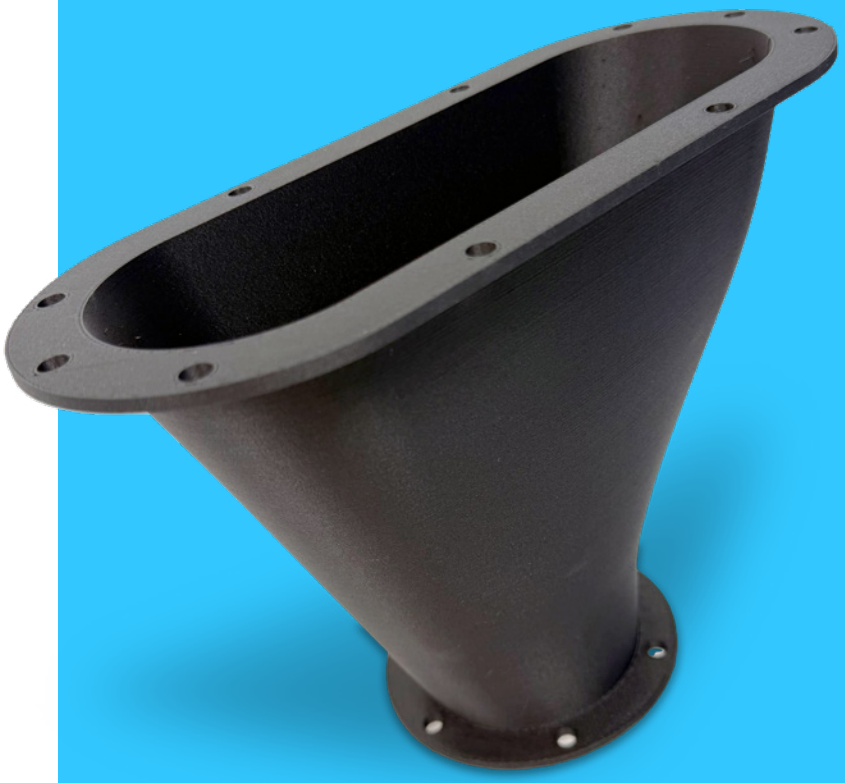
stratasys

MATERIAL DATA SHEET
FDM



FDM
PA6/66-GF30-FR

Overview

FDM® PA6/66-GF30-FR is a 30% by weight glass fiber reinforced, flame-retardant nylon filament designed for rail and transportation OEMs and Tier suppliers using Fortus 450mc and F900 systems who need EN 45545-2 HL2 (R22/R23) compliance, strong mechanical performance, and high-quality, production-ready parts at a lower total cost.

Unlike PC-FR, which can fall short on strength, or ULTEM™ 9085 resin, which often exceeds performance needs and budget, FDM PA6/66-GF30-FR delivers excellent strength and stiffness, best-in-class Fortus printability, and a cost-effective balance of fire safety, performance, and value for certified end-use applications.

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Ordering Information

Table 1: Printer and Support Material Compatibility

Printer	Model Tip	Layer Height	Support Material	Support Tip
Fortus 450mc™	T20G	0.25 mm (0.010 in.)	SUP4050B™	T16
F900®	T20G	0.25 mm (0.010 in.)	SUP4050B	T16

Build Sheet

Fortus Nylon Build Sheets

- 0.51 x 660 x 965 mm (0.02 x 26 x 38 in.)
- 0.51 x 406 x 470 mm (0.02 x 16 x 18.5 in.)

System Requirements

Fortus 450mc

- Hardened machine upgrade
- Hardened Fortus 450mc head
- FDM PA6/66-GF30-FR material license (included if new system)

