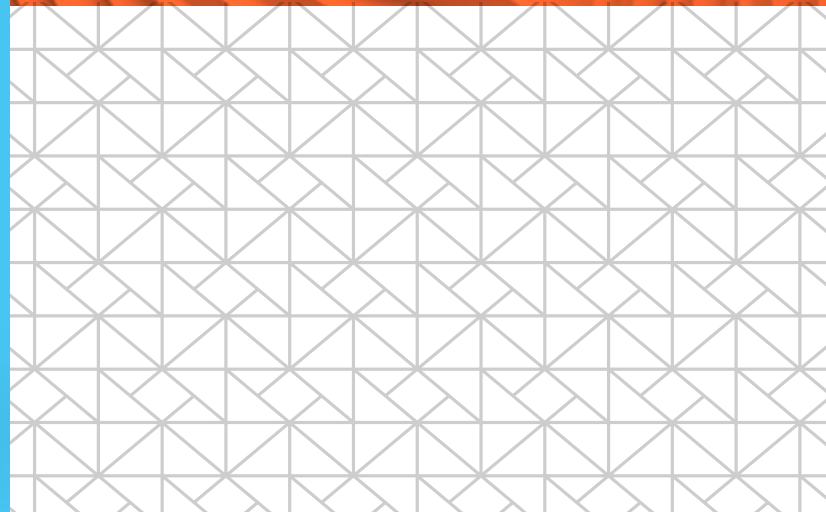
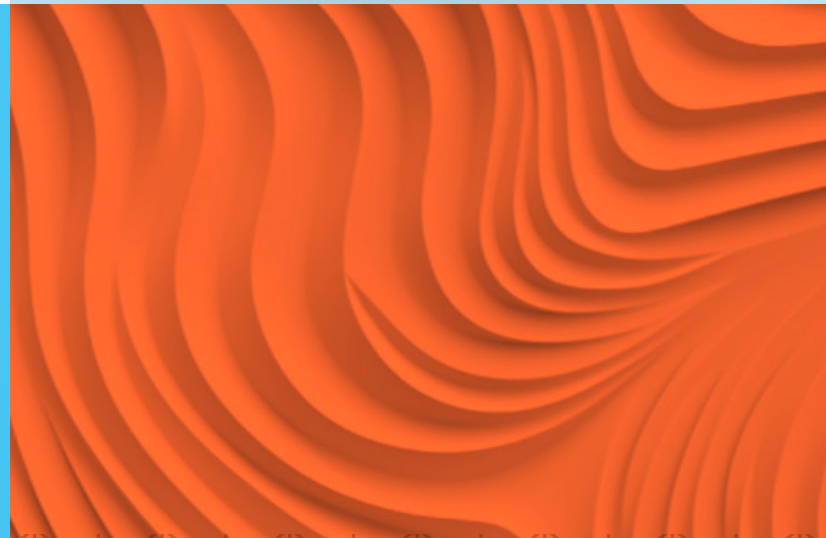
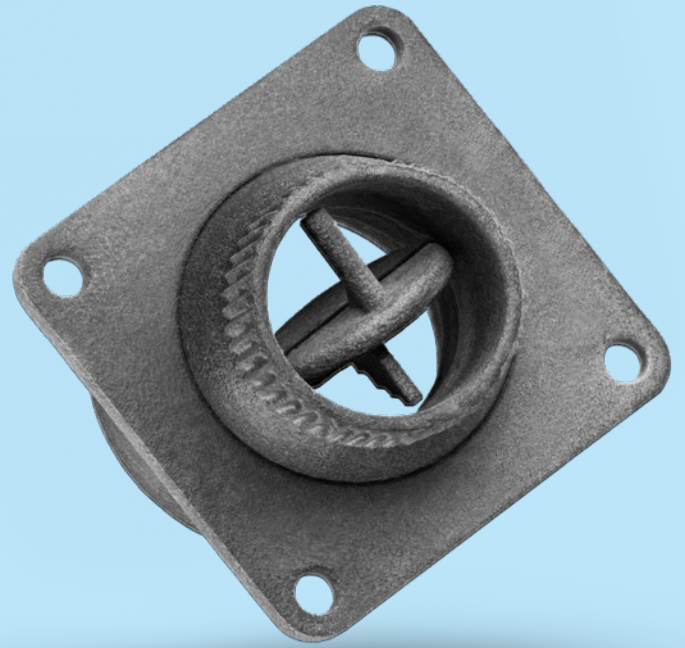




Stratasys High Yield PA11

Stratasys H350™
using SAF™ technology

The information presented are typical values intended for reference and comparison purposes only. They should not be used for design specifications or quality control purposes.





