

MATERIAL DATA SHEET FDM

FDM Nylon-CF10

Carbon Fiber Filled 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.





Overview

FDM® Nylon-CF10 is a composite material combining a blended nylon polymer with 10% chopped carbon fiber (by weight), enhancing the material's strength and rigidity. The nylon base polymer also gives FDM Nylon-CF10 good chemical resistance.

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Ordering Information

Table 1: Printer and Support Material Compatibility

Printer	Model Tip	Layer Height	Support Material	Support Tip
F190™CR	F123CR Hardened Extrusion Head	0.178 mm (0.007 in.), 0.254 mm (0.010 in.), 0.330 mm (0.013 in.)	QSR Support™ (soluble support) SUP4000B™ (breakaway support)	F123 Standard Head
F370°CR	F123CR Hardened Extrusion Head	0.178 mm (0.007 in.), 0.254 mm (0.010 in.), 0.330 mm (0.013 in.)	QSR Support (soluble support) SUP4000B (breakaway support)	F123 Standard Head

Build Tray

- F190CR build tray
- F370CR build tray

System Requirements¹

F190CR

• F123CR Hardened Head for FDM Nylon-CF10 (white cover, T20H tip)

F370CR

• F123CR Hardened Head for FDM Nylon-CF10 (white cover, T20H tip)

Table 2: FDM Nylon-CF10 Ordering Information

Part Number	Description			
Filament Spools				
333-90450	FDM Nylon-CF10 90 cu. in.			
333-63500	QSR Support 60 cu. in.			
333-60400	SUP4000B 60 cu. in.			
Printer Consumable	Printer Consumables			
123-00602-S	F123CR Hardened Head for FDM Nylon-CF10 (white cover, T20H tip)			
123-00402-S	Standard Extrusion Head (Black Cover)			
123-00303-S	F190CR Build Tray, Standard			
123-00304	F370CR Build Tray, Standard			

¹Contact your Stratasys representative for ordering information.



Physical Properties

Values are measured as printed. XY, XZ, and ZX orientations were tested. For full details refer to the <u>Stratasys Materials Test Report</u>.

Table 3: FDM Nylon-CF10 Physical Properties

Droporty	Test Method	Typical Values	
Property	Test Method	XY	XZ/ZX
HDT @ 66 psi	ASTM D648 Method B	58 °C (136 °F)	77 °C (171 °F)
HDT @ 264 psi	ASTM D648 Method B	52 °C (126 °F)	62 °C (144 °F)
Molded HDT @ 66 psi	ASTM D648 Method B	109 °C (228 °F)	
Molded HDT @ 264 psi	ASTM D648 Method B	105 °C (221 °F)	
Unidirectional Toolpaths HDT @ 66 psi	ASTM D648 Method B	67 °C (153 °F)	-
Unidirectional Toolpaths HDT @ 264 psi	ASTM D648 Method B	56 °C (133 °F)	-
Тд	ASTM D7426 Inflection Point	109 °C (228 °F)	
CTE (XY)	ASTM E831 (RT to 60 °C)	94 μm/[m*°C]	79 μm/[m*°C]
CTE (Z)	ASTM E831 (RT to 60 °C)	180 μm/[m*°C]	148 μm/[m*°C]
Volume Resistivity	ASTM D257	1.88E+15 Ω*cm	4.25E+13 Ω*cm
Specific Gravity	ASTM D792 @23 °C	1.1411	

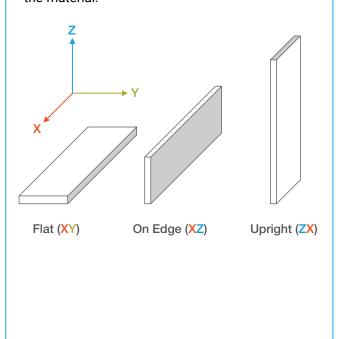


Mechanical Properties

FDM Nylon-CF10 samples were printed with a 0.254 mm (0.010 in.) layer height. For full test procedure please see the <u>Stratasys Materials Test Procedure</u>.

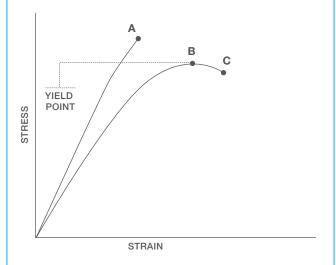
Print Orientation

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.