F900

- Hardened F900 head
- FDM PA6/66-GF30-FR material license

Table 2: FDM PA6/66-GF30-FR Ordering Information

Part Number	Description	System Compatibility
Filament Consumables		
Fortus Plus Canister (black snout)		
355-02280	FDM PA6/66-GF30-FR, 92.3 cu in - Plus	Fortus 450mc, F900
355-70160	SUP4050B Support, 92.3 cu in. - Plus	
Printer Consumables		
Fortus		
511-10745	T20G tip	Fortus 450mc, F900
511-10701	T16 tip	
325-00750-S	Nylon build sheet, 0.51 x 406 x 470 mm (0.02 x 16 x 18.5 in.), 20 pack	
325-00650-S	Nylon build sheet, 0.51 x 660 x 965 mm (0.02 x 26 x 38 in.), 10 pack	F900
Print Heads		
Fortus		
821726-XXXX	Hardened Fortus 450mc head (blue handle)	Fortus 450mc
325-63500	Hardened F900 head (folded sheet metal handle)	F900

Physical Properties

Values are measured as molded and printed on the Fortus 450mc with a 0.25 mm (0.010 in.) layer height. XY and XZ orientations were tested. For full details refer to the Stratasys Materials Test Procedure. DSC and TMA curves can be found in the Appendix.

Table 3: FDM PA6/66-GF30-FR Physical Properties

Physical Properties - Printed			
Property	Test Method	Typical Values XY	Typical Values XZ
HDT @ 66 psi	ASTM D648 Method B	161 °C (321.8 °F)	185 °C (365 °F)
HDT @ 264 psi	ASTM D648 Method B	35 °C (95 °F)	153 °C (307.4 °F)
Mean CTE	ASTM E831 (-20 °C to 5 °C)	95.44 µm/[m·°C] (53.02 µin/[in·°F])	-
	ASTM E831 (25 °C to 80 °C)	214.2 µm/[m·°C] (119 µin/[in·°F])	-
	ASTM E831 (180 °C to 130 °C)	72.67 µm/[m·°C] (40.37 µin/[in·°F])	-
	ASTM E831 (140 °C to 150 °C)	156.3 µm/[m·°C] (86.83 µin/[in·°F])	-
Dielectric Constant	ASTM D150 1 kHz test condition	6.2	-
Dissipation Factor	ASTM D150 1 kHz test condition	0.14	-
Volume Resistivity	ASTM D257	1.3×10^{12} Ω*cm	-
Thermal Conductivity	ASTM E1952 @20 °C	0.3221 W/[m*K] (0.1861 BTU/[hr*ft°F])	-
	ASTM E1952 @90 °C	0.3252 W/[m*K] (0.1879 BTU/[hr*ft°F])	-
Thermal Diffusivity	ASTM E1952 @20 °C	0.177 mm^2/s (2.74×10^{-4} in^2/s)	-
	ASTM E1952 @90 °C	0.151 mm^2/s (2.34×10^{-4} in^2/s)	-

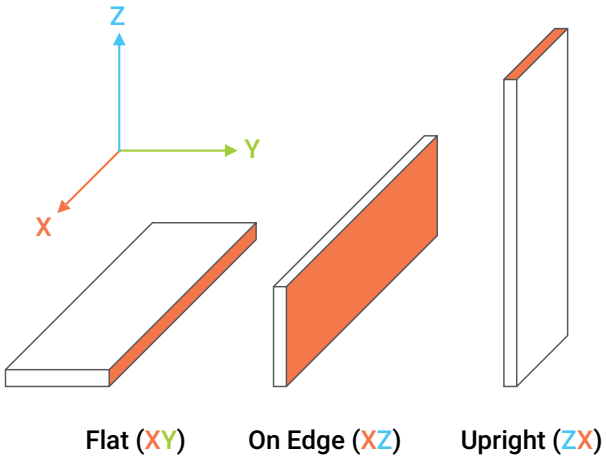
Physical Properties - Non Printed		
Property	Test Method	Molded Plaques / Filament Samples
Tg	ASTM D7426 Inflection Point	51.5 °C (124.7 °F)
Specific Gravity	ASTM D792 @23 °C	1.400

Mechanical Properties

FDM PA6/66-GF30-FR samples were printed with a 0.25 mm (0.010 in.) layer height on the F900 and the Fortus 450mc using a T20G tip. The breakaway support was manually removed before the samples were conditioned per the respective ASTM standard. For the full test procedure please see the Stratasys Materials Test Procedure. For more information on compression testing and reporting please see the Refining Compressive Yield Stress Measurement for FDM Materials one pager.