Overview

Processed with SAF™ technology on the Stratasys H350 3D printer, Stratasys High Yield PA11 delivers production-grade plastic parts for high-volume demands – driving new areas of business growth. Stratasys High Yield PA11 enables a high nesting density while maintaining high part consistency to deliver production-level yields. Crucially, this datasheet includes both mechanical and geometric properties from within the same builds, highlighting the H350's ability to produce both strong and accurate parts, with no compromise.

In additive manufacturing, PA12 is the go-to material for prototyping. But in traditional high-volume production of end-use parts, PA11 is much more widely used due to its higher ductility and higher impact resistance, as well as its suitability for a wider range of industry applications. PA11 is also eco-friendly and 100 percent bio-based from sustainable castor oil.

Contents:

Mechanical Properties.....	3
Geometric Properties	6
Physical Properties	7
Testing Varying Temperatures	7



Mechanical Properties

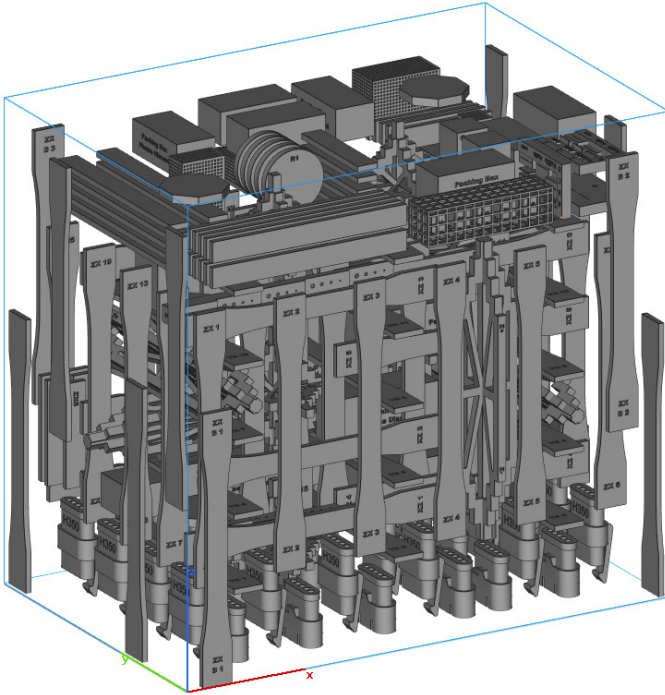


Figure 1: The Full Standard Test Build

The mechanical data in this datasheet were generated from parts in the “Full Standard Test Build” (figure 1) built using Stratasys High Yield PA11, processed using SAF™ technology on the Stratasys H350.

Comprehensive Sample Sizes

The mechanical data come from over 2000 tensile specimens (972 in X/Y and 1,080 in Z direction), 540 flexural specimens (360 in X/Y and 180 in Z) and 540 impact specimens (360 in X/Y and 180 in Z), all printed in 36 builds from 5 different printers split between the UK and Denmark. Each build has 30 tensile specimens in the ZX orientation and 27 collectively in the XZ and YX orientations.

Standard Build and Test Practices

The build was prepared using Materialise Magics and sliced using the Stratasys Build Processor. The parts were built with standard machine settings following the H350 installation process. The material consisted of 70% used powder and 30% virgin powder by mass, as per H350 guidelines. Post processing of parts followed H350 guidelines including 24 hours cooling after removal from the machine, manual breaking out, and powder removal via automated bead blasting. No further post processing was performed. All testing was to ASTM or ISO standards where applicable. All parts were preconditioned according to ASTM D618-13.