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-CF10 Mechanical Properties with QSR Support

Tensile Properties: ASTM D638 Yield Strength MPa psi 69.1 (3.74) 25.4 (3.61) Flongation @ Yield % 4.44 (0.61) 2.52 (0.60) Strength @ Break MPa 67.6 (4.12) 24.7 (3.81) Elongation @ Break % 4.74 (0.73) 241 (0.62) Modulus (Elastic) GPa 4.15 (0.12) 1.57 (0.071) Kis 602 (16.7) 228 (10.3) Flexural Properties: ASTM D790, Procedure A Strength @ Break MPa 123.7 (2.74) 39.7 (3.49) Strain @ Break % 4.61 (0.24) 31.6 (0.44) Modulus 6Pa 5.37 (0.17) 1.54 (0.101) Modulus 79 (24.7) 223 (14.7) Compression Properties: ASTM D55 Yield Strength No Yield No Yield Pas No Yield No Yield Pask Strength psi 11034 (5801) 18016 (1762) Pas 2.13 (0.041) 1.57 (0.045) ksi 309 (59) 228 (6.5) <th colspan="2">0.254 mm (0.010 in.) Layer Height</th> <th>XZ Orientation¹</th> <th>ZX Orientation¹</th>	0.254 mm (0.010 in.) Layer Height		XZ Orientation ¹	ZX Orientation ¹
Vield Strength psi 10034 (543) 3684 (524) Elongation @ Yield % 4.44 (0.61) 2.52 (0.60) Strength @ Break MPa 67.6 (4.12) 24.7 (3.81) psi 9809 (598) 3576 (552) Elongation @ Break % 4.74 (0.73) 2.41 (0.62) Modulus (Elastic) GPa 4.15 (0.12) 1.57 (0.071) ksi 602 (16.7) 228 (10.3) Flexural Properties: ASTM D790, Procedure A Strength @ Break MPa 123.7 (2.74) 39.7 (3.49) psi 17940 (398) 5751 (506) Strain @ Break % 4.61 (0.24) 3.16 (0.44) Modulus MPa 5.37 (0.17) 1.54 (0.101) ksi 779 (24.7) 223 (14.7) Compression Properties: ASTM D695 Weld Strength MPa No Yield No Yield No Yield Peak Strength MPa 76.1 (40.0) 124.2 (12.15) Peak (Tensile Properties: ASTM D638			
Pai 10034 (543) 3684 (524)	Yield Strength	MPa	69.1 (3.74)	25.4 (3.61)
Strength @ Break MPa 67.6 (4.12) 24.7 (3.81) psi 9809 (598) 3576 (552) Elongation @ Break % 4.74 (0.73) 2.41 (0.62) Modulus (Elastic) GPa 4.15 (0.12) 1.57 (0.071) ksi 602 (16.7) 228 (10.3) Flexural Properties: ASTM D790, Procedure A MPa 123.7 (2.74) 39.7 (3.49) psi 17940 (398) 575 (506) Strain @ Break % 4.61 (0.24) 3.16 (0.44) Modulus GPa 5.37 (0.17) 1.54 (0.101) ksi 779 (24.7) 223 (14.7) Compression Properties: ASTM D695 Yield Strength MPa No Yield No Yield No Yield Peak Strength MPa 76.1 (40.0) 124.2 (12.15) psi 11034 (5801) 18016 (1762) Modulus GPa 2.13 (0.041) 1.57 (0.045) ksi 309 (5.9) 228 (6.5) Impact Properties: ASTM D256, ASTM D256, ASTM D4812 3.79 (0.16		psi	10034 (543)	3684 (524)
Strength @ Break Psi 9809 (598) 3576 (552)	Elongation @ Yield	%	4.44 (0.61)	2.52 (0.60)
PSI PSI	Character C. Barrela	MPa	67.6 (4.12)	24.7 (3.81)
Modulus (Elastic) GPa 4.15 (0.12) 1.57 (0.071) Elexural Properties: ASTM D790, Procedure A Strength @ Break MPa 123.7 (2.74) 39.7 (3.49) Strain @ Break % 4.61 (0.24) 3.16 (0.44) Modulus GPa 5.37 (0.17) 1.54 (0.101) Compression Properties: ASTM D695 Yield Strength MPa No Yield No Yield psi No Yield No Yield Modulus MPa 76.1 (40.0) 124.2 (12.15) psi 11034 (5801) 18016 (1762) Modulus GPa 2.13 (0.041) 1.57 (0.045) Impact Properties: ASTM D256, ASTM D4812 Notched J/m 202.7 (8.6) 36.4 (13.4) ft*lb/in 3.79 (0.16) 0.68 (0.25) J/m 1030.5 (74.3) 117.11 (17.1)	Strength @ Break	psi	9809 (598)	3576 (552)
Modulus (Elastic) ksi 602 (16.7) 228 (10.3)	Elongation @ Break	%	4.74 (0.73)	2.41 (0.62)
Residence Resi	Madulus (Floris)	GPa	4.15 (0.12)	1.57 (0.071)
Strength @ Break MPa 123.7 (2.74) 39.7 (3.49) Strain @ Break % 1.7940 (398) 5751 (506) Strain @ Break % 4.61 (0.24) 3.16 (0.44) Modulus GPa 5.37 (0.17) 1.54 (0.101) Vield Strength MPa No Yield				

