Ultimaker

Ultimaker PP
Technical data sheet

General overview

Chemical composition	See PP safety data sheet, section 3
Description	Ultimaker PP (polypropylene) is durable. It has high toughness, exceptional fatigue resistance and low friction. It also has good chemical, temperature, and electrical resistance.
Key features	Durable with high toughness and fatigue resistance (PP retains its shape after torsion, bending, and/or flexing); low friction and smooth surfaces; semi-flexible; chemical-resistant to a wide range of bases and acids, including industrial cleaning agents; high electrical resistance; translucent; low density resulting in lightweight parts (high strength-to-weight ratio); excellent layer bonding; adequate bed adhesion and low warping when using adhesion sheets
Applications	Functional prototypes, living hinges, connectors, lab equipment, moldings, stationery folders, packaging, storage boxes, protective covers, and light shades
Non-suitable for	Food contact applications and in vivo applications. Long term UV and/or moisture immersion, and applications where the printed part is exposed to temperatures higher than 99 °C

Filament specifications

	Method (standard)	Value
Diameter	–	2.85 ± 0.05 mm
Max roundness deviation	–	0.05 mm
Net filament weight	–	500 g
Filament length	–	~ 88 m

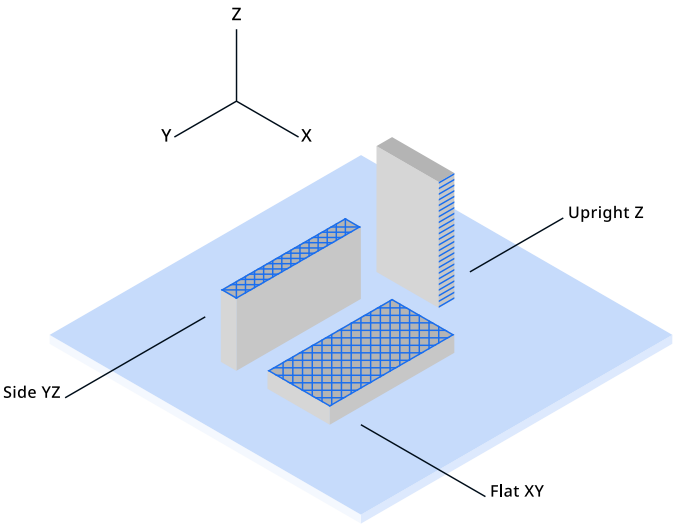
Color information

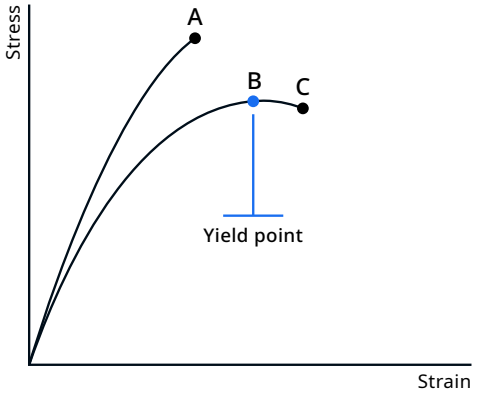
Color	Color code
Natural	N/A

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)	253 ± 16 MPa	273 ± 7 MPa	234 ± 16 MPa
Tensile stress at yield	ASTM D3039 (50 mm / min)	10.2 ± 0.6 MPa	12.1 ± 0.9 MPa	8.6 ± 0.4 Mpa
Tensile stress at break	ASTM D3039 (50 mm / min)	No break	No break	8.2 ± 0.3 Mpa
Elongation at yield	ASTM D3039 (50 mm / min)	34.8 ± 4.6%	29.1 ± 0.9%	18.7 ± 3.0%
Elongation at break	ASTM D3039 (50 mm / min)	>800%	>800%	22.8 ± 4.6%
Flexural modulus	ISO 178 (1 mm / min)	293 ± 13 MPa	250 ± 9 MPa	212 ± 9 MPa
Flexural strength	ISO 178 (5 mm / min)	15.3 ± 0.5 MPa at 8.4% strain	12.9 ± 0.5 MPa at 8.2% strain	9.4 ± 0.3 MPa at 8.9% strain
Flexural strain at break	ISO 178 (5 mm / min)	No break (>10%)	No break (>10%)	No break (>10%)
Charpy impact strength (at 23 °C)	ISO 179-1 / 1eB (notched)	49.1 ± 3.2 kJ/m²	–	–
Hardness	ISO 7619-1 (Durometer, Shore D)	42 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 part 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 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 ilustration 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 Transparant, 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 (230 °C, 2.16 kg)	20 g / 10 min
Heat deflection (HDT) at 0.455 MPa*	ISO 75-2 / B	64.1 ± 3.6 °C
Vicat softening temperature*	ISO 306 / A120	99.0 ± 0.7 °C
Glass transition	ISO 11357 (DSC, 10 °C / min)	–
Melting temperature	ISO 11357 (DSC, 10 °C / min)	130.6 °C

Other properties

Specific gravity	ISO 1183	0.89 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	April 20, 2022