Technical Data Sheet

Ultrafuse® PLA Tough

Date / Revised: 20.10.2023 Version No.: 2.2

General information

Components

Polylactic acid based filament for Fused Filament Fabrication.

Product Description

Ultrafuse® PLA Tough is a highly versatile biocompatible and biobased material specially developed for the needs of professional users. It effortlessly accommodates validated high printing speeds without the need for any hardware adjustment while offering an exceptional surface finish and an impressive impact strength. Moreover, it boasts a notably high success rate for large print jobs, ensuring a straightforward and cost-effective printing process. Ultrafuse® PLA Tough can be an alternative for ABS as it is more sustainable, strong and easy to print. As it is compatible with water-soluble BVOH support material, it is the perfect solution for printing complex geometries for demanding high-volume applications. Furthermore, Ultrafuse® PLA Tough parts can be annealed in a separate process step, which will increase the toughness and its heat resistance significantly.

Delivery form and warehousing

Ultrafuse® PLA Tough filament should be stored at 15 - 25°C in its originally sealed package in a clean and dry environment. If the recommended storage conditions are observed the products will have a minimum shelf life of 12 months.

Product safety

Recommended: Process materials in a well-ventilated room, or use professional extraction systems. For further and more detailed information please consult the corresponding material safety data sheets.

Disclaimer

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out their own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed. Values in this document are average values, measured and calculated according to the instructions in the listed standards. The used specimens are produced with the Fused Filament Fabrication method. Measured values can vary depending on used print orientation and print parameters.

Please contact us for further product information, like for example REACH, RoHS, FCS.

Filament Properties		
Filament Diameter	1.75 mm	2.85 mm
Diameter Tolerance	±0.050 mm	±0.1 mm
Roundness	0 - 0.050 mm	
Available Spool size	750 g, 1.0 kg, 2.0 kg, 4.0 kg, 8.0 kg	
Available colors	Natural, black	

Spool Properties					
Available Spool size	750 g	1.0 kg	2.0 kg	4.0 kg	8.0 kg
Outer diameter	200 mm	200 mm	300 mm	350 mm	355 mm
Inner diameter	50.5 mm	52 mm	51.5 mm	51.7 mm	36 mm
Width	55 mm	67 mm	103 mm	103 mm	167 mm

Recommended 3D-Print processing parameters		Used for test specimens
Printer	FFF printer	Ultimaker S5
Nozzle Temperature[1]	200 – 220 °C / 392 – 428 °F	220 °C / 428 °F
Build Chamber Temperature	-	Indirect heating (cover)
Bed Temperature	50 – 70 °C / 122 – 158 °F	60 °C / 140 °F
Bed Material	Glass	Glass
Nozzle Diameter	≥ 0.4 mm	0.4 mm
Print Speed	40 – 300 mm/s[1]	40 mm/s

Please check your standard and/or high speed print profile availability for an easy start at www.forward-am.com.

[1]Fast printing might require an additional increase of the nozzle temperature; the stated printing speed of 300 mm/s is based on current validations. As equipment and technology continues to evolve, it is possible that even higher printing speeds may be attainable in the future.

Annealing Recommendations for Performance Enhancement		
Equipment	Use an oven which can heat up to ~120°C.	
Part preparation	Place the parts inside the oven. Fix larger parts to avoid potential deformation during the annealing process.	
Annealing Process[2]	Heating	From room temperature to 120°C / 248 °F in ~15 min (ramp up time).
	Holding the temperature	120°C / 248 °F for 30 min (thicker parts might require a longer time).
	Cooling	From 120°C / 248 °F to room temperature in ~15 min (ramp down time).

[2]The annealing process can lead to a minor deviation in the dimensional accuracy. It is observed for the cross section of DIN EN ISO 527 Type 1A tensile bars minor deviation of up to +2% in thickness (nominal value 4 mm) and -1% in width (nominal value 10mm).

Further Recommendations	
Drying recommendations to ensure printability and best mechanical properties	Ultrafuse® PLA Tough is in a printable condition, drying is not necessary.
Support material compatibility	Single material breakaway, Ultrafuse® BVOH.