Mechanical Properties

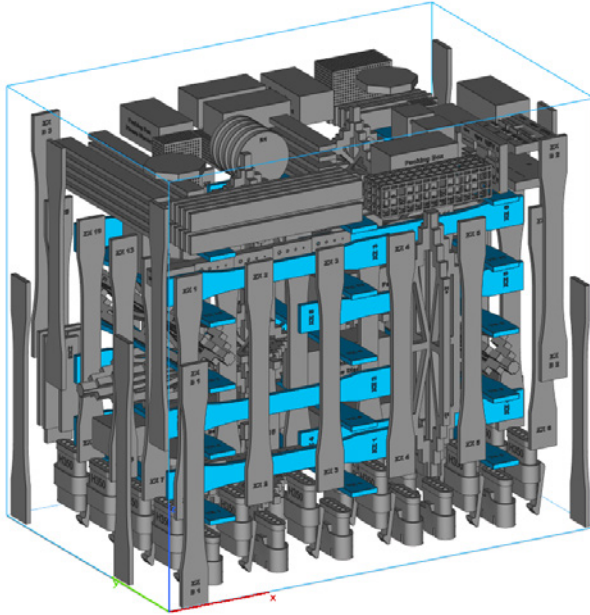


Figure 2: The placement of the XZ and YX tensile specimens

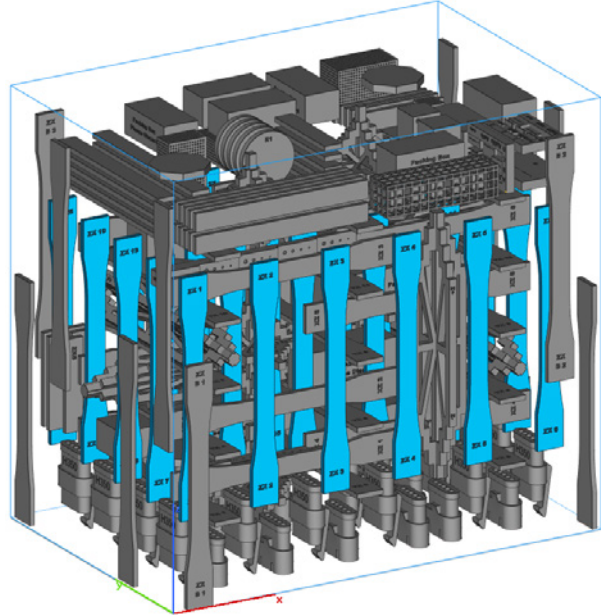


Figure 3: The placement of the ZX tensile specimens

Full Build Characterisation

The “Full Standard Test Build” contains a wide spread of ASTM D638-14 Type 1 tensile specimens in three orientations: ZX (upright), XZ (on end) and YX (laid flat).

The 27 XZ and YX specimens (highlighted in figure 2) and the 30 ZX specimens (highlighted in figure 3) are comprehensively placed within the test build, allowing full characterisation of the build volume and real confidence in the mechanical performance of the H350.

The test build also contains geometric property specimens, physical property specimens and give-away parts at a part nesting density of 12%.

