

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.

Tensile Properties ASTM D412, Die C, 500 mm/min	Metric	US
Tensile Modulus	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	Metric	US
Tear Strength, Die C (die cut), ASTM D624	25 kN/m	140 lbf/in
Compression Set, 23 °C, 72 h, ASTM D395-B	35% (20%*)	
Bayshore Rebound Resilience, ASTM D2632	17% (30%*)	

Thermal Properties	Metric	US
T _g (DMA, tan(d)), ASTM D4065	10 °C	50 °F

Dielectric/Electric Properties		
Dielectric Constant, ASTM D150	4	
Dissipation Factor, ASTM D150	0.03	

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

The information in this document includes values derived from printing various parts, reflects an approximation of the mean value of a range of values, and is intended for reference and comparison purposes only. This information should not be used for testing, design specification or quality control purposes. End-use material performance can be impacted by, but not limited to, design, processing, color treatment, operating and end-use conditions, test conditions, etc. Actual values will vary with build conditions. In addition, product specifications are subject to change without notice.

This information and Carbon's technical advice are given to you in good faith but without warranty. The application, use and processing of these and other Carbon products by you are beyond Carbon's control and, therefore, entirely your own responsibility. Carbon products are only to be used by you, subject to the terms of the written agreement by and between you and Carbon.

You are responsible for determining that the Carbon material is safe, lawful, and technically suitable for the intended application, as well as for identifying the proper disposal (or recycling) method consistent with applicable environmental laws and regulations. CARBON MAKES NO WARRANTIES OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR USE, OR NON-INFRINGEMENT. Further, it is expressly understood and agreed that you assume and hereby expressly release Carbon from all liability, in tort, contract or otherwise, incurred in connection with the use of Carbon products, technical assistance and information. No license with respect to any intellectual property is implied.

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

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

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

The information in this document includes values derived from printing various parts, reflects an approximation of the mean value of a range of values, and is intended for reference and comparison purposes only. This information should not be used for testing, design specification or quality control purposes. End-use material performance can be impacted by, but not limited to, design, processing, color treatment, operating and end-use conditions, test conditions, etc. Actual values will vary with build conditions. In addition, product specifications are subject to change without notice.

This information and Carbon's technical advice are given to you in good faith but without warranty. The application, use and processing of these and other Carbon products by you are beyond Carbon's control and, therefore, entirely your own responsibility. Carbon products are only to be used by you, subject to the terms of the written agreement by and between you and Carbon.

You are responsible for determining that the Carbon material is safe, lawful, and technically suitable for the intended application, as well as for identifying the proper disposal (or recycling) method consistent with applicable environmental laws and regulations. CARBON MAKES NO WARRANTIES OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR USE, OR NON-INFRINGEMENT. Further, it is expressly understood and agreed that you assume and hereby expressly release Carbon from all liability, in tort, contract or otherwise, incurred in connection with the use of Carbon products, technical assistance and information. No license with respect to any intellectual property is implied.

