EPU 40

EPU 40 is a high-performance polyurethane elastomer that is a good choice for applications where high elasticity and tear resistance are needed.

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Tensile Properties	Test Standard	Metric	US
Tensile Modulus	ASTM D412 Die C 500 mm/min	8 MPa	1200 psi
Elongation at Break		400%	400%
Stress at 50% Elongation		2 MPa	290 psi
Stress at 100% Elongation		3 MPa	440 psi
Stress at 200% Elongation		6 MPa	870 psi
Ultimate Tensile Strength		19 MPa	2700 psi

Other Mechanical Properties	Test Standard	Metric	US
Tear Strength	ASTM D624 Die C (die-cut)	25 kN/m	140 lbf/in
Compression Set	ASTM D395-B 23 °C, 72 h	35% (20%*)	
Bayshore Rebound Resilience	ASTM D2632	17% (30%*)	

Thermal Properties	Test Standard	Metric	US
T_g (DMA, tan(d))	ASTM D4065	10 °C	50 °F

Dielectric/Electric Properties	Test Standard	
Dielectric Constant	ASTM D150	4
Dissipation Factor		0.03
Dielectric Strength	ASTM D149	18 kV/mm
Volume Resistivity	ASTM D257	3.2 x 10^{12} ohm-cm

General Properties	Test Standard	
Shore A Hardness	ASTM D2240	72 (Instant), 71 (5 sec)
Bulk Density	ASTM D792	1.03 g/mL
Relative Abrasion Volume Loss	ISO-4649 A	170 mm^3

Parts were processed using an M series printer and a Smart Part Washer with DPM or VF 1 as the solvent. The washed test articles were baked following the standard baking schedule for EPU 40.

*Values obtained from materials printed using software versions prior to v1.33.

EPU 40

Liquid Properties	
Liquid Density (Part A)	0.99 g/mL
Liquid Density (Part B)	0.95 g/mL
Liquid Density (Part A+B)	0.99 g/mL
Part A:B Volume Ratio (Mass Ratio)	10.0 (10.4)
25 °C Viscosity (Part A)	5100 cP
25 °C Viscosity (Part B)	110 cP
25 °C Viscosity (Part A+B)	3600 cP

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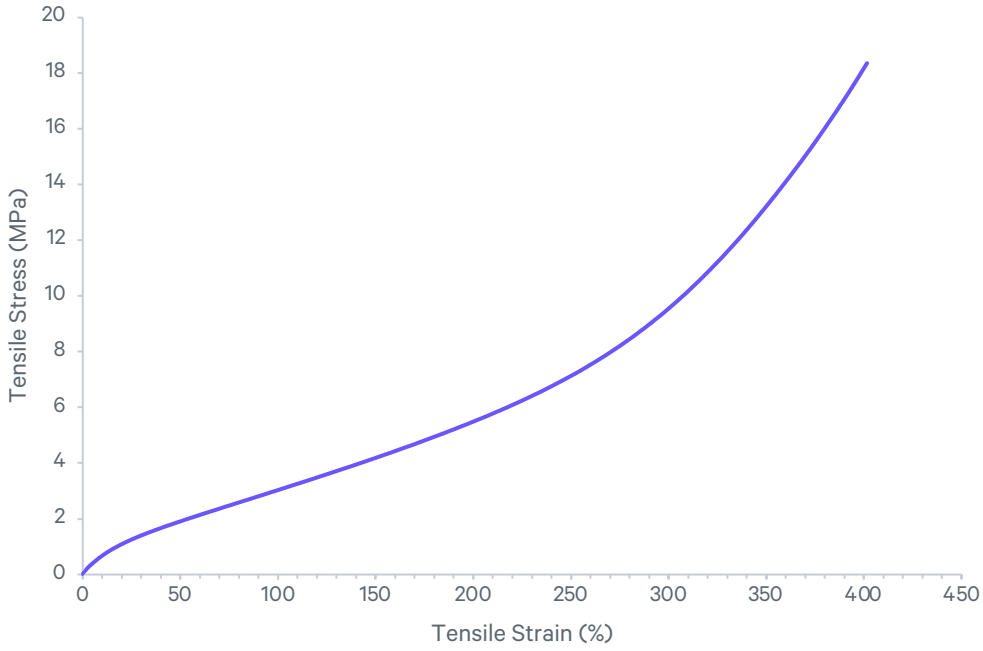
EPU 40