General Properties		Standard
Filament Density*	1215 kg/m^3 / 75.9 lb/ft^3	ISO 1183-1

*measured on filament

Classification and Certification		Standard
Biocompatibility		
Cytotoxicity XTT neutral red	Passed	ISO 10993-5
Skin irritation	Passed	ISO10993-10
Skin sensitization LLNA KretinoSens	Passed	ISO10993-10

Thermal Properties		Standard
HDT A (at 1.8 MPa)	55 °C / 131 °F	ISO 75-2
HDT A (at 1.8 MPa) (annealed)	65 °C / 149 °F	ISO 75-2
HDT B (at 0.45 MPa)	57 °C / 135 °F	ISO 75-2
HDT B (at 0.45 MPa) (annealed)	94 °C / 201 °F	ISO 75-2
Vicat softening point at 50 N	59 °C / 138 °F	ISO 306
Vicat softening point at 50 N (annealed)	86 °C / 187 °F	ISO 306
Vicat softening point at 10 N	61 °C / 142 °F	ISO 306
Vicat softening point at 10 N (annealed)	157 °C / 315 °F	ISO 306
Glass Transition Temperature	62 °C / 143.6 °F	ISO 11357-2
Melting Temperature	172 °C / 341.6 °F	ISO 11357-3
Melt Volume-Flow Rate	5.31 cm^3/10 min / 0.32 in^3/10 min (210 °C, 2.16 kg)	ISO 1133
Melt Mass-Flow Rate	5.68 g/10 min / 0.20 oz/10 min (210 °C, 2.16 kg)	ISO 1133

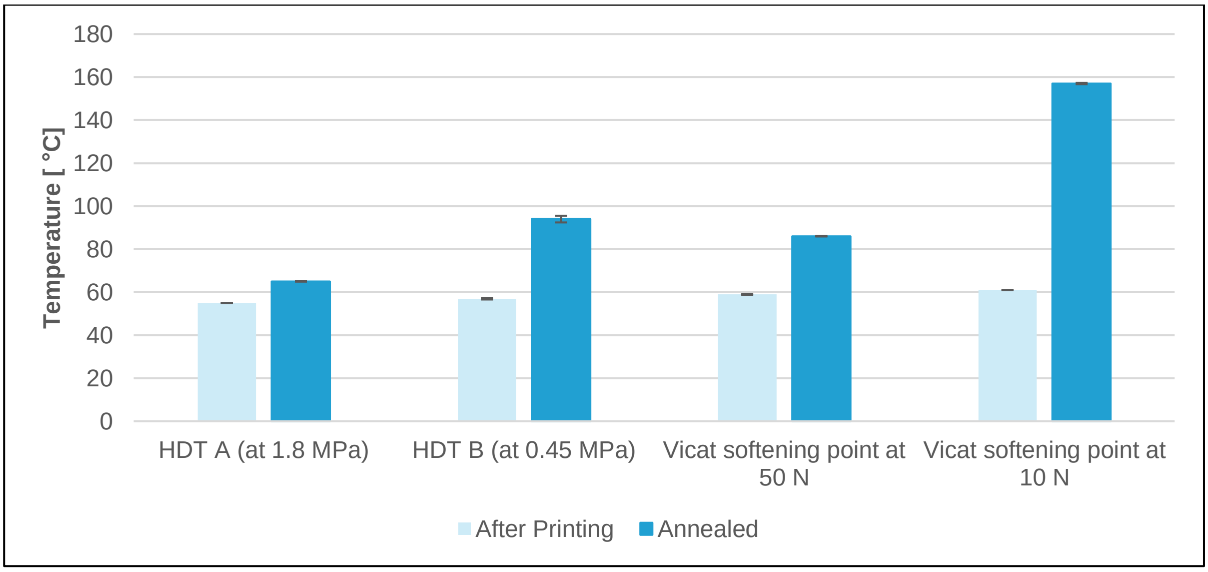
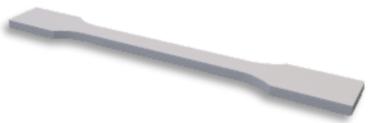


