Technical Data Sheet

FULCRUM* Thermoplastic Composites are produced from an engineering thermoplastic polyurethane (ETPU) matrix using the patented FULCRUM Technology process. FULCRUM Technology has no volatile organic compound (VOC) emissions and can produce solid and hollow profiles using pultrusion techniques. FULCRUM Composite materials typically have high strength and stiffness, greater toughness, and better damage tolerance than most thermoset materials. Additionally, FULCRUM Composites can be produced at higher speeds with greater design freedom than typical pultrusion processes. And, scrap material from FULCRUM Composites can be recycled and used in other thermoplastic processes.

Typical Properties for FULCRUM Thermoplastic Composite Materials

Properties[1,2]	Test Method	English Units		S.I. Units	
		High Glass Content	Typical Glass Content	High Glass Content	Typical Glass Content
Physical					
Glass Content, % by Volume	Burn Off	59%	47%	59%	47%
Glass Content, % by Weight	–	76%	66%	76%	66%
Density	ASTM D 792	0.069 lb/in^3	0.067 lb/in^3	1.91 g/cm^3	1.86 g/cm^3
Water Absorption, 24 hrs[3]	ISO 62	0.13%	0.13%	0.13%	0.13%
Mechanical					
Flexural Modulus	ASTM D 790 Transverse ASTM D 4476	6.53x10^6 psi 870,000 psi –	5.14x10^6 psi 684,800 psi 5.80x10^6 psi	45 GPa 6.7 GPa –	35 GPa 4.7 GPa 40 GPa
Flexural Strength	ASTM D 790 Transverse ASTM D 4476	167,000 psi 17,400 psi –	131,450 psi 10,000 psi 152,300 psi	1150 MPa 120 MPa –	906 MPa 69 MPa 1050 MPa
Tensile Modulus	ASTM D 3039	6.53x10^6 psi	5.14x10^6 psi	45 GPa	35 GPa
Tensile Strength	ASTM D 3039	145,000 psi	–	1000 MPa	–
Tensile Elongation	ASTM D 3039	2.2%	–	2.2%	–
Compressive Modulus	ASTM D 695	6.67x10^6 psi	5.08x10^6 psi	46 GPa	35 GPa
Compressive Strength	ASTM D 695	114,900 psi	63,800 psi	792 MPa	440 MPa
Compressive Elongation	ASTM D 695	–	1.5%	–	1.5%
Shear Strength	ASTM D 3846 ASTM D 4475	8,000 psi N/A	N/A No break	55 MPa N/A	N/A No break
Izod Impact	ASTM D 4812	102 ft-lb/in	110 ft-lb/in	5460 J/m	5900 J/m
Notched Izod Impact	ASTM D 256	79 ft-lb/in	77 ft-lb/in	4200 J/m	4100 J/m
Instrumented Impact	ASTM D 3763	265 in-lb	–	30 J	–
Electrical					
Dielectric Strength[4]	ASTM D 149	> 34 kV/in	–	> 1.3 kV/mm	–
Thermal					
Coefficient of Linear Thermal Expansion	ASTM D 696 Transverse	5.0x10^{-6} in/in/°F 2.9x10^{-5} in/in/°F	3.8x10^{-6} in/in/°F 2.5x10^{-5} in/in/°F	9.0x10^{-6} mm/mm/°C 5.2x10^{-5} mm/mm/°C	6.9x10^{-6} mm/mm/°C 4.5x10^{-5} mm/mm/°C
Thermal Conductivity	Parallel Transverse	5.6 BTU-in/hr-ft^2-°F 3.1 BTU-in/hr-ft^2-°F	4.7 BTU-in/hr-ft^2-°F 2.1 BTU-in/hr-ft^2-°F	0.808 W/m-K 0.449 W/m-K	0.685 W/m-K 0.303 W/m-K
Heat Deflection Temperature[5]	–	176°F	–	80°C	–
Glass Transition Temperature[6]	–	194°F	–	90°C	–

(1) Typical property values, not to be used for design.
(2) Uni-directional glass fibers only, no off-axis materials.
(3) Conditioned at 50°C for 24 hrs then submerged in 23°C water for 24 hrs. Specimen size: 20 mm x 2 mm x 50 mm long.
(4) Results vary with thickness. Specimen size: 20 mm x 2 mm x 30 mm long. Test was stopped at 40 kV due to to arc formation between electrodes.
(5) A common thermoplastic test standard providing a temperature at which a 0.010 inch deflection occurs with a psi fiber stress.
(6) Temperature at which thermoplastic begins to lose its rigidity.

