UltiMaker PPS CF

Technical data sheet

UltiMaker PPS CF is a carbon fiber reinforced polyphenylene sulfide (PPS) filament and the next level composite material for the UltiMaker Factor 4. It has excellent performance while still being easy to print using HT print cores.

General overview

Chemical composition	See UltiMaker PPS CF safety data sheet, section 3
Key features	Replace metal and PEEK parts with a cost effective and easy to manufacture solution. PPS CF prints reliably in great precision on the UltiMaker Factor 4 yielding flame retardant, temperature resistant (>230 °C) and chemical resistant (insoluble in all solvents below 200 °C) parts. It has great strength and stiffness with next level durability.
Applications	Functional prototyping, tooling, manufacturing aids in various industries such as automotive, railway, aerospace.
Non-suitable for	In vivo applications. Applications where the printed parts are exposed to temperatures higher than 230 °C.

Filament specifications

	Method (standard)	**Value**
Diameter	-	2.85 mm
Max. roundness deviation	-	0.1 mm
Net. filament weight	-	500 g
Filament length	-	~61 m

Color information

	Color	**Color code**
	Metallic Anthracite	RAL 7016

UltiMaker

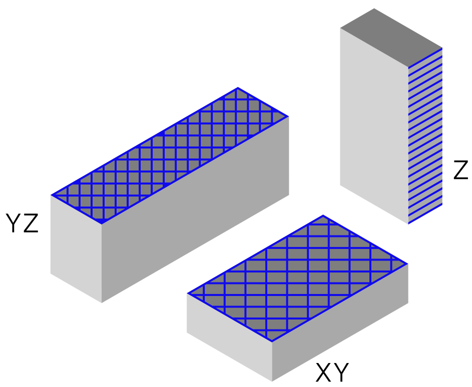
Mechanical properties

All samples where 3D printed, see notes section.

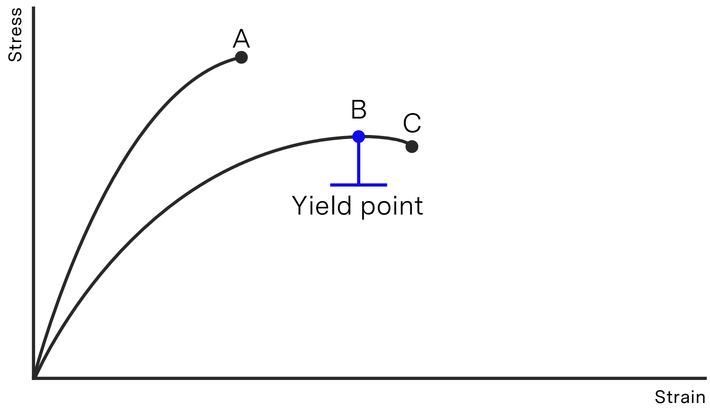
	Test method	Typical value XY (flat)	Typical value YZ (side)	Typical value Z (up)
Tensile (Young's) modulus	ASTM D3039 (1 mm / min)	4376 ± 72 MPa	7766 ± 166 Mpa	2392 ± 114 MPa
Tensile stress at yield	ASTM D3039 (5 mm / min)	47.5 ± 1.9 MPa	-	-
Tensile stress at break	ASTM D3039 (5 mm / min)	47.3 ± 1.7 MPa	72.6± 2.3 MPa	20.1 ± 1.3 MPa
Elongation at yield	ASTM D3039 (5 mm / min)	1.9 ± 0.1 %	-	-
Elongation at break	ASTM D3039 (5 mm / min)	2.0 ± 0.1 %	2.2 ± 0.1 %	1.1 ± 0.2 %
Flexural modulus	ISO 178 (1 mm / min)	5106 ± 75 MPa	6175 ± 96 MPa	1886 ± 51 MPa
Flexural strength	ISO 178 (5 mm / min)	87.0 ± 1.2 MPa at 2.6% strain	95.2 ± 0.6 MPa at 1.9% strain	56.3 ± 0.8 MPa at 3.6% strain
Flexural strain at break	ISO 178 (5 mm / min)	2.8 ± 0.2 %	1.9 ± 0.0 %	3.6 ± 0.3 %
Charpy impact strength (at 23 °C)	ISO 179-1 / 1eB (notched)	4.8 ± 0.2 kJ/m²		
Charpy impact strength (at 23 °C)	ISO 179-1 / 1eU (Unnotched)	11.6 ± 0.8 kJ/m²		
Hardness	ISO 7619-1 (Durometer, Shore D)	80 Shore D		

Mechanical properties (Annealed)

Tensile (Young's) modulus	ASTM D3039 (1 mm / min)	4616 ± 94 Mpa	8632 ± 184 MPa	2507 ± 39 Mpa
Tensile stress at yield	ASTM D3039 (5 mm / min)	-	-	-
Tensile stress at break	ASTM D3039 (5 mm / min)	52.3 ± 2.8 Mpa	83.9 ± 1.4	19.4 ± 2.4
Elongation at yield	ASTM D3039 (5 mm / min)	-	-	-
Elongation at break	ASTM D3039 (5 mm / min)	2.0 ± 0.1	2.0 ± 0.1	1.1 ± 0.2
Flexural modulus	ISO 178 (1 mm / min)	5558 ± 92 MPa	6782 ± 98 MPa	1880± 132 MPa
Flexural strength	ISO 178 (5 mm / min)	97.3 ± 1.3 MPa at 2.3% strain	108.1 ± 1.7 MPa at 1.8% strain	55.6 ± 1.3 MPa at 3.2% strain
Flexural strain at break	ISO 178 (5 mm / min)	2.3 ± 0.1 %	1.8 ± 0.1 %	3.2 ± 0.1 %
Charpy impact strength (at 23 °C)	ISO 179-1 / 1eB (notched)	3.8 ± 0.2 kJ/m²		
Charpy impact strength(at 23 °C)	ISO 179-1 / 1eU (Unnotched)	12.0 ± 0.5 kJ/m²		
Hardness	ISO 7619-1 (Durometer, Shore D)	81 Shore D		



I. Side YZ
II. Flat XY
III. Upright Z



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

Print orientation
As the FDM process produces a 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 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 (Z direction) give information on the strength of the interlayer adhesion of the material. Typically the interlayer strength (Z) has the lowest strength in FDM.
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 thoughness 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

	Test method	Value
Melt mass-flow rate (MFR)	ISO 1133 (300 °C, 2.16 kg)	22.1 g / 10 min
Heat Deflection(HDT) at 0.455 MPa*	ISO 75-2 / B	> 230 °C
Heat Deflection(HDT) at 1.82 MPa*	ISO 75-2/ A	104 °C
Vicat softening temperature*	ISO 306 / A120	> 230 °C
Glass transition	ISO 11357 (DSC, 10 °C / min)	102 °C
Melting temperature	ISO 11357 (DSC, 10 °C / min)	282 °C

Thermal properties (annealed)

	Test method	Value
Heat Deflection(HDT) at 0.455 MPa*	ISO 75-2 / B	> 230 °C
Heat Deflection(HDT) at 1.82 MPa*	ISO 75-2 / A	137 °C
Vicat softening temperature*	ISO 306 / A120	> 230 °C

Other properties

	Test method	Value
Specific gravity	ISO 1183	1.28 g / cm^3
Flame classification	Meets UL94 V0	

Notes

*3D printing: all samples were printed using a new spool of material loaded in a Factor 4 with normal intent profiles using 0.2 mm layer height with HT 0.6 print core and 100 % infill, using UltiMaker Cura 5.7.0. 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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