Ultimaker

Ultimaker Tough PLA
Technical data sheet

General overview

Chemical composition	See Tough PLA safety data sheet, section 3
Description	Ultimaker Tough PLA is a technical PLA filament with toughness comparable to Ultimaker ABS. Ideal for reliably printing technical models at large sizes, our Tough PLA offers the same safe and easy use as regular PLA
Key features	With an impact strength similar as and higher stiffness compared to Ultimaker ABS, Tough PLA is less brittle than regular PLA and gives a more matte surface finish quality. Heat resistance is similar to standard PLA filaments, so printed parts should not be exposed to tempera-ture above 58 °C. More reliable than ABS for larger prints, with no delamination or warping. Ultimaker Tough PLA is compatible with Ultimaker support materials (PVA and Breakaway), giving full geometric freedom when designing parts
Applications	Functional prototyping, tooling, manufacturing aids
Non-suitable for	Food contact and in vivo applications. Long term outdoor usage or applications where the printed part is exposed to temperatures higher than 58 °C.

Filament specifications

	Method (standard)	Value
Diameter	–	2.85 ± 0.05 mm
Max roundness deviation	–	0.05 mm
Net filament weight	–	750 g
Filament length	–	~96 m

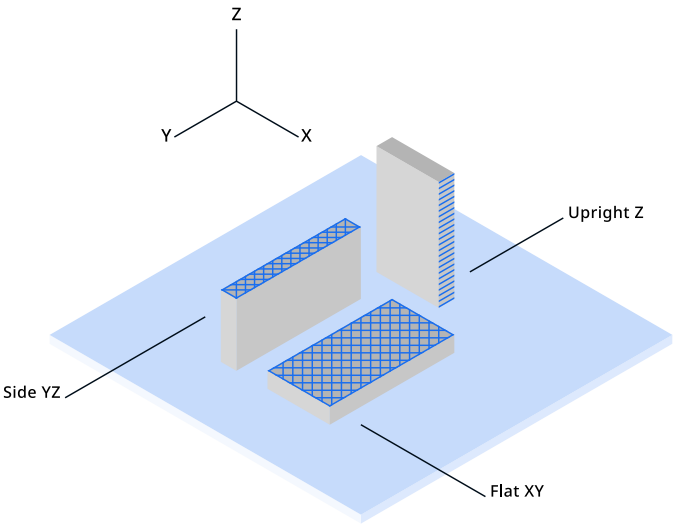
Color information

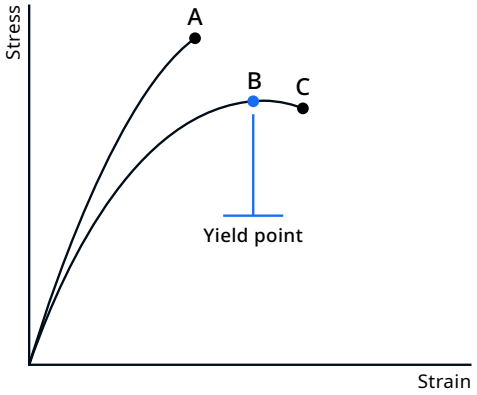
Color	Color code
Black	RAL 9017
White	RAL 9003
Green	RAL 6038
Red	RAL 3018
Gray	RAL 7000
Yellow	RAL 1018
Blue	RAL 5019

Mechanical properties

All samples were 3D printed. See ‘Notes’ section for details.

	Test method	Typical value		
		XY (Flat)	YZ (Side)	Z (Up)
Tensile (Young’s) modulus	ASTM D3039 (1 mm / min)	2797 ± 151 MPa	2797 ± 99 MPa	2696 ± 180 MPa
Tensile stress at yield	ASTM D3039 (5 mm / min)	45.3 ± 2.0 MPa	47.5 ± 0.5 MPa	33.4 ± 0.5 MPa
Tensile stress at break	ASTM D3039 (5 mm / min)	27.5 ± 7.8 MPa	31.3 ± 4.4 MPa	32.5 ± 0.8 MPa
Elongation at yield	ASTM D3039 (5 mm / min)	3.2 ± 0.0%	3.5 ± 0.0%	2.6 ± 0.1%
Elongation at break	ASTM D3039 (5 mm / min)	9.4 ± 1.9%	8.2 ± 1.8%	3.1 ± 0.7%
Flexural modulus	ISO 178 (1 mm / min)	2882 ± 61 MPa	2503 ± 45 MPa	2358 ± 78 MPa
Flexural strength	ISO 178 (5 mm / min)	91.6 ± 1.3 MPa at 4.1% strain	83.0 ± 1.4 MPa at 4.4% strain	61.3 ± 5.2 MPa at 3.4% strain
Flexural strain at break	ISO 178 (5 mm / min)	No break (>10%)	No break (>10%)	3.4 ± 0.5%
Charpy impact strength (at 23°C)	ISO 179-1 / 1eB (notched)	8.9 ± 0.8 kJ/m² (Hinge)	–	–
Hardness	ISO 7619-1 (Durometer, Shore D)	80 Shore D	–	–





A. Tensile stress at break, elongation at break (no yield point)
B. Tensile stress at yield, elongation at yield
C. Tensile stress at break, elongation at break

Print orientation

As the FFF process produces parts in a layered structure, mechanical properties of the part vary depending on orientation of the part. In-plane there are differences between walls (following the contours of the part) and infill (layer of 45° lines). These differences can be seen in the data for XY (printed flat on the build plate – mostly infill) and YZ (printed on its side – mostly walls). Additionally, the upright samples (Z direction) give information on the strength of the interlayer adhesion of the material. Typically the interlayer strength (Z) has the lowest strength in FFF. Note: All samples are printed with 100% infill – blue lines in the illustration indicate typical directionality of infill and walls in a printed part.

Tensile properties

Printed parts can yield before they break, where the material is deforming (necking) before it breaks completely. When this is the case, both the yield and break points will be reported. Typical materials that yield before breaking are materials with high toughness like Tough PLA, Nylon and CPE+. If the material simply breaks without yielding, only the break point will be reported. This is the case for brittle materials like PLA and PC Transparent, as well as elastomers (like TPU).

Thermal properties

Samples marked with an asterisk (*) were 3D printed. See ‘Notes’ section for details.

	Test Method	Typical value
Melt mass-flow rate (MFR)	ISO 1133 (210 °C, 2.16 kg)	6 - 7 g / 10 min
Heat deflection (HDT) at 0.455 MPa*	ISO 75-2 / B	58.3 ± 0.7 °C
Vicat softening temperature*	ISO 306 / A120	63.7 ± 0.3 °C
Glass transition	ISO 11357 (DSC, 10 °C / min)	59 °C
Melting temperature	ISO 11357 (DSC, 10 °C / min)	152 °C

Other properties

Specific gravity	ISO 1183	1.22 g / cm^3

Notes

*3D Printing: all samples were printed using a new spool of material loaded in an Ultimaker S5 Pro bundle with engineering intent profiles using 0.15 mm layer height with AA0.4 printcore and 100% infill, using Ultimaker Cura 4.9. Samples were printed ‘one-at-a-time’. Printed samples were conditioned in room temperature for at least 24h before measuring.

Specimen dimensions (L x W x H):
- Tensile test: 215 x 20 x 4 mm
- Flexural/Vicat/HDT: 80 x 10 x 4 mm
- Charpy: 80 x 10 x 4 mm with printed Notch (Type 1eB)

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Version	v2.00
Date	May 9, 2022