Extended TDS

EPU 40 Mechanical Properties

Representative Tensile Curve

ASTM D412, Die C, 500 mm/min

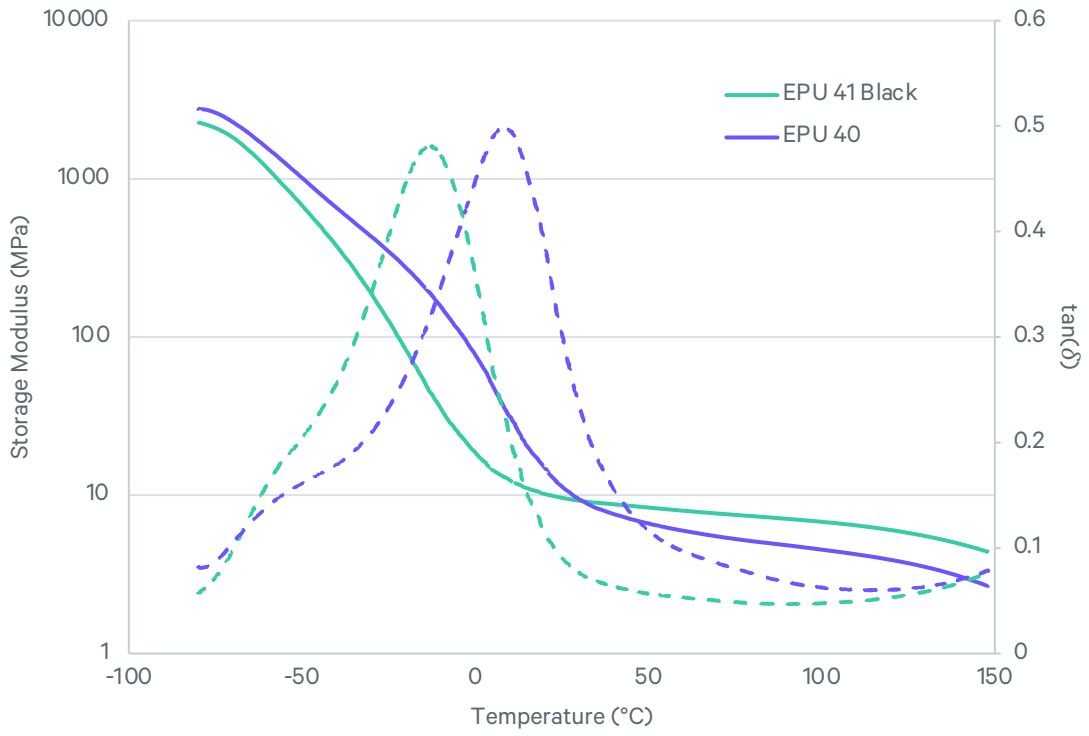


EPU 40 Dynamic Mechanical Analysis (DMA)

In impact and shock performance, damping properties are important. EPU 40 has a higher T_g compared to EPU 41 (tan(δ) peak) and overall higher damping coefficient (tan(δ)), indicating better damping performance at a broader temperature window.