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

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

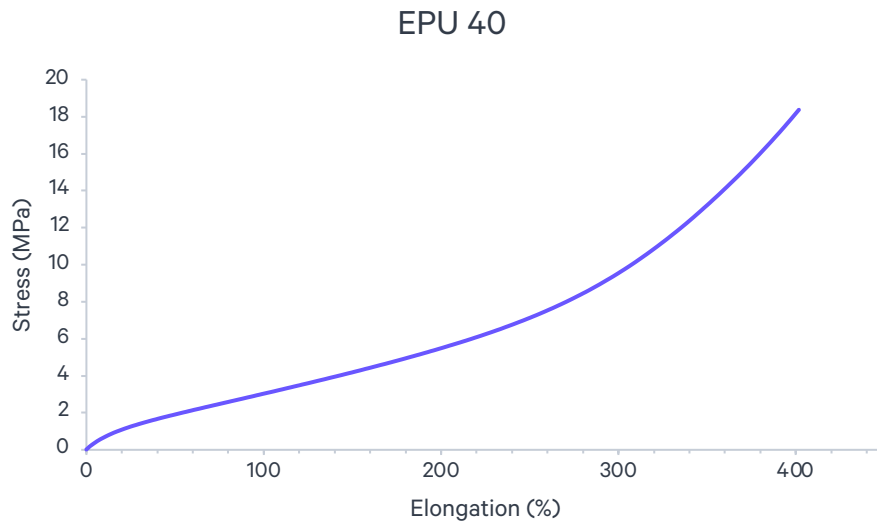
EPU 40

Extended TDS

EPU 40 Mechanical Properties

Representative Tensile Curve

ASTM D412, Die C, 500 mm/min



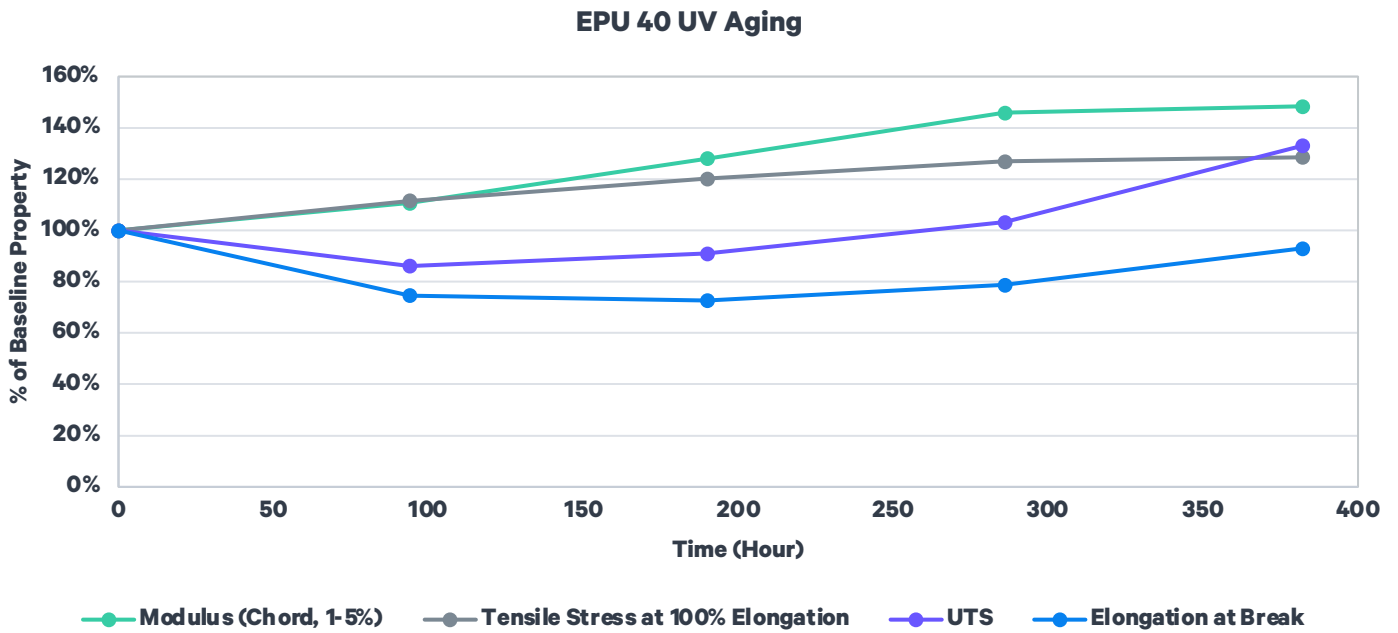
EPU 40 Chemical Compatibility

	Mass Gain (%)
Household Chemicals	
Bleach (NaClO, 5%)	< 5%
Sanitizer (NH ₄ Cl, 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.



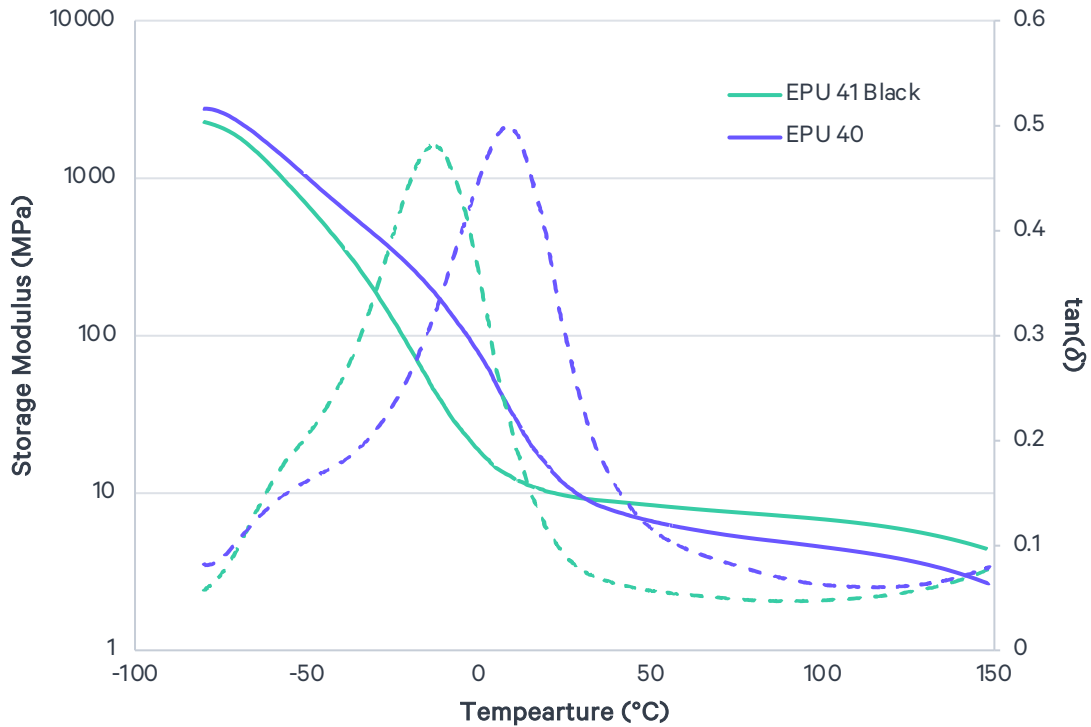
ASTM D4459: Q-Sun XE-1, 0.8 W/m²/nm at 420 nm, 55 °C
ASTM D412: Die C, 500 mm/min, average values represented

