FPU 50

FPU 50 is an impact, abrasion, and fatigue resistant semi-rigid material that is a good choice for parts that must withstand repetitive stresses, such as living hinges or friction fits.

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Tensile Properties	Test Standard	Metric	US
Tensile Modulus	ASTM D638 Type 1 50 mm/min	700 MPa	100 ksi
Yield Strength		15 MPa	2 ksi
Strain at Yield		7%	7%
Ultimate Tensile Strength		25 MPa	4 ksi
Elongation at Break		200%	200%
Tensile Modulus	ASTM D638 Type V 10 mm/min	700 MPa	100 ksi
Yield Strength		15 MPa	2 ksi
Strain at Yield		7%	7%
Ultimate Tensile Strength		25 MPa	4 ksi
Elongation at Break		200%	200%

Flexural Properties ASTM D790-B	Test Standard	Metric	US
Flexural Stress at 5% strain	ASTM D790-B	30 MPa	4 ksi
Flexural Modulus (Chord, 0.5-1%)		800 MPa	120 ksi

Impact Properties	Test Standard	Metric	US
Notched Charpy (Machined Notch)	ISO 179-1/1eA	2.5 kJ/m²	1.2 ft-lb/in²
Notched Izod (Machined Notch), 23 °C	ASTM D256	40 J/m	0.7 ft-lb/in
Notched Izod (Machined Notch), -30 °C		30 J/m	0.5 ft-lb/in

Thermal Properties	Test Standard	Metric	US
Heat Deflection Temperature at 0.455 MPa/66 psi	ASTM D648	70 °C	155 °F
Heat Deflection Temperature at 1.82 MPa/264 psi		45 °C	110 °F
Coefficient of Thermal Expansion (-40, 40 °C)	ASTM E831	130 ppm/°C	70 ppm/°F
Heat Capacity, 23 °C	ASTM E1269	1.5 J/g-°C	0.35 BTU/lb-°F
Thermal Conductivity	ASTM C518	0.14 W/m-K	0.08 BTU/h-ft-°F

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Parts were processed using an M series printer and a Smart Part Washer with VF 1 as the solvent.

Dielectric/Electric Properties	Test Standard	Metric	US
Dielectric Strength	ASTM D149	13 kV/mm	330 V/mil
Dielectric Constant	ASTM D150	3.2	3.2
Dissipation Factor		0.013	0.013
Volume Resistivity	ASTM D257	1 x 10^{13} ohm-cm	4 x 10^{12} ohm-in

General Properties		
Hardness	ASTM D2240	71, Shore D
Bulk Density	ASTM D792	1.05 g/mL
Taber Abrasion	ASTM D4060 CS-10, 1 kg, 100% vacuum	6.5 mg / 1000 cycles
Water Absorption, 23 °C, 24 hours	ASTM D570	< 1%
Water Absorption, 23 °C, 7 days		< 1%

Liquid Properties	
Liquid Density (Part A)	1.00 g/mL
Liquid Density (Part B)	0.97 g/mL
Liquid Density (Part A+B)	1.00 g/mL
Part A:B Volume Ratio (Mass Ratio)	10.0 (10.3)
25 °C Viscosity (Part A)	2300 cP
25 °C Viscosity (Part B)	160 cP
25°C Viscosity (Part A+B)	2100 cP

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Parts were processed using an M series printer and a Smart Part Washer with VF 1 as the solvent.