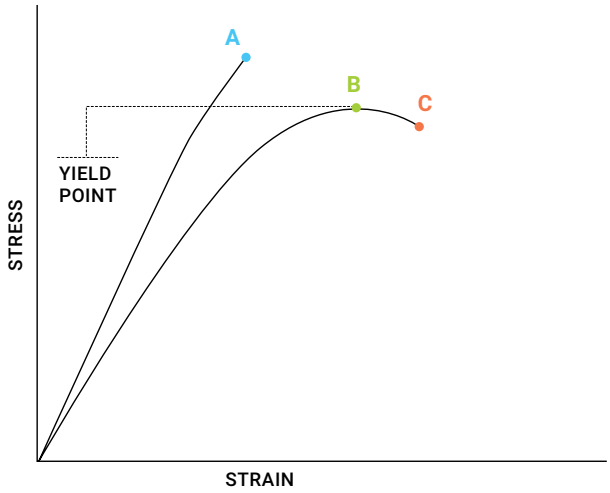
Print Orientation

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 PA6/66-GF30-FR Mechanical Properties - Fortus 450mc - T20G tip

0.25 mm (0.010 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	61.7 (2.2)	No yield
	psi	8,950 (320)	No yield
Elongation at Yield	%	4.4 (0.73)	No yield
Strength at Break	MPa	61.1 (2.3)	23.7 (1.4)
	psi	8,860 (330)	3,440 (210)
Elongation at Break	%	4.6 (0.86)	1.1 (0.14)
Modulus (Elastic)	GPa	5.6 (0.31)	3.05 (0.18)
	ksi	813 (44)	443 (27)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	121 (5)	47.4 (10)
	psi	17,500 (720)	6,880 (1,500)
Strain at Break	%	3.7 (0.35)	3.1 (0.72)
Modulus	GPa	6.07 (0.39)	2.1 (0.23)
	ksi	880 (57)	305 (34)
Compression Properties: ASTM D695			
0.2% Offset Yield	MPa	22.3 (0.98)	31 (1.4)
	psi	3,230 (140)	4,490 (200)
1.0% Offset Yield	MPa	30.8 (1.1)	45.6 (1.7)
	psi	4,470 (150)	6,620 (250)
Modulus	GPa	1.6 (0.16)	1.67 (0.063)
	ksi	232 (23)	243 (9.2)
Impact Properties: ASTM D256, ASTM D4812			
Notched	J/m	74.6 (3.4)	17.2 (2.7)
	ft*lb/in	1.4 (0.064)	0.322 (0.05)
Unnotched	J/m	730 (79)	83.5 (22)
	ft*lb/in	13.7 (1.5)	1.56 (0.4)

[1] Values in parenthesis are standard deviations.

Table 5: FDM PA6/66-GF30-FR Mechanical Properties - F900 - T20G tip

0.25 mm (0.010 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	62.3 (6.2)	No yield
	psi	9,040 (890)	No yield
Elongation at Yield	%	3.2 (0.7)	No yield
Strength at Break	MPa	60.2 (7.6)	24.4 (4.2)
	psi	8,730 (1,100)	3,540 (620)
Elongation at Break	%	3.3 (0.76)	1.1 (0.22)
Modulus (Elastic)	GPa	5.83 (0.8)	3.14 (0.16)
	ksi	845 (120)	456 (23)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	114 (10)	46.2 (10)
	psi	16,500 (1,400)	6,700 (1,500)
Strain at Break	%	4.1 (0.32)	3.4 (0.85)
Modulus	GPa	5.66 (0.52)	1.96 (0.22)
	ksi	820 (75)	284 (31)
Compression Properties: ASTM D695			
0.2% Offset Yield	MPa	33 (11)	53.7 (8.1)
	psi	4,790 (1,500)	7,780 (1,200)
1.0% Offset Yield	MPa	43.1 (12)	72.4 (7.4)
	psi	6,250 (1,800)	10,500 (1,100)
Modulus	GPa	2.34 (0.65)	2.62 (0.28)
	ksi	339 (94)	381 (41)
Impact Properties: ASTM D256, ASTM D4812			
Notched	J/m	77.1 (7)	22.1 (4.5)
	ft*lb/in	1.44 (0.13)	0.413 (0.085)
Unnotched	J/m	391 (53)	95.4 (19)
	ft*lb/in	7.32 (1)	1.79 (0.35)

[1] Values in parentheses are standard deviations.