EPU 41 T_g(tan(δ)) = -10 °C

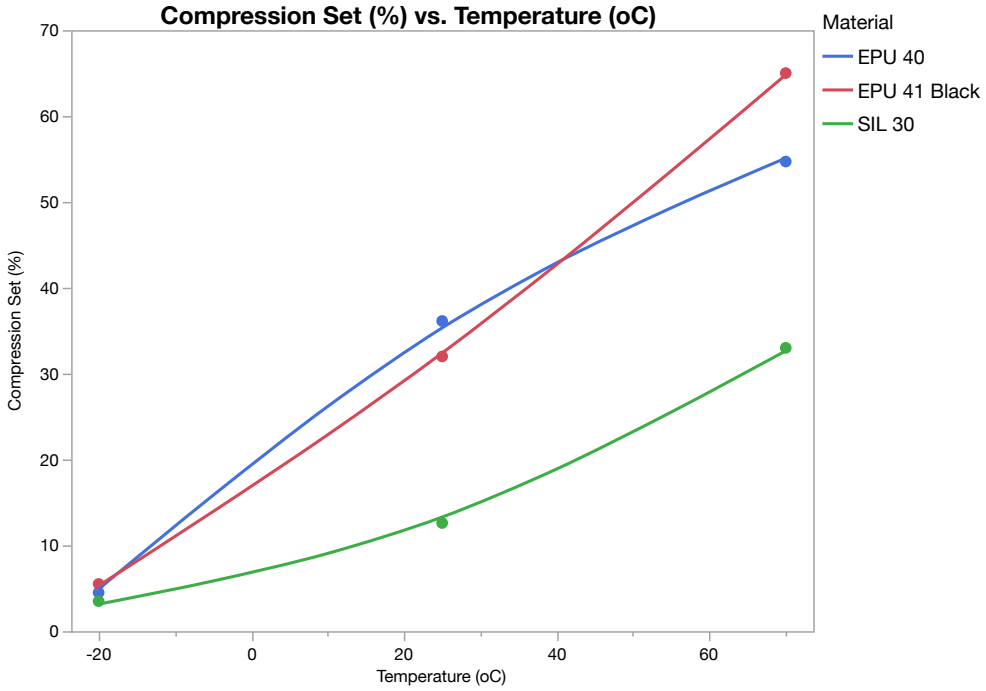
EPU 40 T_g (tan(δ)) = 10 °C



ASTM D4065
Q800 Tension Mode, Ramp Rate 2 °C/min, 1 Hz, 0.1% strain
Samples were post processed using DPM Smart Part Washer.

EPU 40 Compression Set

In many elastomeric applications, compression set is an important property that reflects the amount of residual deformation after holding compression at a fixed time, temperature, and displacement. EPU 40, EPU 41 Black, and SIL 30 were compressed to 25% of its original sample height and held at various temperatures (-20, 25, and 70 °C) for 72 hours. The compression set measurement is the residual deformation of a test specimen, where 0% represents full recovery of the original thickness and 100% indicates no recovery. The image below summarizes the compression set results for various Carbon elastomers.