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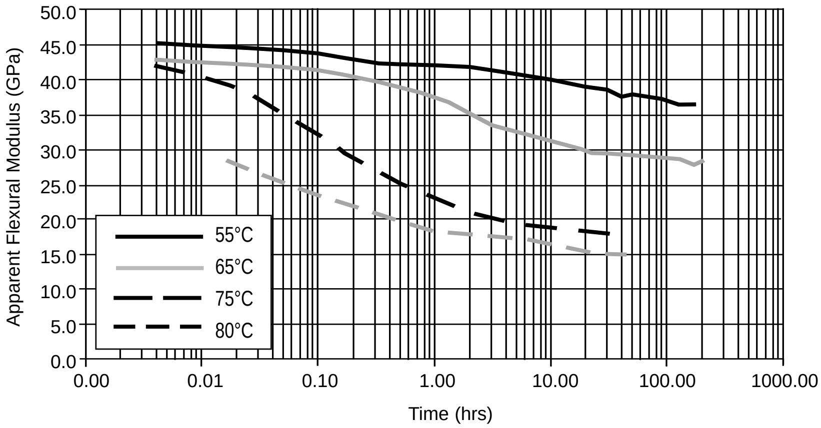
Figure 1 – Elevated Temperature Creep Data



The curves in Figure 1 show the response of FULCRUM* Composite material to a continuously applied load at elevated temperature over an extended time period.

Figure 2 – Temperature Effect on Flex Modulus

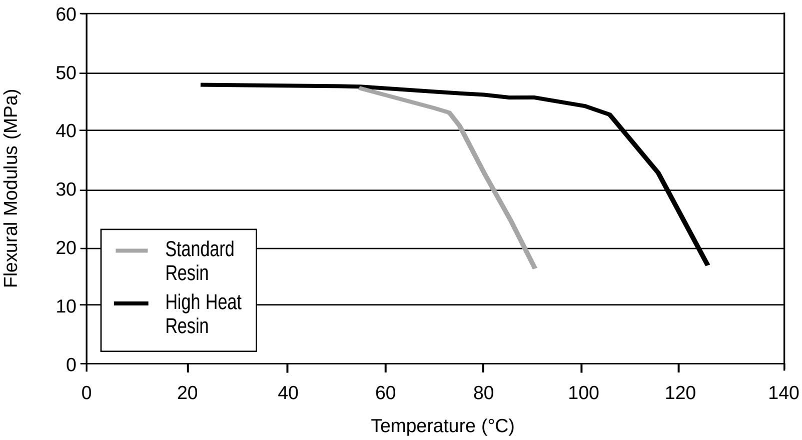
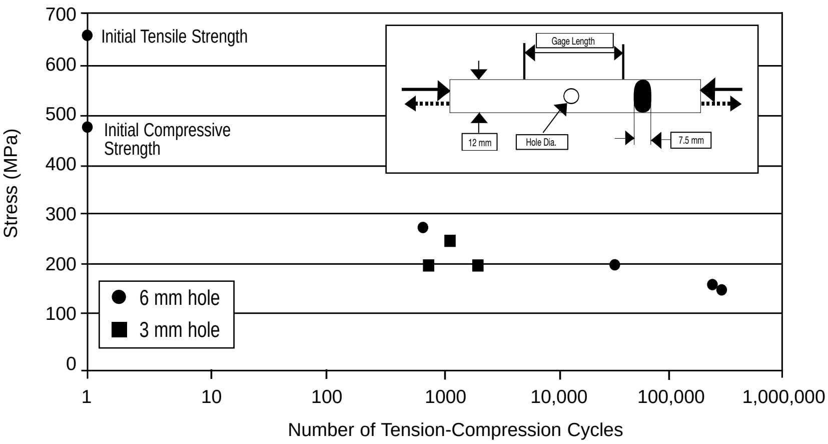


Figure 2 shows the effect of temperature on short term modulus of the material. The standard resin is the one most frequently used and is the same resin for which all of the single point data was generated. The high heat resin is an alternative grade which can be used where higher heat resistance is required.

Figure 3 – Notched Fatigue



The data in Figure 3 shows the effect of repeated tension-compression loading on samples which are notched by drilling a small hole in the center of the gage length. The hole acts as a stress concentration point, which lowers the initial strength of the composite. Extended cycling between tension and compression further reduces the strength. This is not a standard test, but gives an indication of how the material performs under complex geometry and loading conditions.

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