Fire Protection of Railway Vehicles
EN 45545-2

These tests were done to show that FDM PA6/66-GF30-FR complies to the tested standard, not to show certification to any specific standard. It is suggested that additional testing be conducted if there are any questions about how FDM PA6/66-GF30-FR will perform for a specific part.

FDM PA6/66-GF30-FR was printed in the XY orientation with a T20G tip on the Stratasys Fortus 450mc and F900 systems using default settings and tested per EN 45545-2 testing standards. Results were given for requirement sets R22 and R23.

* It should be noted that products printed with different settings or on different machines may perform differently
* Further testing should be done by the end user to make sure the material fits their final application

Table 6: FDM PA6/66-GF30-FR EN 45545-2 Fire Safety Classification Matrix - Fortus 450mc

Requirement Set	1 mm	7 mm
R22	HL2	HL2
R23	HL3	HL3

Table 7: FDM PA6/66-GF30-FR EN 45545-2 Fire Safety Classification Matrix - F900

Requirement Set	1.1 mm	7.3 mm
R22	HL2	HL2
R23	HL3	HL3

Table 8: FDM PA6/66-GF30-FR Fire Protection of Railway Vehicles Test Results For R22 and R23 Requirement Sets - Fortus 450mc

Test Standard	Results	1 mm XY	7 mm XY
ISO 5659-2 (smoke opacity) 25 kW/m²	Ds(4)	19.8	2.6
	VOF4	23.6	3.6
	Dm	168.1	172.1
EN 17084 Method 1 (smoke toxicity)	ITC 4 mins	0.01	0.01
	ITC 8 mins	0.02	0.02
ISO 4589-2 (limit oxygen index)	ILO (%O2)	34.3	38.3

Table 9: FDM PA6/66-GF30-FR Fire Protection of Railway Vehicles Test Results For R22 and R23 Requirement Sets - F900

Test Standard	Results	1.1 mm XY	7.3 mm XY
ISO 5659-2 (smoke opacity) 25 kW/m²	Ds(4)	70.6	46.3
	VOF4	110.3	47.3
	Dm	171.7	209.2
EN 17084 Method 1 (smoke toxicity)	ITC 4 mins	0.35	0.4
	ITC 8 mins	0.35	0.4
ISO 4589-2 (limit oxygen index)	ILO (%O2)	34.1	36.5

Fire Protection of Automotive Interiors

These tests were done to show that FDM PA6/66-GF30-FR complies to the tested standard, not to show certification to any specific standard. It is suggested that additional testing be conducted if there are any questions about how FDM PA6/66-GF30-FR will perform for a specific part.

FDM PA6/66-GF30-FR was printed in the XY orientation with a T20G tip on the Stratasys F900 system using default settings and tested per FMVSS 302 testing standards. Results show that FDM PA6/66-GF30-FR does not support combustion and meets the flammability requirements of FMVSS 302.

Table 10: FDM PA6/66-GF30-FR Fire Protection of Automotive Interior Test Results

Specimen	Thickness (mm)	Burn Distance (mm)	Burn Time (sec)	Burn Rate (mm/min)	Remarks
1	1.1	0	0	0	DSC[1]
2	1.1	0	0	0	DSC
3	1.1	0	0	0	DSC
4	1.1	0	0	0	DSC
5	1.1	0	0	0	DSC
Average Burn Rate				0	DSC
Maximum Burn Rate				0	

