FDM Nylon 12CF

FDM Thermoplastic Filament

The information presented are typical values intended for reference and comparison purposes only.
They should not be used for design specifications or quality control purposes.

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Overview

FDM® Nylon 12CF™ is a PA12 (polyamide 12) thermoplastic filament reinforced with chopped carbon fiber, 35% by weight. It has the highest flexural strength of any FDM thermoplastic, resulting in the highest stiffness-to-weight ratio. The combination of high strength, stiffness and light weight makes it an optimal replacement for heavier metal components in appropriate use cases.

Typical applications include strong, lightweight tooling, functional prototyping and select end-use parts.

Contents:

Ordering Information

Table 1. Printer and Support Material Compatibility

Printer	Model Tip (Slice)	Support Material	Support Tip
Fortus 450mc™	T20C (10 slice)	SR-110™ (soluble)	T12SR100
Fortus 380mc™ CFE[1]	T20C (10 slice)	SR-110 (soluble)	T12SR100
F900™	T20C (10 slice)	SR-110 (soluble)	T12SR100

[1] CFE – Carbon Fiber Edition.

Build Sheet

Nylon

- 0.02 x 26 x 38 in.
- 0.02 x 16 x 18.5 in.
- 0.02 x 14 x 16.5 in.

Hardware

Due to the high abrasion of this material, a system upgrade is required to support a hardened head and drive wheels. Ordering information can be found in Table 2.

Table 2. FDM Nylon 12CF Ordering Information

Part Number	Description
Filament Canisters	
355-02411	FDM Nylon 12CF, 92.3 cu in. - Plus
355-03130	SR-110 Soluble Support, 92.3 cu in. - Plus
Printer Consumables	
511-10720	T20C tip
511-10100	T12SR100 tip
325-00600	Nylon build sheet, 0.2 x 26 x 38 in. (0.76 x 660 x 965 mm)
325-00700	Nylon build sheet, 0.2 x 16 x 18.5 in. (0.76 x 406 x 470 mm)
355-00700	Nylon build sheet, 0.2 x 16 x 16.5 in. (0.76 x 406 x 420 mm)
System Upgrades	
335-60000	Fortus 900mc Gen 3 Upgrade from Gen 1 & 2 Systems
325-63500	Hardened F900 Head Only

Physical Properties

Values are measured as printed. XY, XZ, and ZX orientations were tested. For full details refer to the Stratasys Materials Test Report (immediate download upon clicking the link). DSC and TMA curves can be found in the Appendix.

Table 3. FDM Nylon 12CF Physical Properties

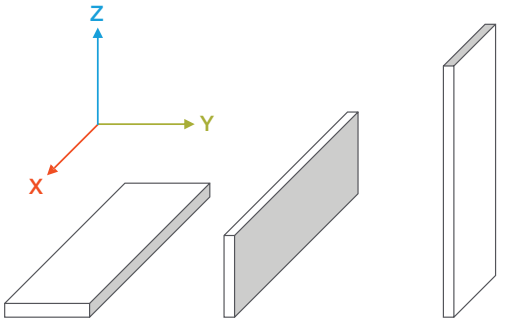
Property	Test Method	Typical Values	
		XY	XZ/ZX
HDT @ 66 psi	ASTM D648 Method B	160 °C (320 °F)	168 °C (335 °F)
HDT @ 264 psi	ASTM D648 Method B	130 °C (266 °F)	154 °C (309 °F)
Tg	ASTM D7426 Inflection Point	38 °C (100 °F)	
Mean CTE	ASTM E831 (-50 °C to 20 °C)	155 µm/[m*°C] (86 µin./[in.*°F])	37 µm/[m*°C] (21 µin./[in.*°F])
Mean CTE	ASTM E831 (20 °C to 60 °C)	180 µm/[m*°C] (100 µin./[in.*°F])	
Mean CTE	ASTM E831 (60 °C to 115 °C)	195 µm/[m*°C] (108 µin./[in.*°F])	
Mean CTE	ASTM E831 (115 °C to 150 °C)	295 µm/[m*°C] (164 µin./[in.*°F])	
Mean CTE	ASTM E831 (20 °C to 105 °C)		46 µm/[m*°C] (26 µin./[in.*°F])
Mean CTE	ASTM E831 (105 °Cto 150 °C)		58 µm/[m*°C] (32 µin./[in.*°F])
Volume Resistivity	ASTM D257	3*10^7 Ω*cm	
Dielectric Constant	ASTM D150 1 kHz test condition	Too conductive	
Dielectric Constant	ASTM D150 2 MHz test condition	11.4	10.0
Dissipation Factor	ASTM D150 1 kHz test condition	Too conductive	
Dissipation Factor	ASTM D150 2 MHz test condition	0.100	0.000
Specific Gravity	ASTM D257 @23 °C	1.19	