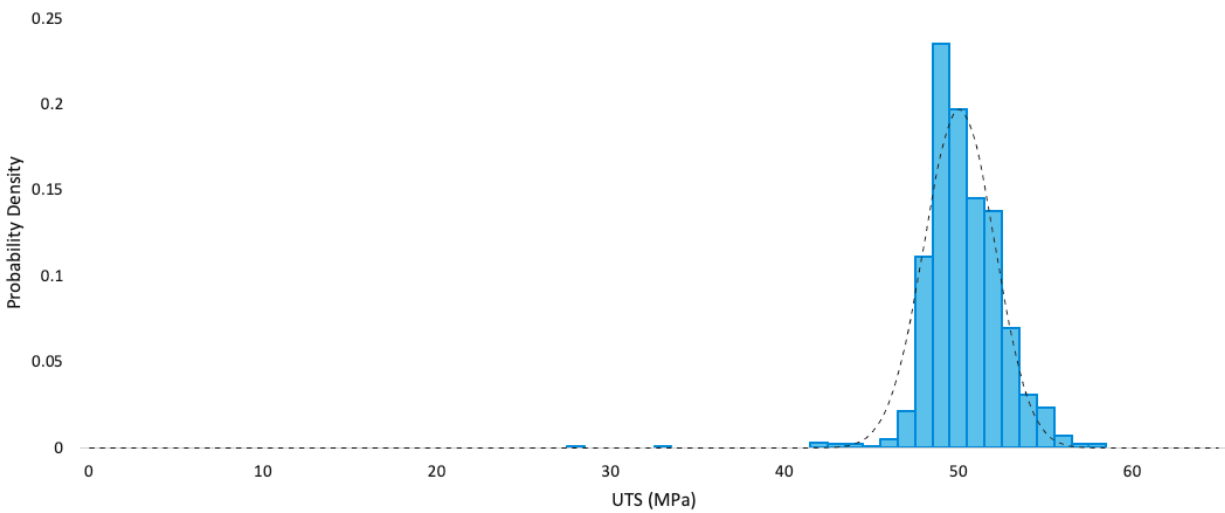
Property	Mean	Standard Deviation	Unit	Standard
Tensile Strength (XZ,YX)	51 (7397)	2.2 (319)	MPa (psi)	ASTM D638-14
Tensile Strength (ZX)	47 (6817)	4.4 (638)	MPa (psi)	ASTM D638-14
Elongation at Break (XZ,YX)	30	5.6	%	ASTM D638-14
Elongation at Break (ZX)	11	4.8	%	ASTM D638-14
0.2% Offset Yield Strength (XZ,YX)	35 (5076)	1.6 (232)	MPa (psi)	ASTM D638-14
0.2% Offset Yield Strength (ZX)	34 (4931)	2.5 (363)	MPa (psi)	ASTM D638-14
Tensile Modulus (XZ,YX)	1529 (222)	76 (11)	MPa (ksi)	ASTM D638-14
Tensile Modulus (ZX)	1609 (233)	99 (14)	MPa (ksi)	ASTM D638-14
Flexural Strength (XZ,YX)	51 (7357)	1.56 (227)	MPa (psi)	ASTM D790-17
Flexural Strength (ZX)	52 (7513)	1.4 (202)	MPa (psi)	ASTM D790-17
Flexural Modulus (XZ,YX)	1340 (195)	40 (5.7)	MPa (ksi)	ASTM D790-17
Flexural Modulus (ZX)	1390 (202)	37 (5.4)	MPa (ksi)	ASTM D790-17
Notched Impact Strength (XZ,YX)	7.4 (3.5)	0.6 (0.3)	kJ/m ² (Ft.lbf/in ²)	ASTM D256-10
Notched Impact Strength (ZX)	4.5 (2.1)	0.2 (0.1)	kJ/m ² (Ft.lbf/in ²)	ASTM D256-10