¹Values in parenthesis are standard deviations.



Table 5: FDM Nylon-CF10 Mechanical Properties with SUP4000B Support

Tensile Properties: ASTM D638 Yield Strength MPa (1900) (280)	0.254 mm (0.010 in.) Layer Height		XZ Orientation ¹	ZX Orientation ¹		
Yield Strength psi 10900 (280) 5190 (160) Elongation @ Yield % 5.0 (0.29) 3.7 (0.33) Strength @ Break MPa 74.3 (2.1) 35.7 (1.1) psi 10800 (300) 5170 (160) Elongation @ Break % 5.4 (0.59) 3.7 (0.33) Modulus (Elastic) GPa 4.20 (0.086) 1.73 (0.031) ksi 609 (12) 251 (4.4) Flexural Properties: ASTM D790, Procedure A Strength @ Break MPa 132 (2.1) 57.7 (1.7) psi 19100 (310) 8370 (250) Strain @ Break % 4.7 (0.16) 4.6 (0.20) Modulus GPa 5.24 (0.084) 1.67 (0.039) ksi 760. (120) 243 (5.6) Compression Properties: ASTM D695 Peak Strength MPa 80.6 (2.7) 139 (1.7) psi 11700 (390) 20100 (250) Modulus Impact Properties: ASTM D256, ASTM D4812 <td col<="" td=""><td colspan="5">Tensile Properties: ASTM D638</td></td>	<td colspan="5">Tensile Properties: ASTM D638</td>	Tensile Properties: ASTM D638				
Psi 10900 (280) 5190 (160)	Yield Strength	MPa	75.2 (2.0)	35.8 (1.1)		
Strength @ Break MPa 74.3 (2.1) 35.7 (1.1) Elongation @ Break % 5.4 (0.59) 3.7 (0.33) Modulus (Elastic) 6Pa 4.20 (0.086) 1.73 (0.031) Kei 609 (12) 251 (4.4) Flexural Properties: ASTM D790, Procedure A Strength @ Break MPa 132 (2.1) 57.7 (1.7) psi 19100 (310) 8370 (250) Strain @ Break % 4.7 (0.16) 4.6 (0.20) Modulus 6Pa 5.24 (0.084) 1.67 (0.039) ksi 760. (120) 243 (5.6) Compression Properties: ASTM D695 WPa 80.6 (2.7) 139 (1.7) psi 11700 (390) 20100 (250) Modulus GPa 1.85 (0.036) 1.43 (0.034) ksi 268 (5.2) 208 (4.9) Impact Properties: ASTM D256, ASTM D4812 Notched ft¹lb/in 3.50 (0.13) 0.772 (0.12) Unnotched		psi	10900 (280)	5190 (160)		
Strength @ Break Psi 10800 (300) 5170 (160)	Elongation @ Yield	%	5.0 (0.29)	3.7 (0.33)		
Psi 10800 (300) 5170 (160)	Ctrongth @ Brook	MPa	74.3 (2.1)	35.7 (1.1)		
Modulus (Elastic) GPa 4.20 (0.086) 1.73 (0.031) Flexural Properties: ASTM D790, Procedure A Strength @ Break MPa 132 (2.1) 57.7 (1.7) psi 19100 (310) 8370 (250) Modulus GPa 4.7 (0.16) 4.6 (0.20) Modulus GPa 5.24 (0.084) 1.67 (0.039) ksi 760. (120) 243 (5.6) Compression Properties: ASTM D695 MPa 80.6 (2.7) 139 (1.7) psi 11700 (390) 20100 (250) Modulus GPa 1.85 (0.036) 1.43 (0.034) ksi 268 (5.2) 208 (4.9) Impact Properties: ASTM D256, ASTM D4812 J/m 187 (7.2) 41.2 (6.3) Notched ft*lb/in 3.50 (0.13) 0.772 (0.12) Unnotched J/m 1030 (73) 145 (15)	Strength (ii) break	psi	10800 (300)	5170 (160)		
Modulus (Elastic) Ksi 609 (12) 251 (4.4)	Elongation @ Break	%	5.4 (0.59)	3.7 (0.33)		
Recurrence Rec	Modulus (Flastia)	GPa	4.20 (0.086)	1.73 (0.031)		
Strength @ Break MPa 132 (2.1) 57.7 (1.7) Strength @ Break % 4.7 (0.16) 4.6 (0.20) Modulus GPa 5.24 (0.084) 1.67 (0.039) Reak Strength MPa 80.6 (2.7) 139 (1.7) Peak Strength MPa 80.6 (2.7) 139 (1.7) Modulus GPa 1.85 (0.036) 1.43 (0.034) Impact Properties: ASTM D256, ASTM D4812 Notched Impact Properties: ASTM D256, ASTM D4812 Unnotched 187 (7.2) 41.2 (6.3) Unnotched 19/m 1930 (73) 195 (0.12)	Wouldes (Liastic)	ksi	609 (12)	251 (4.4)		