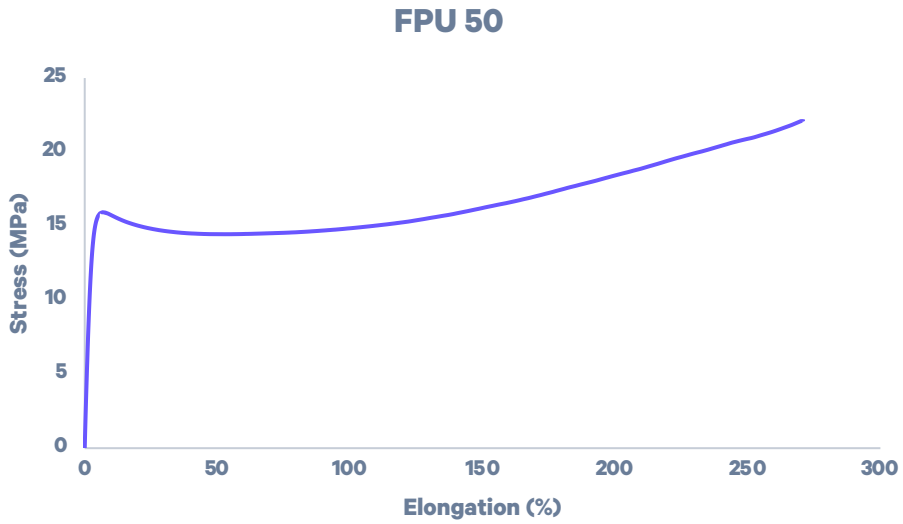
FPU 50

Extended TDS

FPU 50 Mechanical Properties

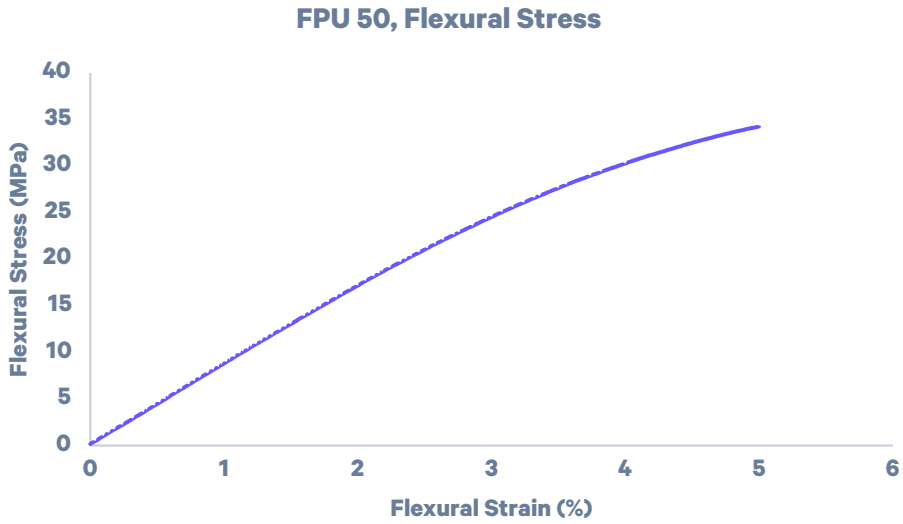
Representative Tensile Curve

ASTM D638, Type I, 50 mm/min



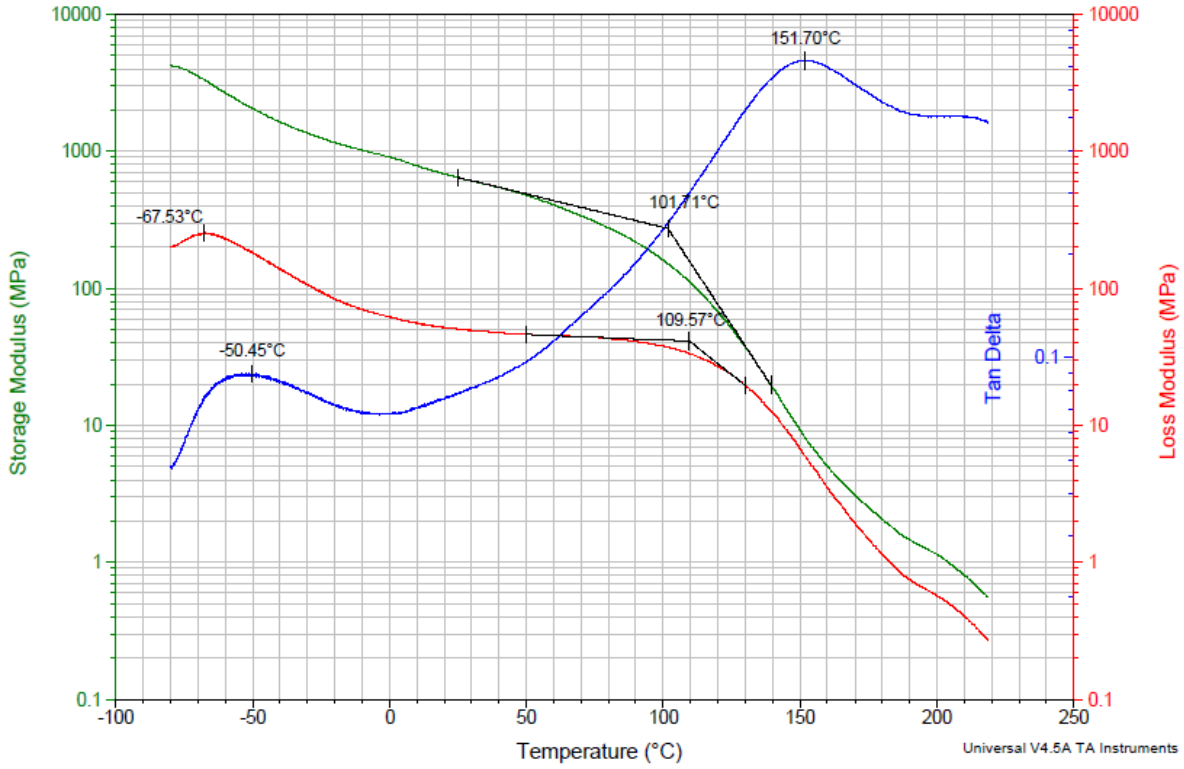
Representative Flexural Curve

ASTM D790-B
Samples are tested to 5% extension.