[1] Doesn't Support Combustion (DSC): material never ignites

Appendix

Figure 1: DSC at 20 °C 0.4 mm

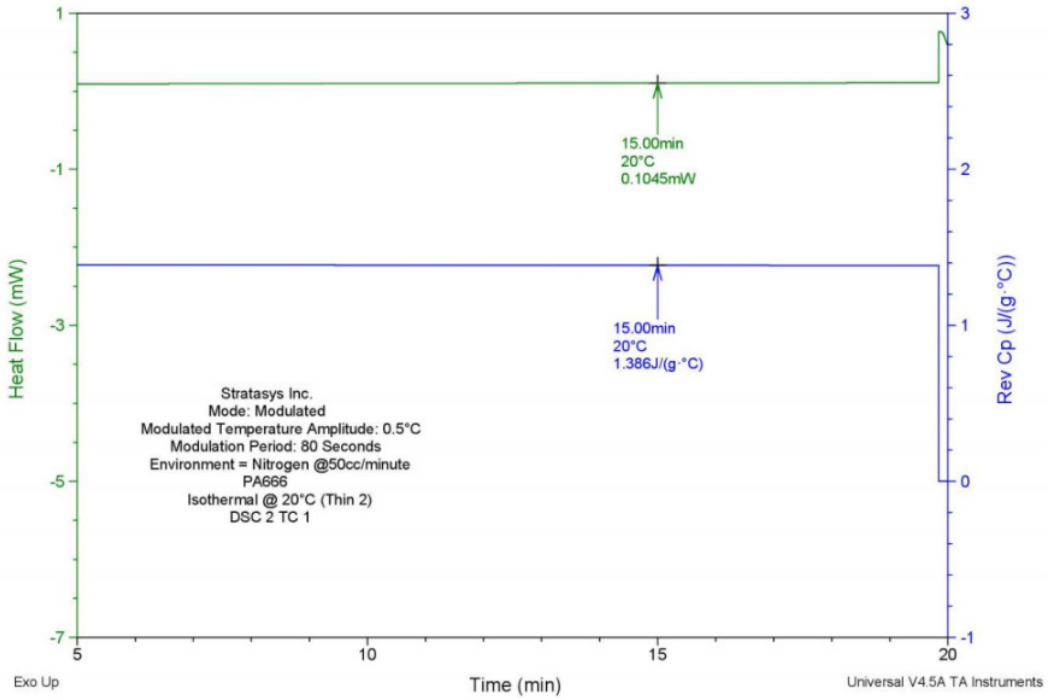