Strength @ Break psi 19100 (310) 8370 (250) Strain @ Break % 4.7 (0.16) 4.6 (0.20) Modulus Compression Properties: ASTM D695 Peak Strength MPa 80.6 (2.7) 139 (1.7) psi 11700 (390) 20100 (250) Modulus GPa 1.85 (0.036) 1.43 (0.034) ksi 268 (5.2) 208 (4.9) Impact Properties: ASTM D256, ASTM D4812 Notched 187 (7.2) 41.2 (6.3) Impact Properties: ASTM D256, ASTM D4812 J/m 187 (7.2) 41.2 (6.3) Unnotched	Flexural Properties: ASTM D790, Pro	cedure A				
Strain @ Break Honor Hon	Strangth @ Break	MPa	132 (2.1)	57.7 (1.7)		
Modulus GPa 5.24 (0.084) 1.67 (0.039) Compression Properties: ASTM D695 Peak Strength MPa 80.6 (2.7) 139 (1.7) psi 11700 (390) 20100 (250) Modulus GPa 1.85 (0.036) 1.43 (0.034) ksi 268 (5.2) 208 (4.9) Impact Properties: ASTM D256, ASTM D4812 J/m 187 (7.2) 41.2 (6.3) Notched ft*lb/in 3.50 (0.13) 0.772 (0.12) Unnotched J/m 1030 (73) 145 (15)	Strength (ii) break	psi	19100 (310)	8370 (250)		
Modulus Ksi 760. (120) 243 (5.6) Compression Properties: ASTM D695 MPa 80.6 (2.7) 139 (1.7) psi 11700 (390) 20100 (250) Modulus GPa 1.85 (0.036) 1.43 (0.034) ksi 268 (5.2) 208 (4.9) Impact Properties: ASTM D256, ASTM D4812 Notched J/m 187 (7.2) 41.2 (6.3) ft*lb/in 3.50 (0.13) 0.772 (0.12) Unnotched	Strain @ Break	%	4.7 (0.16)	4.6 (0.20)		
Ksi 760. (120) 243 (5.6)	Modulus	GPa	5.24 (0.084)	1.67 (0.039)		
Peak Strength MPa 80.6 (2.7) 139 (1.7) psi 11700 (390) 20100 (250) Modulus GPa 1.85 (0.036) 1.43 (0.034) ksi 268 (5.2) 208 (4.9) Impact Properties: ASTM D256, ASTM D4812 Notched J/m 187 (7.2) 41.2 (6.3) ft*lb/in 3.50 (0.13) 0.772 (0.12) Unnotched	Widulus	ksi	760. (120)	243 (5.6)		
Peak Strength psi 11700 (390) 20100 (250) Modulus GPa 1.85 (0.036) 1.43 (0.034) ksi 268 (5.2) 208 (4.9) Impact Properties: ASTM D256, ASTM D4812 Notched J/m 187 (7.2) 41.2 (6.3) ft*lb/in 3.50 (0.13) 0.772 (0.12) Unnotched J/m 1030 (73) 145 (15)	Compression Properties: ASTM D69	5				
Modulus	Dook Strongth	MPa	80.6 (2.7)	139 (1.7)		
Modulus ksi 268 (5.2) 208 (4.9) Impact Properties: ASTM D256, ASTM D4812 J/m 187 (7.2) 41.2 (6.3) ft*lb/in 3.50 (0.13) 0.772 (0.12) J/m 1030 (73) 145 (15)	reak Sueligui	psi	11700 (390)	20100 (250)		
Resi 268 (5.2) 208 (4.9)	Modulus	GPa	1.85 (0.036)	1.43 (0.034)		
J/m 187 (7.2) 41.2 (6.3) ft*lb/in 3.50 (0.13) 0.772 (0.12) J/m 1030 (73) 145 (15)	Widulius	ksi	268 (5.2)	208 (4.9)		
Notched ft*lb/in 3.50 (0.13) 0.772 (0.12) J/m 1030 (73) 145 (15)	Impact Properties: ASTM D256, ASTM D4812					
ft*lb/in 3.50 (0.13) 0.772 (0.12) J/m 1030 (73) 145 (15)	Mandage	J/m	187 (7.2)	41.2 (6.3)		
Unnotched	Notoneu	ft*lb/in	3.50 (0.13)	0.772 (0.12)		
ft*lb/in 19.4 (1.4) 2.71 (0.28)	Unnotched	J/m	1030 (73)	145 (15)		
	Unnotched	ft*lb/in	19.4 (1.4)	2.71 (0.28)		