Mechanical Properties

FDM Nylon 12CF samples were printed with a 0.010 in. (0.254 mm) layer height on the F900. For the full test procedure please see the Stratasys Materials Test Procedure (immediate download upon clicking the link).

Print Orientation

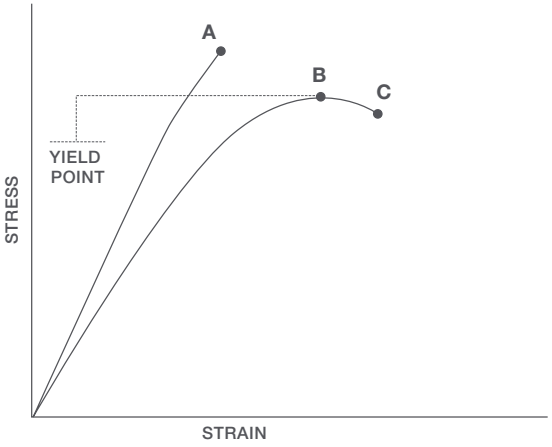
Parts created using FDM are anisotropic as a result of the printing process. Below is a reference of the different orientations used to characterize the material.



Flat (XY) On Edge (XZ) Upright (ZX)

Tensile Curves

Due to the anisotropic nature of FDM, tensile curves look different depending on orientation. Below is a guide of the two types of curves seen when printing tensile samples and what reported values mean.



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

Table 4. FDM Nylon 12CF Mechanical Properties (Fortus 450mc - T20C tip)

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	No yield	No yield
	psi	No yield	No yield
Elongation @ Yield	%	No yield	No yield
Strength @ Break	MPa	83 (2)	33 (4)
	psi	12,110 (250)	4,745 (510)
Elongation @ Break	%	2.4 (0.3)	1.2 (0.2)
Modulus (Elastic)	GPa	9.5 (0.6)	3.0 (0.4)
	ksi	1,380 (95)	434 (62)
Flexural Properties: ASTM D790, Procedure A			
Strength @ Break	MPa	150 (2)	62 (3)
	psi	22,245 (310)	9,070 (490)
Strain @ Break	%	2.7 (0.1)	3.1 (0.2)
Modulus	GPa	11.1 (0.3)	2.3 (0.1)
	ksi	1,610 (40)	340 (12)
Compression Properties: ASTM D695			
Yield Strength	MPa	110 (3)	140 (3)
	psi	15,975 (440)	20,425 (380)
Modulus	GPa	6.8 (0.5)	3.7 (0.1)
	ksi	980 (80)	530 (15)
Impact Properties: ASTM D256, ASTM D4812			
Notched	J/m	105 (7)	25 (3)
	ft*lb/in.	2.0 (0.1)	0.45 (0.06)
Unnotched	J/m	345 (40)	120 (20)
	ft*lb/in.	6.5 (0.7)	2.3 (0.3)

[1] Values in parenthesis are standard deviations.

Appendix

Figure 1. 2nd heating scan DSC data for the Nylon 12CF Flat (XY) sample.

