOCO (2)<br>TORLON®      | 4275        | 20% GRAPHITE<br>POWDER +3%<br>P.T.F.E. | 1.51                             | 22,000  | 8,100<br>(450°F)  | 7.0  | 1.13  | 17,800   | .58  | 30,200   | 1.06   | 1.6  | 4.7  | 536  | 14   | 430-480   | 2   | 1 |   |   |
|                                 | AMOCO (2)<br>TORLON®      | 5030        | 30% GLASS<br>FIBER +1%<br>P.T.F.E.     | 1.61                             | 29,700  | 16,300<br>(450°F)   | 7.0  | 1.56  | 38,300   | 1.15   | 48,300   | 1.70   | 1.5  | 9.5  | 539  | 9  | 430-480   | 5   | 1 |   |   |
|                                 | AMOCO (2)<br>TORLON®      | 7130        | 30% GRAPHITE<br>FIBER +1%<br>P.T.F.E.  | 1.48                             | 29,400  | 15,700<br>(450°F)   | 6.0  | 3.22  | 36,900   | 1.14   | 50,700   | 2.88   | .9   | 6.4  | 540  | 5  | 430-480   | 2   | 1 |   |   |
| Polyetheretherketone<br>(PEEK)  | I.C.I. (3)<br>VICTREX®    | 450 G       | NONE                                   | 1.32                             | 13,300  | 1,700<br>(480°F)  | 50.0   | .52   | 17,100   | —  | 24,700   | 0.53   | 1.6  | NO BREAK   | 320  | 26   | 430-480   | 3   | 1 | BEST RESISTANCE TO STEAM; VERY<br>GOOD RESISTANCE TO RADIATION;<br>EXCELLENT MOLDABILITY; MARGINAL<br>PROPERTIES AT 500°F |   |
|                                 | I.C.I. (3)<br>VICTREX®    | 450 GL 30   | 30% GLASS<br>FIBER                     | 1.49                             | 22,800  | 4,900<br>(480°F)  | 2.2  | 1.40  | 31,200   | —  | 33,800   | 1.49   | 1.8  | 13.6   | 600  | 12   | 430-480   | 5   | 1 |   |   |
|                                 | I.C.I. (3)<br>VICTREX®    | 450 CA 30   | 30% CARBON<br>FIBER                    | 1.44                             | 30,200  | 6,200<br>(480°F)  | 1.3  | 1.88  | 34,800   | —  | 46,100   | 1.88   | 1.6  | 14.0   | 600  | 8  | 430-480   | 2   | 1 |   |   |
|                                 | LNP (4)<br>THERMOCOMP®    | LCL 4033    | 15% CARBON<br>FIBER +15%<br>P.T.F.E.   | 1.41                             | 25,600  | —   | 4.5  | —   | —  | —  | 37,100   | 1.80   | 1.5  | 11.0   | 600  | —  | 430-480   | 1   | 1 |   |   |
| Polyphenylene Sulfide<br>(PPS)  | HOECHST (6)<br>FORTRON®   | 0214-P      | NONE                                   | 1.35                             | 12,400  | —   | 3.0  | —   | —  | —  | 21,300   | 0.50   | 0.5  | 11.6   | 220  | —  | 425-450   | 5   | 2 | VERY GOOD PROPERTIES AT LOW COST  |   |
|                                 | PHILLIPS (7)<br>RYTON®    | R-4         | 40% GLASS<br>FIBER                     | 1.67                             | 17,500  | 6,000<br>(400°F)  | 0.9  | 2.25  | 26,000   | —  | 26,000   | 1.70   | 1.3  | 4.5  | 500  | 16   | 425-450   | 5   | 2 |   |   |
|                                 | LNP (4)<br>THERMOCOMP®    | OC-1006     | 30% CARBON<br>FIBER                    | 1.45                             | 27,000  | —   | 3.0  | —   | —  | —  | 34,000   | 2.50   | 1.1  | 6.0  | 505  | 6  | 425-450   | 2   | 2 |   |   |
| Polyphthalamide<br>(PPA)        | AMOCO (23)<br>AMODEL®     | A-1133      | 33% GLASS<br>FIBER                     | 1.43                             | 32,000  | —   | 2.0  | —   | 40,000   | —  | 45,000   | 1.65   | 2.4  | —  | 545  | 13   | 320-370   | 5   | 2 | VERY GOOD PROPERTIES AT LOW COST  |   |
|                                 | RTP (24)<br>PPA®          | 4085        | 30% CARBON<br>FIBER                    | 1.33                             | 43,000  | —   | 1.7  | 4.2   | —  | —  | 66,000   | 3.2  | 1.6  | 14   | 540  | —  | 320-370   | 4   | 2 |   |   |
| Polyetherimide<br>(PEI)         | G.E. (5)<br>ULTEM®        | 1000        | NONE                                   | 1.27                             | 15,200  | 6,000<br>(350°F)  | 60.0   | .43   | 20,300   | .42  | 21,000   | 0.48   | 1.0  | 25.0   | 392  | 31   | 350-400   | 5   | 3 | GOOD PROPERTIES AT LOW COST   |   |
|                                 | G.E. (5)<br>ULTEM®        | 2300        | 30% GLASS<br>FIBER                     | 1.51                             | 24,500  | 11,000<br>(350°F)   | 3.0  | 1.30  | 23,500   | .55  | 33,000   | 1.20   | 2.0  | 8.0  | 410  | 11   | 350-400   | 5   | 3 |   |   |
|                                 | LNP (4)<br>THERMOCOMP®    | EC 1006     | 30% CARBON<br>FIBER                    | 1.39                             | 34,000  | —   | 4.0  | —   | —  | —  | 44,000   | 2.50   | 1.4  | 13.0   | 420  | 7  | 350-400   | 2   | 3 |   |   |
| Liquid Crystal Polymer<br>(LCP) | CELANESE (8)<br>VECTRA®   | A-950       | NONE                                   | 1.40                             | 24,000  | —   | 3.0  | 1.40  | —  | —  | 24,500   | 1.30   | 10.0   | —  | 356  | —  | 400-420   | 3   | 1 |   |   |