Figure 1: Heat resistance of the material after printing and annealed

Mechanical Properties[1]



Print direction	Standard	XY	XZ	ZX[5]
		Flat	On its edge (annealed)	Upright
Tensile strength[2]	ISO 527	40 MPa / 5.8 ksi	-	28 MPa / 4.1 ksi
Elongation at Break[2]	ISO 527	7.4 %	-	2.5 %
Young's Modulus[3]	ISO 527	2672 MPa / 387.5 ksi	-	2576 MPa / 373.6 ksi
Flexural Strength[4]	ISO 178	73 MPa / 10.6 ksi	75 MPa / 10.9 ksi	51 MPa / 7.4 ksi
Flexural Modulus[4]	ISO 178	2690 MPa / 390.2 ksi	2410 MPa / 349.5 ksi	2390 MPa / 346.6 ksi
Flexural Elongation at Break[4]	ISO 178	No break	No break	3.1 %
Impact Strength Charpy (notched)	ISO 179-2	18 kJ/m^2	8.6 kJ/m^2 (19.8 kJ/m^2)	2.5 kJ/m^2
Impact Strength Charpy (unnotched)	ISO 179-2	33 kJ/m^2	34 kJ/m^2 (54.1 kJ/m^2)	10 kJ/m^2
Impact Strength Izod (notched)	ISO 180	18 kJ/m^2	7,1 kJ/m^2	2,4 kJ/m^2
Impact Strength Izod (unnotched)	ISO 180	28 kJ/m^2	27 kJ/m^2	10 kJ/m^2

[1]Conditioning of the specimens: Standard climate (23°C, 50% RH 72h)
[2]testing speed: 5 mm/min
[3]testing speed: 1 mm/min
[4]testing speed: 2 mm/min
[5]messured on milled specimens

Mechanical Properties: Diagrams

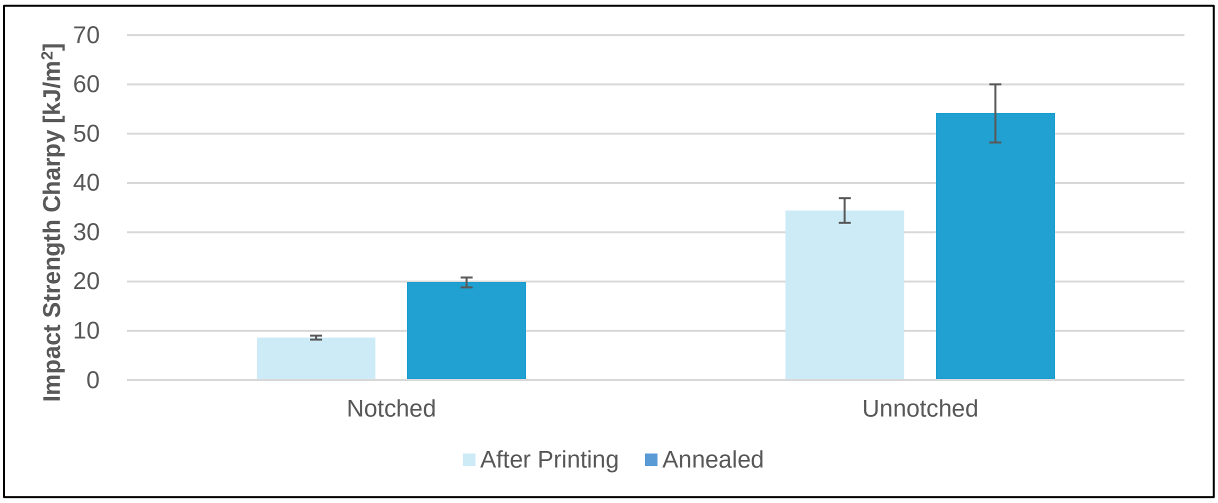


Figure 2: Impact Strength Charpy after printing vs. annealed (Printed in XZ-orientation).