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 ($\tan(\delta)$ peak) and overall higher damping coefficient ($\tan(\delta)$), indicating better damping performance at a broader temperature window.

EPU 41 $T_g(\tan(\delta)) = -10\text{ }^\circ\text{C}$

EPU 40 $T_g(\tan(\delta)) = 10\text{ }^\circ\text{C}$



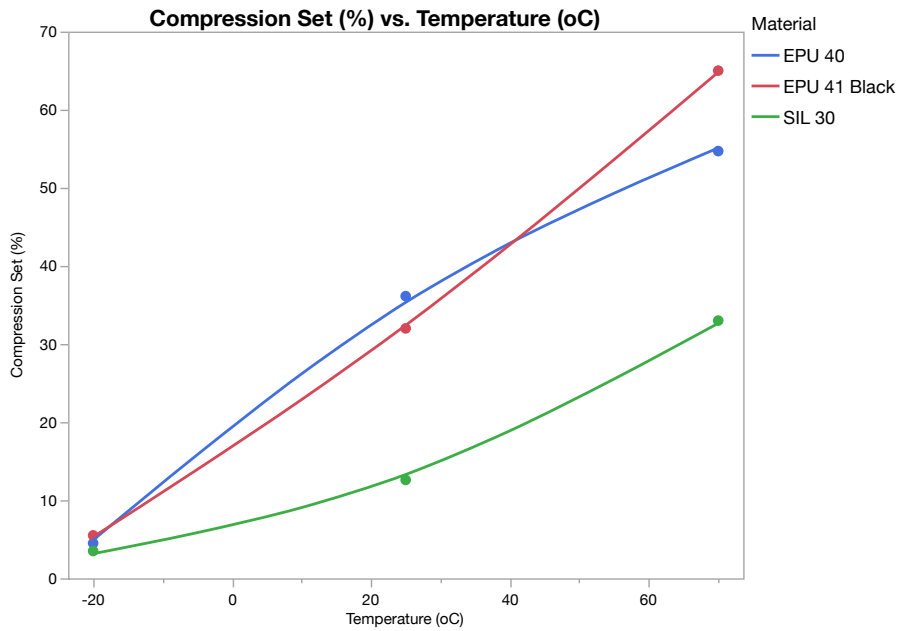
ASTM D4065

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, 4, 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 D394-14 Method B

EPU 40 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*, and ISO 10993-10, *Biological evaluation of medical devices - Part 10: Tests for irritation and skin sensitization* (specifically the Closed Patch Sensitization Study). Parts were processed using an M series printer and a Smart Part Washer with VF 1 as the solvent. The results for all tests indicated that EPU 40 passed the requirements for biocompatibility according to the above tests. **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.

Subscriber acknowledges the contents of this document are subject to the Terms and Conditions outlined in the Subscription Agreement, including the Restrictions on Use section.

DO NOT USE CARBON MATERIALS IN MEDICAL APPLICATIONS INVOLVING IMPLANTATION IN THE HUMAN BODY OR CONTACT WITH BODY FLUIDS OR TISSUES UNLESS THE MATERIAL HAS BEEN PROVIDED FROM CARBON UNDER A WRITTEN CONTRACT THAT IS CONSISTENT WITH THE CARBON POLICY REGARDING MEDICAL APPLICATIONS AND EXPRESSLY ACKNOWLEDGES THE CONTEMPLATED USE. CARBON MAKES NO REPRESENTATION, PROMISE, EXPRESS WARRANTY OR IMPLIED WARRANTY CONCERNING THE SUITABILITY OF THESE MATERIALS FOR USE IN IMPLANTATION IN THE HUMAN BODY OR IN CONTACT WITH BODY FLUIDS OR TISSUES. If Carbon has permitted in the Subscription Agreement use of the Carbon printer for applications that require biocompatibility, Subscriber acknowledges that it is the responsibility of Subscriber, its respective customers and end-users to determine the biocompatibility of all printed parts for their respective uses.

Carbon, Inc. | www.carbon3d.com
1089 Mills Way Redwood City, CA 94063
1 (650) 285-6307