

CE 221

CE 221 is a high performance material with excellent strength, stiffness, and temperature resistance (231C).

Tensile Properties —ASTM D638-Type V, 1mm/min	Metric	U.S.
Tensile Modulus	3870 ± 140 MPa	561 ± 20 ksi
Ultimate Tensile Strength	92 ± 13 MPa	13 ± 2 ksi
Elongation-at-Break	3.3 ± 0.8 %	3.3 ± 0.8 %

Flexural Properties —ASTM D790, 0.01mm/mm-min	Metric	U.S.
Flexural Strength	131 ± 27 MPa	19 ± 4 ksi
Flexural Modulus (chord, 0.5-1% strain)	3780 ± 113 MPa	548 ± 16 ksi

Impact Properties	Metric	U.S.
Notched Izod (Machined), ASTM D256	15 ± 1 J/m	0.28 ± 0.02 ft-lb/in.
Unnotched Izod, ASTM D4812	291 ± 46 J/m	5.5 ± 0.9 ft-lb/in.

Thermal Properties	Metric	U.S.
Heat Deflection Temperature @ 0.45 MPa/66 psi, ASTM D648	231 °C	448 °F
Heat Deflection Temperature @ 1.82 MPa/264 psi ASTM D648	201 °C	394 °F
Coefficient of Thermal Expansion (-60, 100 °C), ASTM E831	52 ppm/°C	29 ppm/°F
(100, 180 °C), ASTM E831	90 ppm/°C	50 ppm/°F
(180, 200 °C), ASTM E831	147 ppm/°C	82 ppm/°F
Heat Capacity, 23°C, ASTM E1269	1.17 J/g-°C	0.279 BTU/lb-°F
Thermal Conductivity, ASTM C518	0.167 W/m-k	0.097 BTU/hr-ft-°F

Electrical Properties	Metric
Dielectric Strength, ASTM D149	22.0 kV/mm
Dielectric Constant, 1kHz, ASTM D150	3.12
Dissipation Factor, 1kHz, ASTM D150	0.00456
Volume Resistivity, ASTM D257	2.24E+14 ohm-cm

General Properties	Metric
Hardness, ASTM D2240	92, Shore D
Density, ASTM D792	1.210 g/cm ³
Water Absorption, 23°C, 24 hours, ASTM D570	0.21%
Water Absorption, 23°C, long term ASTM D570	0.55%

NOTES—Test specimens were produced using Carbon M1 printer and a Type C2 cassette. Print parameters were generated using software v.1.9. Tensile dog bones were 4.0 mm thick. Three-point bending flexural bars were 3.2 mm thick. Notched Izod bars were 3.2 mm thick and unnotched impact bars were 6.3 mm thick. Electrical properties were collected using 2mm thick specimens. Tensile and Flexural data are average ± 1 standard deviation from 16 specimens. Impact data are from 10 specimens. The U.S. value are converted from Metric measurements and are for reference only. All test specimens were printed, cleaned, and post-processed per instructions provided in the Carbon User Manual. Results provided herein are representative of these processes and may vary if these established protocols are not followed.