FPU 50 Dynamic Mechanical Analysis (DMA)

Dynamic mechanical analysis provides insight into the resin's viscoelastic properties across a range of temperatures. The figure below shows a temperature ramp of FPU 50. This material exhibits a storage modulus softening temperature near 100 °C. The peak in the tan(d) curves indicates that the glass transition temperature of FPU 50 is approximately 150 °C.



Standard: ASTM D4065

Instrument: TA DMA Q800

DMA Mode: Tension

Sample Dimensions: L=20 mm, W=10 mm, t=1 mm (rectangular block)

Strain Amplitude: 0.1% (linear regime of viscoelasticity)

Oscillation frequency: 1 Hz

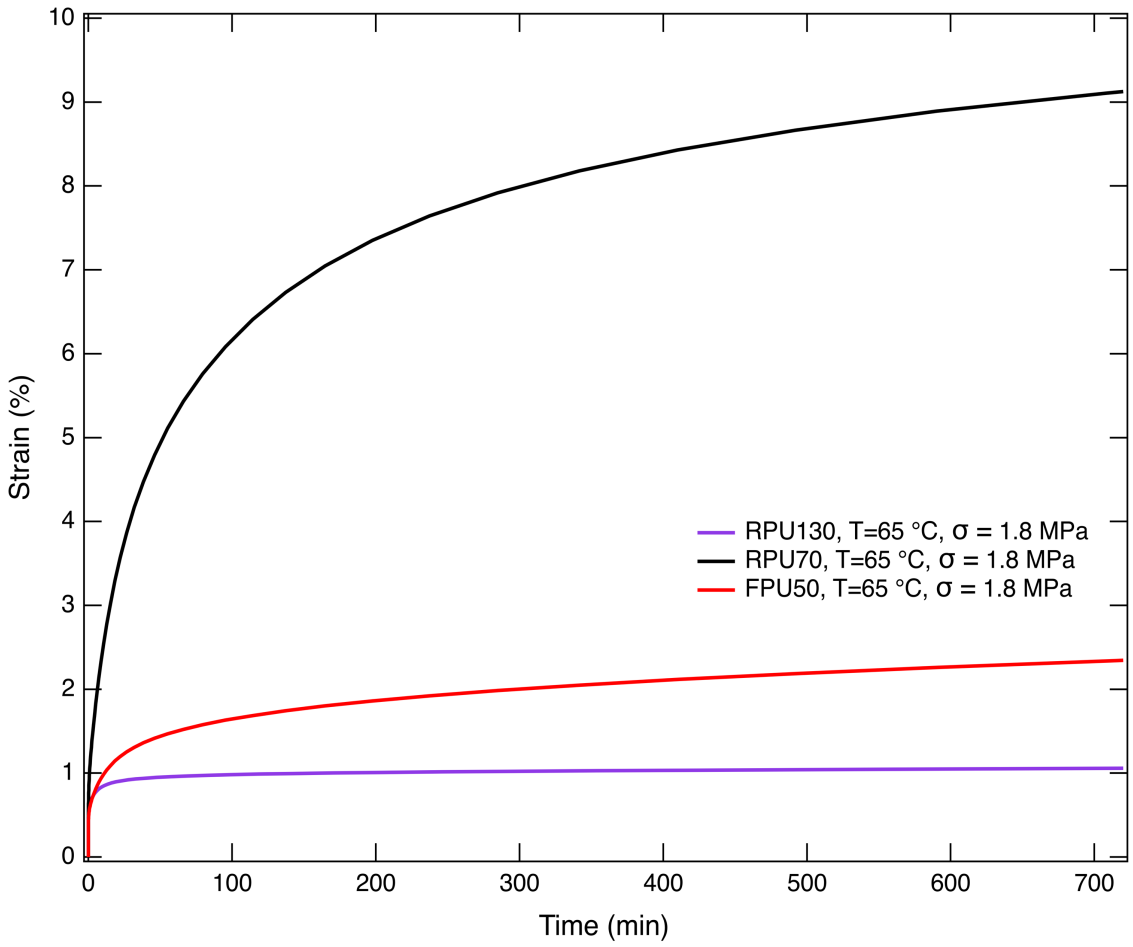
Temperature Range: -80 °C to 220 °C

Ramp Rate: 1.5 °C/min

Print Conditions: Samples were hand-wiped and not washed with solvent. The thermal cure for all materials complies with the Carbon user manual. Values may differ based on post processing conditions.