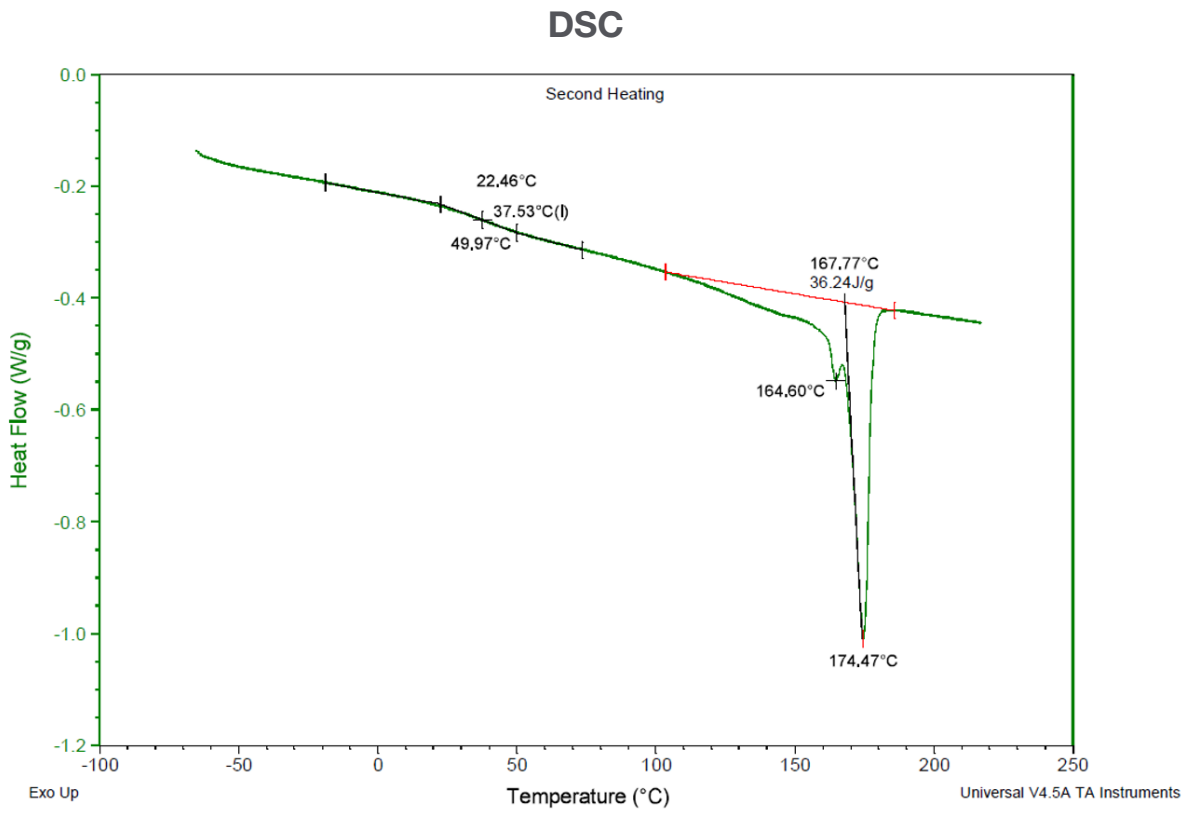


Figure 2. Dimension change data as a function of temperature for the Nylon 12CF Flat (XY) sample.