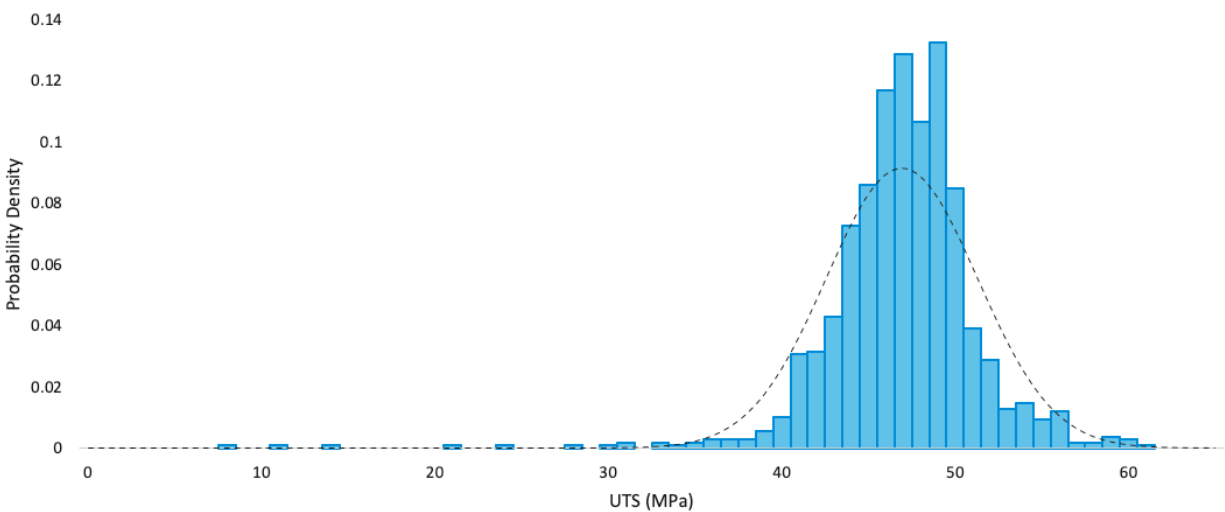
Mechanical Properties

The below histograms visualise the mechanical data presented in this datasheet.

Ultimate Tensile Strength (XZ/YX) (n=972 specimens, 36 builds, 5 machines)



Ultimate Tensile Strength (ZX) (n=1,080 specimens, 36 builds, 5 machines)





Geometric Properties

The following geometric data were generated from the same builds as the previous mechanical data, made possible by the H350's ability to make both strong and accurate parts with the same settings. The days of compromising are over.

All parts were built and post-processed using the same standard methods as stated in the mechanical section. All parts were measured with a Mitutoyo touch probe co-ordinate measuring machine (CMM).

The geometric data come from the same 36 builds across 5 machines split between the UK and Denmark, with each build providing 522 geometric data points from a wide range of XY locations and Z heights, split evenly through the X, Y and Z axes and covering a nominal range from 5mm to 80mm.