Figure 2: DSC at 20 °C 3.4 mm

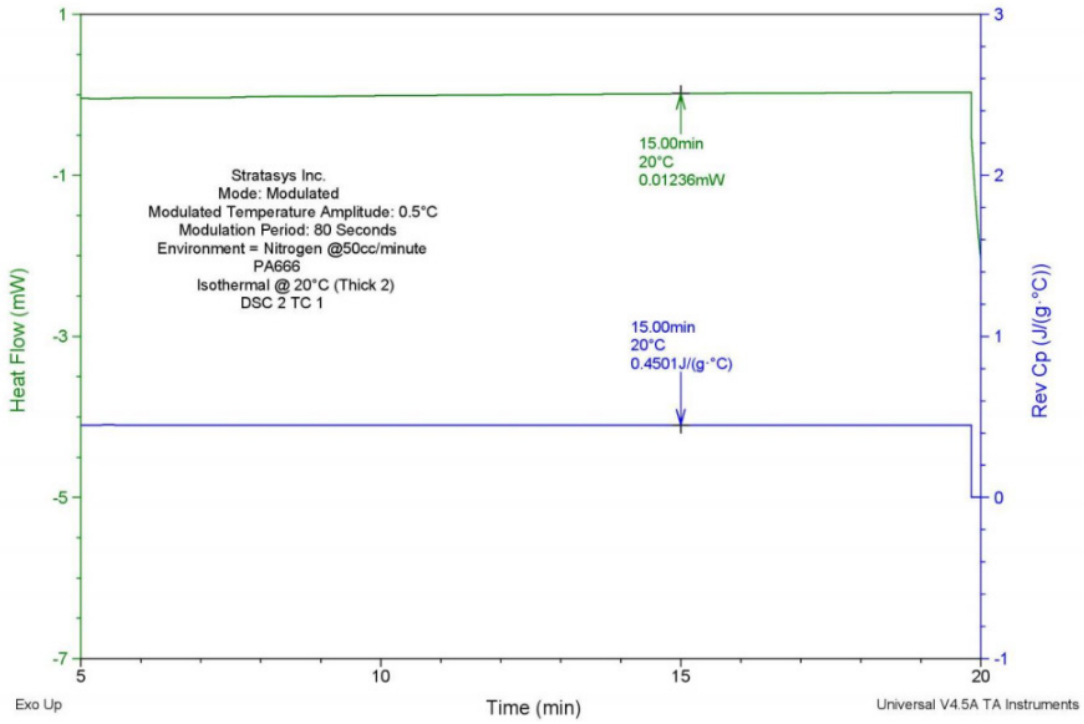


Figure 3: DSC at 90 °C 0.4 mm

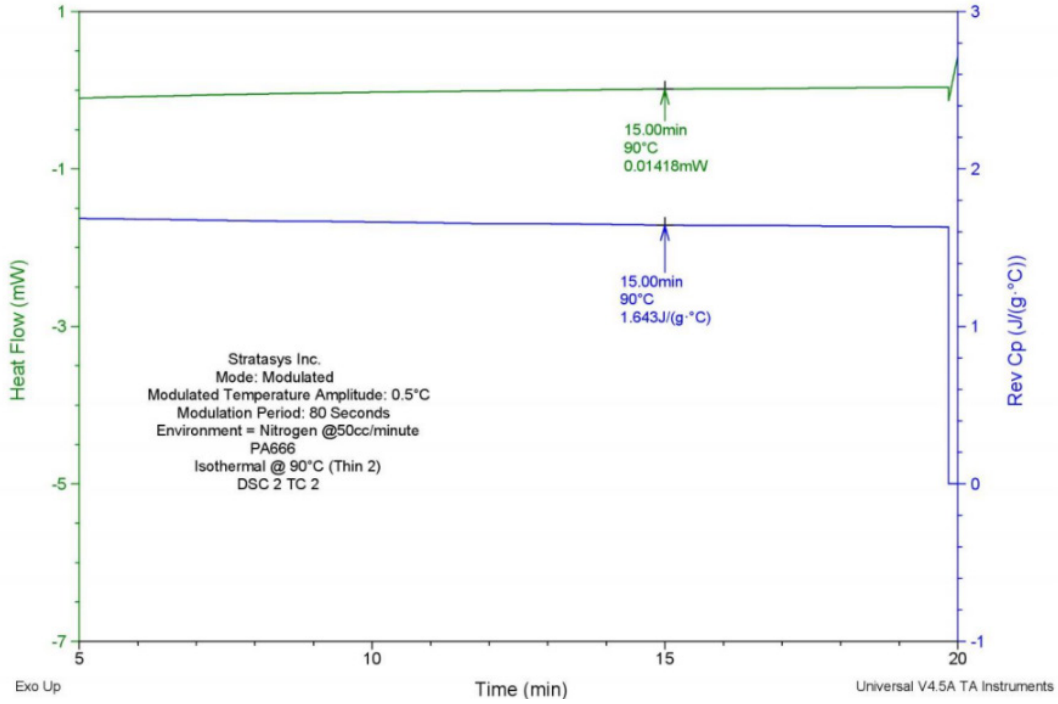


Figure 4: DSC at 90 °C 3.4 mm