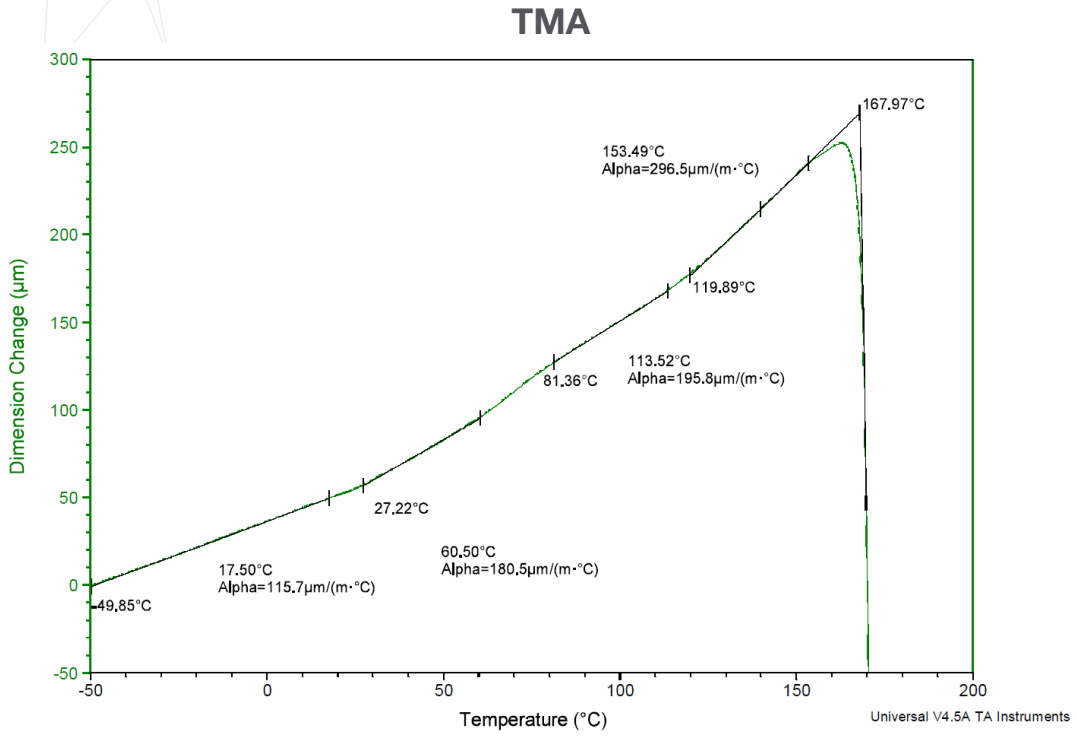


Figure 3. Dimension change data as a function of temperature for the Nylon 12CF On Edge (XZ) sample.

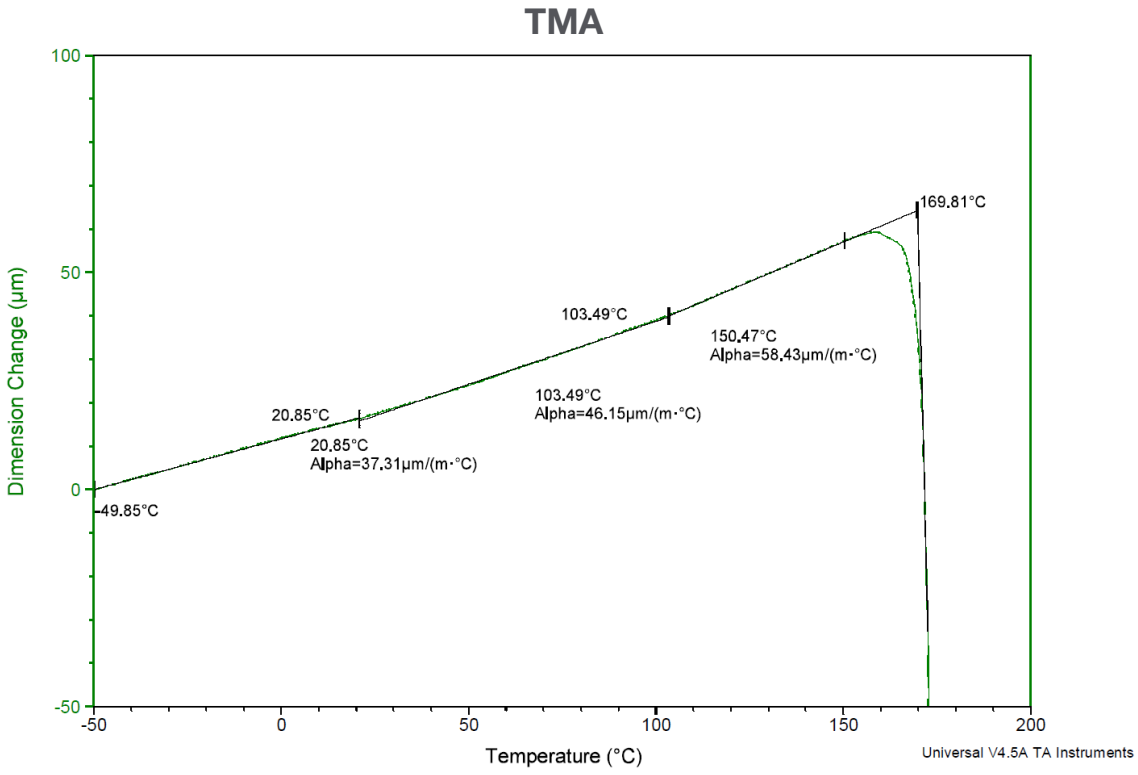


Figure 4. Overlay of the dimension change data for the Flat (XY) and On Edge (XZ) Nylon 12CF samples.