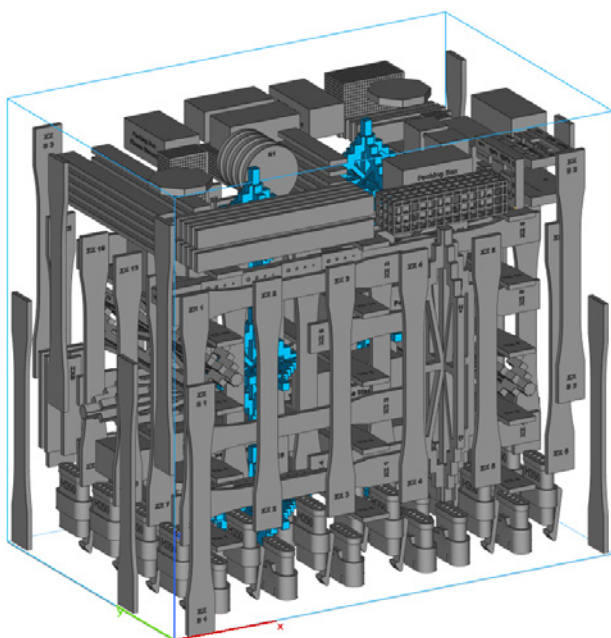


Figure 4: The placement of the geometric specimens

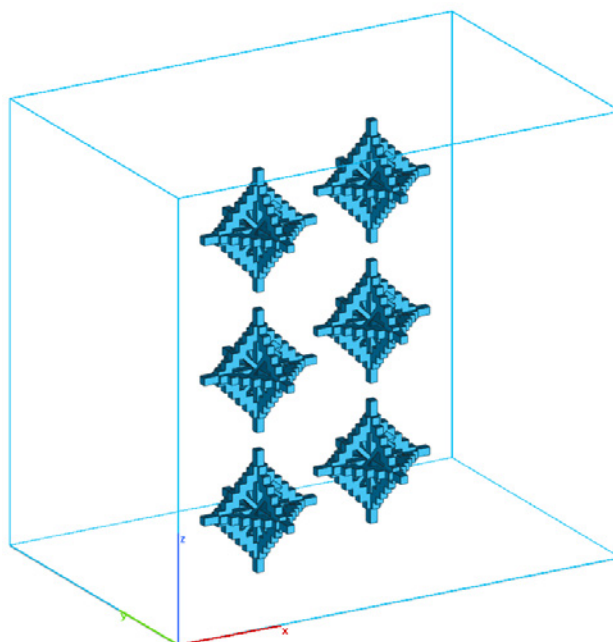


Figure 5: The geometric specimens highlighted

The data come from 6 “Star” parts (in figures 4 and 5) built in a range of locations in the bed. This allows comprehensive characterisation of the build volume and real confidence in the consistency and accuracy of the geometric performance of the H350.

The geometric data are quoted as yields against an example tolerance of $\pm 300\mu\text{m}$ (12 thou). This tolerance is applied to all measurements across all nominals and recorded as pass/fail. These pass/fails are then used to calculate an overall yield.

Tolerance	Yield (XY)	Yield (Z)
$\pm 300\mu\text{m}$ (12 thou)	95.9%	93.5%



Physical Properties

General	Value	Unit	Standard
Part Specific Gravity	1.02	-	ASTM D792-13
Virgin Particle Size D50	47 (1.9)	µm (thou)	-
Virgin Powder Melting Point	202 (396)	°C (°F)	-
Surface	Value	Unit	Standard
Surface Roughness, Top Surface (Ra)	8.5 (0.3)	µm (thou)	ISO 4287
Surface Roughness, Bottom Surface (Ra)	7.2 (0.3)	µm (thou)	ISO 4287
Surface Roughness, Sidewall (Ra)	7.9 (0.3)	µm (thou)	ISO 4287
Thermal	Value	Unit	Standard
Heat Deflection Temperature (0.45MPa/65psi)	185 (365)	°C (°F)	ASTM D648
Heat Deflection Temperature (1.82MPa/264psi)	47 (117)	°C (°F)	ASTM D648
Coefficient of Thermal Expansion	171 (0.095)	µm/°C.m (thou/in.°F)	ASTM E831
Specific Heat Capacity (20°C/68°F)	1.72 (0.411)	J/g.°C (BTU/lbm.°F)	ASTM E1952
Thermal Conductivity (20°C/68°F)	0.263 (0.152)	W/°C.m (BTU/hr.ft.°F)	ASTM E1952
Electrical	Mean	Unit	Standard
Surface resistivity	1.9 x10 ¹⁵	Ohm	ASTM D257
Volume resistivity	3.6 x10 ¹⁴	Ohm-cm	ASTM D257
Bio compatibility	Result	Unit	Standard
Determination of Sensitization - human cell line activation test (h-Clat)	Non-Sensitizer	N/A	OECD 442E 2018-06
Determination of Skin Irritation	Non-irritant	N/A	ISO 10993-10 2014-10 / OECD 439 2015-07
Determination of Cytotoxicity	Material shows no cytotoxic effect	N/A	DIN EN ISO 10993-5, 2009, Annex D
Flammability		Unit	Standard
UL94 HB	Pass*	Not Applicable	UL94 (2013)
Reusability	Value	Unit	Standard
Typical Powder Mix Ratio (Virgin)	30	%	-

* Product is not currently UL Blue Card Registered.