ASTM D395-B

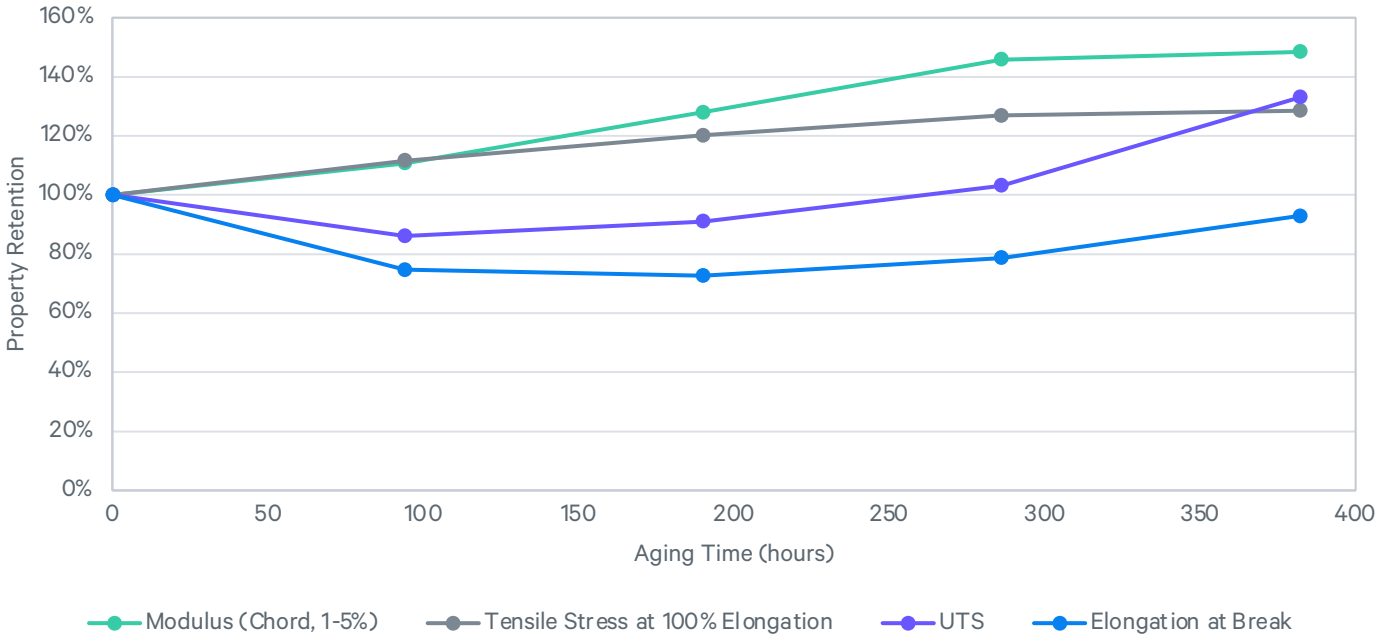
EPU 40 Chemical Compatibility

	Mass Gain* (%)
Household Chemicals	
Bleach (NaClO, 5%)	< 5%
Sanitizer (NH_4Cl, 10%)	< 5%
Distilled Water	< 5%
Sunscreen (Banana Boat, SPF 50)	5 – 15%
Detergent (Tide, Original)	< 5%
Windex Powerized Formula	5 – 15%
Hydrogen Peroxide (30%)	15 – 30%
Ethanol (95%)	> 30%
Industrial Fluids	
Engine Oil (Havoline SAE 5W-30)	< 5%
Brake Fluid (Castrol DOT-4)	15 – 30%
Airplane Deicing Fluid (Type I Ethylene Glycol)	< 5%
Airplane Deicing Fluid (Type I Propylene Glycol)	< 5%
Airplane Deicing Fluid (Type IV Ethylene Glycol)	< 5%
Airplane Deicing Fluid (Type IV Propylene Glycol)	< 5%
Transmission Fluid (Havoline Synthetic ATF)	< 5%
Engine Coolant (Havoline XLC, 50%/50% premixed)	< 5%
Diesel (Chevron #2)	> 30%
Gasoline (Chevron #91)	> 30%
Skydrol 500B-4	> 30%
Strong Acid/Base	
Sulfuric Acid (30%)	> 30%
Sodium Hydroxide (10%)	< 5%

*Percent weight gained after one week submersion following ASTM D543. Values do not represent changes in dimension or mechanical properties.

EPU 40 UV Aging

Natural polymer aging can occur in the presence of light, sun, and heat. Carbon evaluated the UV aging performance of EPU 40 using ASTM D4459, which is intended to simulate indoor exposure of solar radiation through glass.



ASTM D4459: Q-Sun XE-1, 0.8 W/m^2/nm at 420 nm, 55 °C
ASTM D412: Die C, 500 mm/min, average values represented

EPU 40 Biocompatibility

Biocompatibility Testing

Test articles in the form of printed parts were provided to NAMSA for evaluation and met the requirements of each of the following tests:

Biocompatibility Testing	Test Standard
Cytotoxicity	ISO 10993-5: Biological evaluation of medical devices – Part 5: Tests for *in vitro* cytotoxicity (MEM extract)
Sensitization	ISO 10993-10: Biological evaluation of medical devices – Part 10: Tests for skin sensitization (Closed patch sensitization study in guinea pigs)
Irritation	ISO 10993-23: Biological evaluation of medical devices – Part 23: Tests for irritation (Intracutaneous study in rabbits)

Test articles were processed using an M series printer and a Smart Part Washer with VF 1 as the solvent. The washed test articles were baked following the standard baking schedule for EPU 40: 120 °C for 8 hours. Additional details about the tests are available upon request.

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