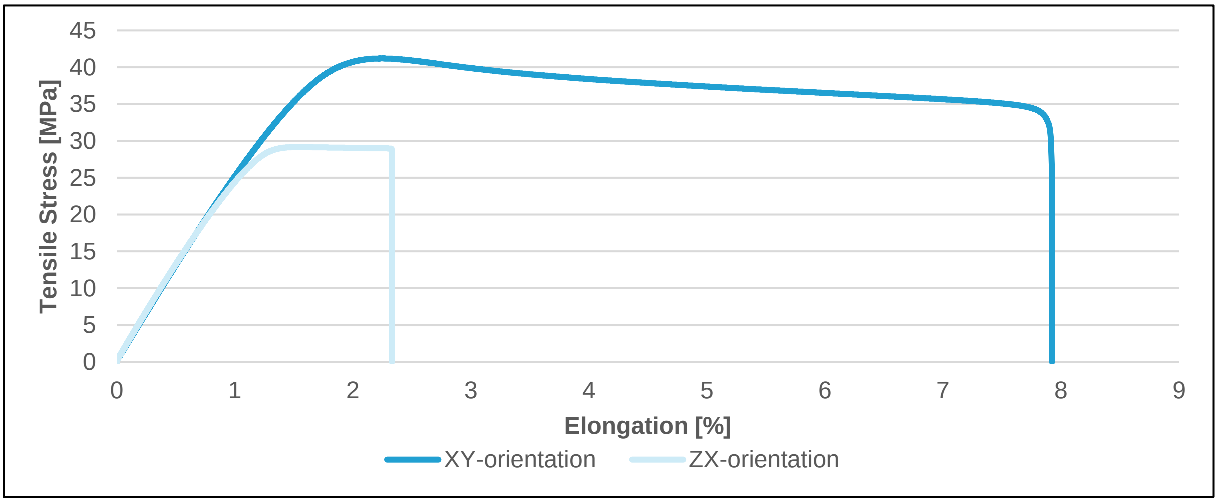


Figure 3: Typical Tensile Stress-Strain curves for the XY and ZX print orientation.

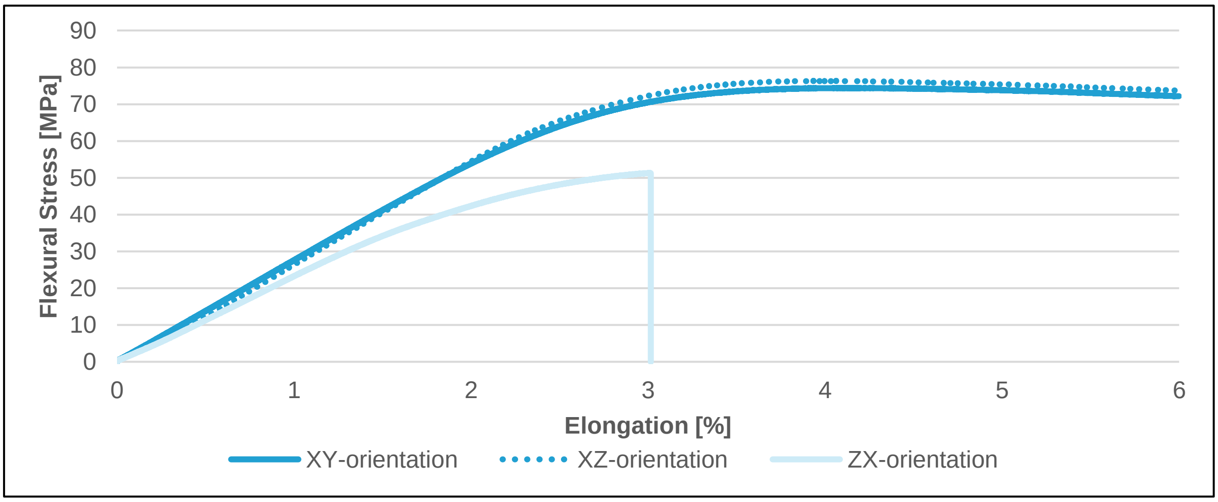


Figure 4: Typical Flexural Stress-Strain curves for the XY and ZX print orientation.