Testing Varying Temperatures

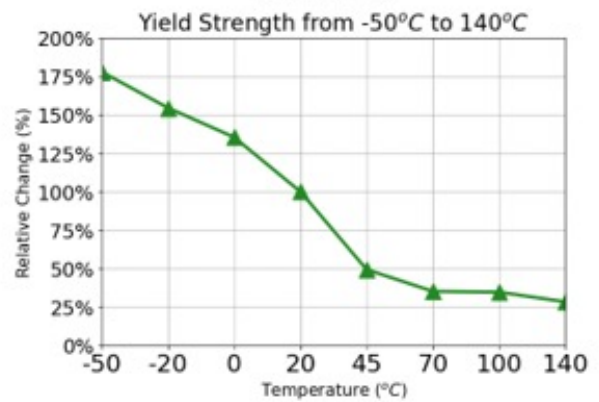
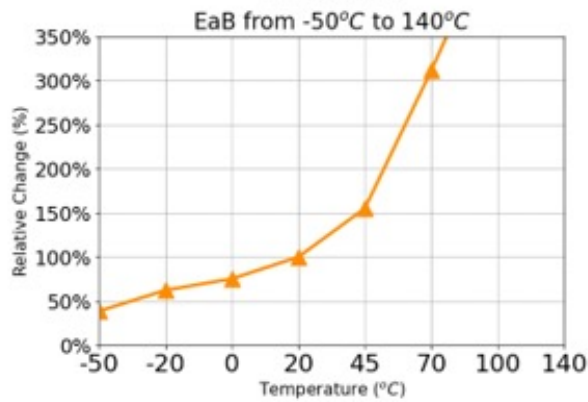
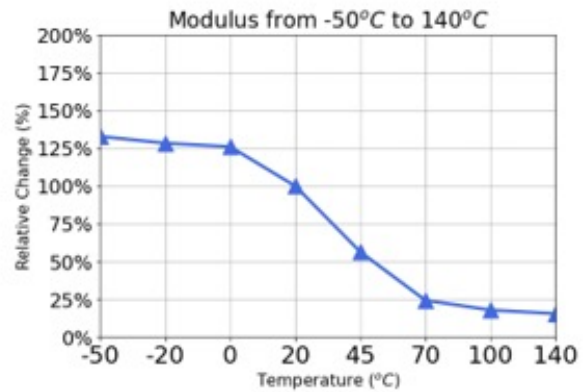
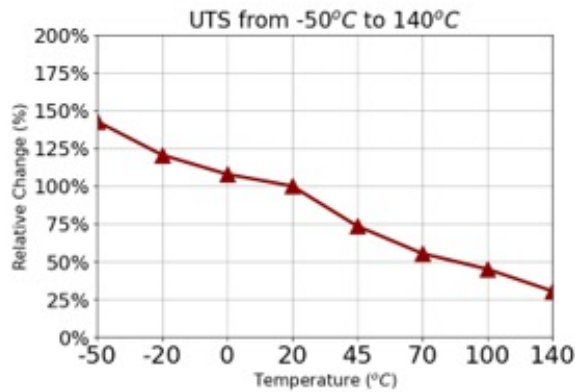
The following results give an indication of the tensile properties of the material across a range of temperatures. Tensile testing was conducted between -50°C (-58°F) and 140°C (284°F) with all coupons and testing in accordance with ASTM D638-22. Coupons were manufactured in both XZ and ZX directions with 5 coupons per direction. The results are presented as a percentage of room temperature properties.

XZ

When testing samples at high temperatures, ductility is significantly increased. This can lead to samples stretching beyond the capability of the test equipment rather than having a definitive failure point. With no failure point, the elongation at break and ultimate strength of the sample cannot be accurately measured. Values affected by this are highlighted in **blue**. Where necessary, these values are excluded from the plots below to keep the scales legible.