Values in parenthesis are standard deviation.



Nylon-CF10 was tested using unidirectional toolpaths to showcase the increased mechanical properties this method of printing yields compared to the standard 45°/-45° toolpaths.

For further details read the <u>Unidirectional Material Testing May Mislead Manufacturing White Paper</u>

Table 6: FDM Nylon-CF10 Mechanical Properties with Unidirectional Toolpaths and QSR Support

0.254 mm (0.010 in.) Layer Height		XY Orientation ¹			
Tensile Properties: ASTM D638	Tensile Properties: ASTM D638				
Yield Strength	MPa	68.1 (1.1)			
Held Strength	psi	9880 (160)			
Elongation @ Yield	%	4.8 (0.48)			
Strength @ Break	MPa	64.4 (0.73)			
Suchigan to Dicak	psi	9330 (110)			
Elongation @ Break	%	5.1 (0.91)			
Modulus (Elastic)	GPa	6.03 (0.15)			
Modulus (Liustie)	ksi	875 (22)			
Flexural Properties: ASTM D790, Proceed	dure B				
Strength @ Break	MPa	138 (0.034)			
Strength to break	psi	20000 (720)			
Strain @ Break	%	3.4 (0.25)			
Modulus	GPa	6.96 (0.16)			
Modulus	ksi	1010 (24)			
Impact Properties: ASTM D256					
Notched	J/m	272 (7.5)			
Notorica	ft*lb/in	5.1 (0.14)			

¹Values in parenthesis are standard deviation.



Chemical Resistance

Nylon-CF10 coupons were built on the F370CR with 0.254 mm (0.010 in.) layer height and QSR support material. The coupons were tested for resistance to chemical exposure by soaking in reagents for 72 hours. Afterwards the coupons were tensile tested following ASTM D638. Chemicals tested and percent change from control is listed below.

Table 6: Change in Mechanical Properties - 72 hour Chemical Exposure

	Reagent	XZ	ZX
	30% Nitric Acid	-32%	-43%
To a 21 a Observatile	30% Sulfuric Acid	-24%	-23%
Tensile Strength	40% Sodium Hydroxide	-1%	-5%
	Concentrated Ammonia	-33%	-34%
% Elongation @ break	30% Nitric Acid	132%	-33%
	30% Sulfuric Acid	59%	-9%
	40% Sodium Hydroxide	-9%	-20%
	Concentrated Ammonia	90%	-1%
	30% Nitric Acid	-21%	6%
Tensile Modulus	30% Sulfuric Acid	3%	13%
	40% Sodium Hydroxide	17%	38%
	Concentrated Ammonia	2%	-12%



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