UltiMaker Nylon CF

Technical data sheet

UltiMaker Nylon CF Slide provides a high-performing alternative to POM, with a proven low friction and high wear resistance against stainless steel. These POM-like properties with a great printability and a PFAS-free formulation allow to further use 3D printed parts in manufacturing.

General overview

Chemical composition	See UltiMaker Nylon CF Slide safety data sheet, section 3. Nylon CF Slide is a Nylon 6/12 copolymer reinforced with 15 % carbon fibers.
Key features	UltiMaker Nylon CF Slide combines strength and stiffness with great layer bonding and impact resistance for the most demanding and lasting applications. Its Nylon 6/12 base copolymer also perfectly balances mechanical properties with moisture uptake and printability.
Applications	Manufacturing tools, spare parts, end use parts. Any part that will slide and will involve motion will be covered by this tribological material and will improve overall efficiency and longevity of components.
Non-suitable for	Printing without local exhaust ventilation due to relatively high ultrafine particle emissions. Not suitable for in vivo parts applications. Applications where the printed parts are exposed to temperatures higher than 135 °C or the annealed printed parts are exposed to temperatures higher than 180 °C.
Compatible with	UltiMaker S and Factor series printers with local exhaust ventilation. Use wear resistant (CC) print cores. Compatible with Breakaway, PVA and self support.

Filament specifications

	Value
Diameter	2.85 ± 0.1 mm
Max. roundness deviation	0.1 mm
Net. filament weight	750 g
Filament length	~114 m

Color information

Color	Color code
Black	RAL 9017

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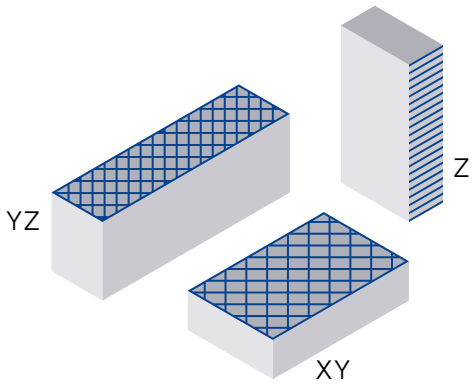
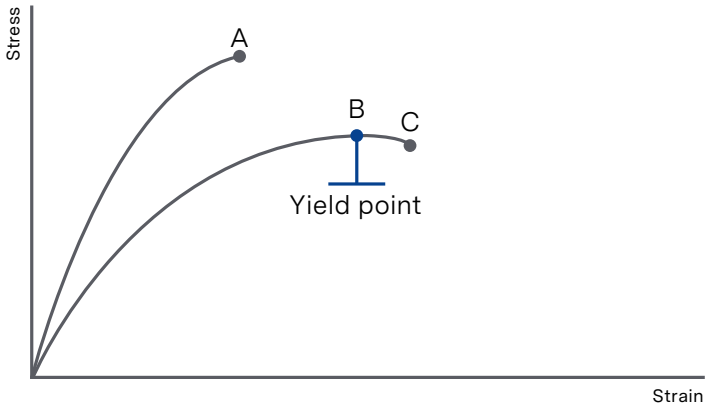
Mechanical properties

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)	3886 ± 199 MPa	8034 ± 396 MPa	2330 ± 185 MPa
Tensile stress at yield	ASTM D3039 (5 mm / min)	52.41 ± 1.49 MPa	no yield	no yield
Tensile stress at break	ASTM D3039 (5 mm / min)	52.12 ± 5.08 MPa	77.49 ± 7.37 MPa	40.88 ± 3.06 MPa
Elongation at yield	ASTM D3039 (5 mm / min)	5.01 ± 0.18%	no yield	no yield
Elongation at break	ASTM D3039 (5 mm / min)	4.67 ± 0.12%	2.20 ± 0.18%	3.07 ± 0.26%
Flexural modulus	ISO 178 (1 mm / min)	2560 ± 135 MPa	5471 ± 432 MPa	1689 ± 368 MPa
Flexural strength	ISO 178 (5 mm / min)	70.36 ± 5.00 MPa at 6.1% strain	124.38 ± 12.58 MPa at 4.2% strain	44.82 ± 12.93 MPa at 4.7% strain
Flexural strain at break	ISO 178 (5 mm / min)	14.7% strain	No break (> 0%)	5.7% strain
Charpy impact strength (at 23 °C)	ISO 179-1 / 1eB (unnotched)	24.0 ± 0.9 kJ/m²	-	-
Hardness	ISO 7619-1 (Durometer)	70 Shore D	-	-
Mechanical properties (Annealed)				
Tensile (Young's) modulus	ASTM D3039 (1 mm / min)	4388 ± 102 MPa	9116 ± 623 MPa	2362 ± 143 MPa
Tensile stress at yield	ASTM D3039 (5 mm / min)	no yield	125.86 ± 1.70 MPa	no yield
Tensile stress at break	ASTM D3039 (5 mm / min)	46.21 ± 1.03 MPa	125.91 ± 1.71 MPa	42.49 ± 3.24 MPa
Elongation at yield	ASTM D3039 (5 mm / min)	no yield	3.77 ± 0.21%	no yield
Elongation at break	ASTM D3039 (5 mm / min)	1.68 ± 0.12%	3.76 ± 0.21%	2.16 ± 0.52%
Flexural modulus	ISO 178 (1 mm / min)	3933 ± 190 MPa	6831 ± 184 MPa	1630 ± 55 MPa
Flexural strength	ISO 178 (5 mm / min)	99.27 ± 3.04 MPa at 4.0% strain	156.89 ± 3.26 MPa at 3.0% strain	38.88 ± 6.80 MPa at 2.6% strain
Flexural strain at break	ISO 178 (5 mm / min)	5.6% strain	3.1% strain	2.6% strain
Charpy impact strength (at 23 °C)	ISO 179-1 / 1eB (unnotched)	18.4 ± 2.6 kJ/m²	-	-
Hardness	ISO 7619-1 (Durometer)	76 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, 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

	Test method	Value
Melt mass-flow rate (MFR)	ISO 1133 (260 °C, 2.16 kg)	9.9 g / 10 min
Heat Deflection(HDT) at 0.455 MPa*	ISO 75-2 / B	135.4°C (non-annealed) / 180.0°C (annealed)
Glass transition	ISO 11357 (DSC, 10 °C / min)	N/A
Melting temperature	ISO 11357 (DSC, 10 °C / min)	210 °C

Other properties

	Test method	Value
Flame retardancy	ISO 1133 (260 °C, 2.16 kg)	HB
Specific density	ISO 1183-1	1.03 g/cm³
Wear rate bearings	Bearing rotation; 8 h (short); 0.3 m/s; 1 MPa	13.3 µm/km
Wear rate Taber Abraser	ISO 9352 1000 cycles, H-10, weight loss	0.045 g
Friction coefficient (stainless steel)	Bearing rotation; 8 hours; 0.3 m/s	0.18
Surface resistivity	ANSI ESD S11.11	OL, >10E¹² Ω

Notes

*3D Printing: all samples were printed using a new spool of material loaded in an UltiMaker Factor 4 using 0.2 mm layer height with CC 0.6 printcore and 100% infill, using UltiMaker Cura 5.9. Tensile samples were printed with the strength profile for maximum Z strength, other samples were printed with engineering profiles. 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/HDT: 80 x 10 x 4 mm
- Charpy: 80 x 10 x 4 mm

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