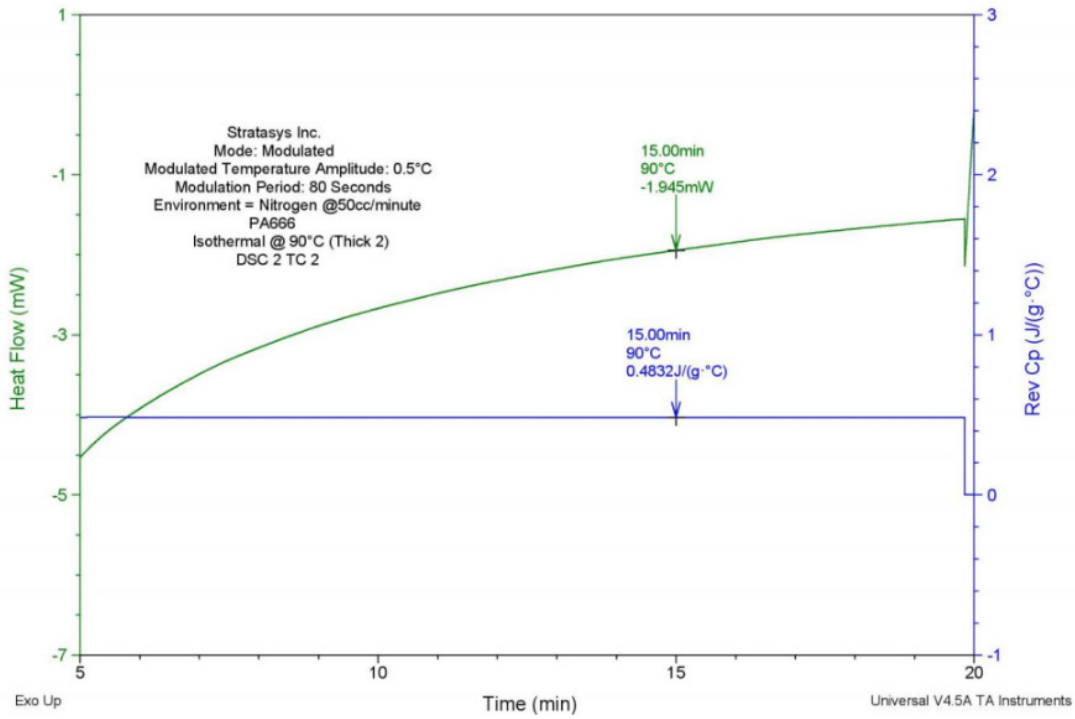
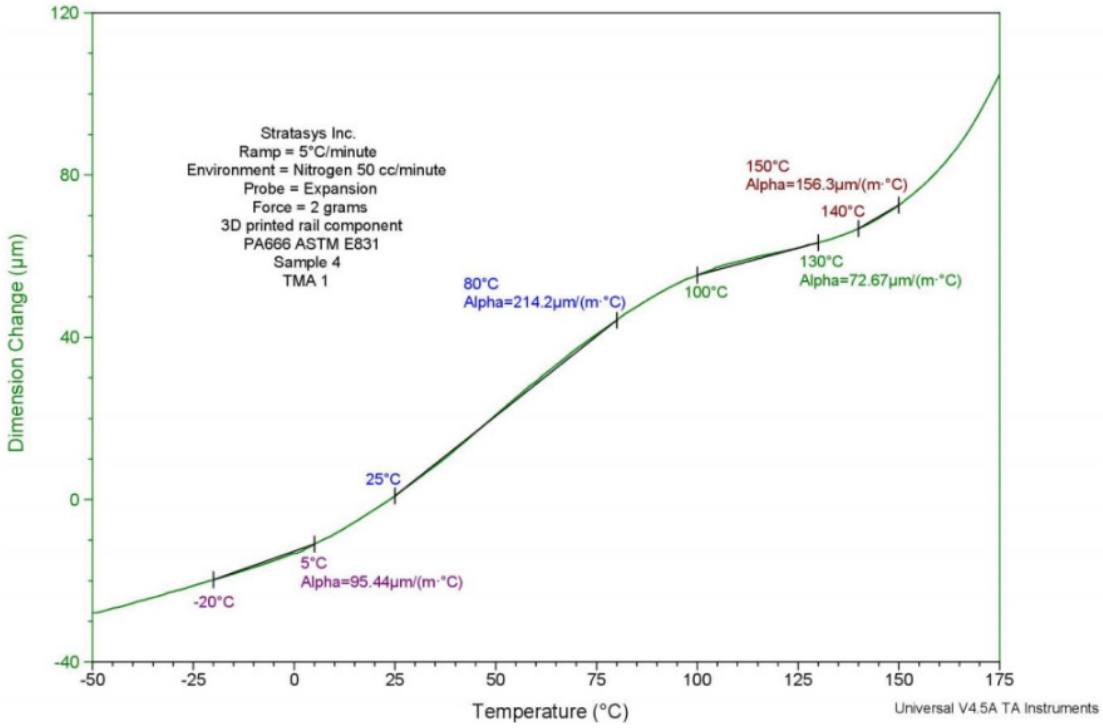


Figure 5: TMA



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