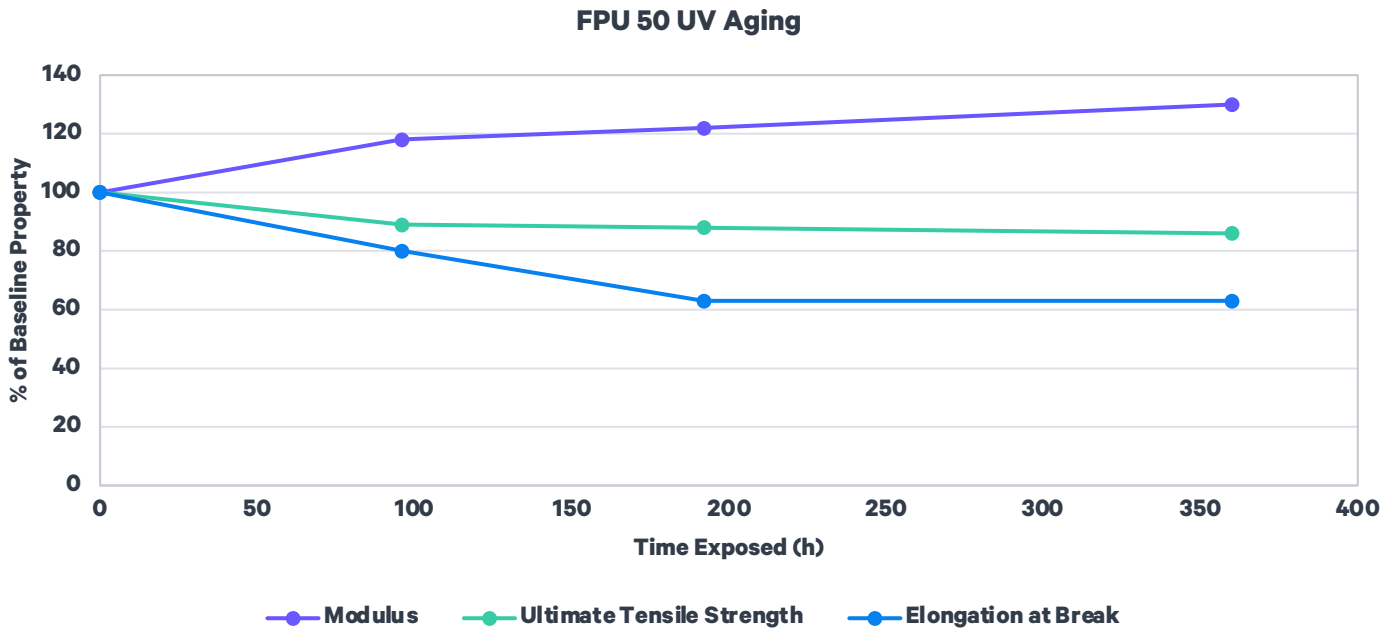
FPU 50 Creep Behavior

A creep test measures a polymer's rate of deformation under constant load at a fixed temperature and is a fundamental property for materials that need to operate under load. The figure below shows FPU 50 creeps approximately 2% strain over 12 hours at 65 °C and 1.8 MPa applied load. Low creep behavior is necessary for dimensional stability over time and loads.



FPU 50 UV Aging

Natural polymer aging can occur in the presence of light, sun, and heat. Carbon evaluated the UV aging performance of FPU 50 using ASTM D4459, which is intended to simulate indoor exposure of solar radiation through glass.



ASTM 4459: Q-Sun XE-1, 0.8 W/m^2 at 420 nm, 55 °C
ASTM D638: Type V, 10 mm/min, average values represented

FPU 50 Biocompatibility

Biocompatibility Testing

Printed parts were provided to NAMSA for evaluation in accordance with ISO 10993-5, *Biological evaluation of medical devices - Part 5: Tests for in vitro cytotoxicity*. Parts were processed using an M series printer and a Smart Part Washer with VF 1 as the solvent. The results indicated that FPU 50 passed the requirements for biocompatibility according to the above test. **Carbon has not conducted ISO 10993-10, *Biological evaluation of medical devices - Part 10: Tests for irritation and skin sensitization (GPMT)* testing. Carbon makes no representation and is not responsible for the results of any biocompatibility tests other than those specified above.**

Disclaimer

Biocompatibility results may vary based on printing and/or post-processing procedures.

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