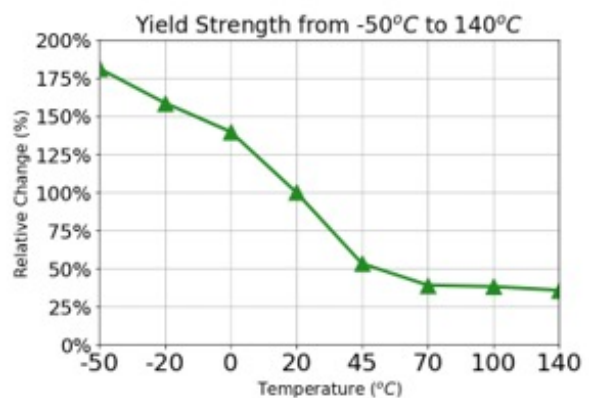
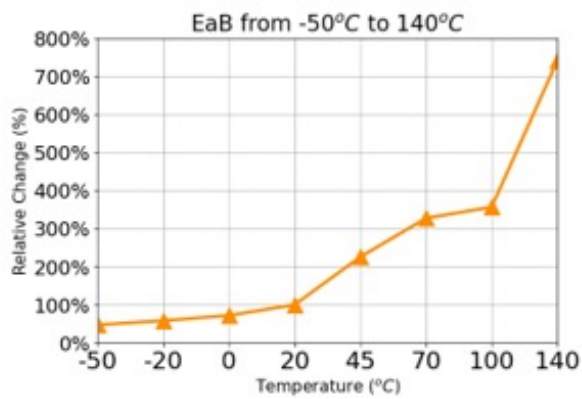
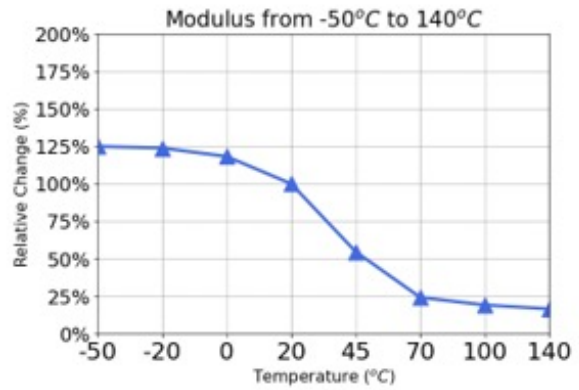
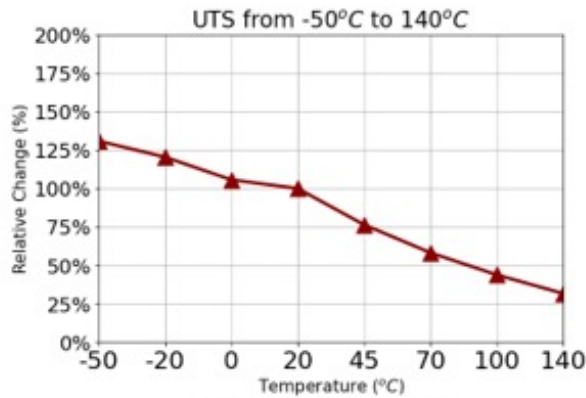


Material	Direction	Temp		Ultimate Tensile Strength	Elongation at Break	Tensile Modulus	Yield Strength
		(F)	(C)				
High Yield PA11	XZ	-58	-50	143%	39%	133%	178%
		-4	-20	121%	62%	128%	155%
		32	0	108%	75%	126%	135%
		113	45	74%	155%	56%	49%
		158	70	55%	311%	24%	35%
		212	100	45%	479%	18%	35%
		284	140	31%	485%	16%	28%



ZX

Material	Direction	Temp		Ultimate Tensile Strength	Elongation at Break	Tensile Modulus	Yield Strength
		(F)	(C)				
High Yield PA11	ZX	-58	-50	131%	47%	125%	181%
		-4	-20	120%	58%	124%	159%
		32	0	106%	72%	118%	140%
		113	45	76%	225%	55%	53%
		158	70	58%	327%	24%	39%
		212	100	44%	356%	19%	38%
		284	140	32%	741%	17%	36%



Disclaimer:

¹ Customer acknowledges the contents of this document and that Stratasys parts, materials, and supplier are subject to its standard terms and conditions, available on <http://www.stratasys.com/legal/terms-and-conditions-of-sale>, which are incorporated herein by reference.

² The specifications and/or information on which this document is based are subject to change without notice.

³ The information presented are typical values intended for reference and comparison purposes only. They should not be used for design specifications or quality control purposes. End-use material performance can be impacted (+/-) by, but not limited to, part design, end-use conditions, test conditions, etc. Actual values will vary with build conditions. Tested parts were built on the Stratasys H350 3D printer. Product specifications are subject to change without notice. The performance characteristics of these materials may vary according to application, operating conditions, or end use. Each user is responsible for determining that the Stratasys 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. Stratasys makes no warranties of any kind, express or implied, including, but not limited to, the warranties of merchantability, fitness for a particular use, or warranty against patent infringement.



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MATERIAL DATA SHEET
SAF

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