stratasys

MATERIAL DATA SHEET
FDM

ULTEM™ 9085 Resin

FDM® Thermoplastic Filament

Fit for High-Performance Applications

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

ULTEM™ 9085 resin filament is a PEI (polyetherimide) thermoplastic FDM material. It features a high strength-to-weight ratio, high thermal and chemical resistance, and meets multiple aerospace and railway industry standards for flame, smoke and toxicity (FST) characteristics. Available colors are Natural, Black, Red, Jana White, White 7362, Dream Gray, Gunship Gray and Aircraft Gray.

ULTEM™ 9085 resin CG (Certified Grade - only available in Natural) meets more stringent test criteria and possesses documented traceability from filament back to raw material lot number. Included documentation:

- Certificate of Analysis — for both raw material and filament are supplied, documenting test results and identification to match filament manufacturing lot number to raw material batch number.
- Certificate of Conformance — confirms that the material is manufactured in compliance to approved Stratasys® and industry specifications.

Typical applications include production parts and functional prototypes.

Contents:

Overview 2
Ordering Information 3
Physical Properties 5
Mechanical Properties 6
UV Aging 15
Performance at Temperature 16
Flame, Smoke and Toxicity Test Results 17
Outgassing 20
Fire Protection for Railway Vehicles 20
Fire Protection of Buses 22
Appendix 23

Ordering Information

Table 1: Printer and Support Material Compatibility

Printer	Model Tip	Layer Height	Support Material	Support Tip
Fortus 450mc™	T16	0.254 mm (0.010 in.)	SUP8500B™ Support	T16
	T16A	0.254 mm (0.010 in.)		
	T20	0.330 mm (0.013 in.)		
F900®	T16	0.254 mm (0.010 in.)	SUP8500B Support	T16
	T16A	0.254 mm (0.010 in.)		
	T20	0.330 mm (0.013 in.)		
	T40A	0.508 mm (0.020 in.)		T40A
F3300	N500	0.250 mm (0.010 in.)	SUP8500B Support	N410
	N750	0.500 mm (0.020 in.)		N750

ULTEM™ 9085 resin colors (Red, Jana White, White 7362, Dream Gray, Gunship Gray and Aircraft Gray) are only available on the F900 and Fortus 450mc with the T16 model tip and SUP8500B support material.

Build Sheet

Fortus High Temperature 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.)

F3300 High Temperature Build Sheets

- 0.51 x 660 x 711 mm (0.02 x 26 x 28 in.)

System Requirements[1]

Fortus 450mc

- Hardened machine upgrade (only required for hardened head)
- Standard Fortus 450mc head (natural, black, CG, Validated Material colors)
- Hardened Fortus 450mc head (Validated Material colors)
- ULTEM™ 9085 resin material license (included if new system)

F900

- Standard F900 head (natural, black, CG, Validated Material colors)
- Hardened F900 head (Validated Material colors)
- ULTEM™ 9085 resin material license

F3300

- F3000 Series Extruder Drive
- Standard Hot Ends
- No material licenses required

[1] Contact your Stratasys representative for ordering information.

Table 2: ULTEM™ 9085 Resin Ordering Information

Part Number	Description
Filament Canisters[1,2]	
355-02310	ULTEM™ 9085 resin Natural, 92.3 cu in - Plus
355-08310	ULTEM™ 9085 resin Natural, 184 cu in - Plus
355-23101	ULTEM™ 9085 resin CG, 92.3 cu in - Plus
312-20001	ULTEM™ 9085 resin CG, 184 cu in - Classic
355-70050	ULTEM™ 9085 resin Red, 92 cu in - Plus
355-70051	ULTEM™ 9085 resin Jana White, 92 cu in - Plus
355-70052	ULTEM™ 9085 resin Dream Gray, 92 cu in - Plus
355-70053	ULTEM™ 9085 resin White 7362, 92 cu in - Plus
355-70054	ULTEM™ 9085 resin Gunship Gray, 92 cu in - Plus
355-70055	ULTEM™ 9085 resin Aircraft Gray, 92 cu in - Plus
355-02311	ULTEM™ 9085 resin Black, 92.3 cu in - Plus
312-20000	ULTEM™ 9085 resin Natural, 92.3 cu in - Classic
312-20018	ULTEM™ 9085 resin Natural, 184 cu in - Classic
312-20200	ULTEM™ 9085 resin Black, 92.3 cu in - Classic
363-00400	MTRL, F3000 Series, (M), ULTEM 9085 resin (Natural), 4100cc
363-00450	MTRL, F3000 Series, (M), ULTEM 9085 resin (Black), 4100cc
363-00720	MTRL, F3000 Series, (S), SUP8500B, 4100cc
355-03220	SUP8500B Support, 92.3 cu in - Plus
310-30600	SUP8500B Support, 92.3 cu in - Classic
Printer Consumables	
511-10401	T16 tip, 0.010 in. (0.254 mm) layer height
511-10410	T16A tip, 0.010 in. (0.254 mm) layer height
511-10701	T20 tip, 0.013 in. (0.330 mm) layer height
511-10750	T40A tip, 0.020 in. (0.508 mm) layer height
325-00475[3]	Fortus 900mc/F900 high temperature build sheet, 0.02 x 26 x 38 in. (0.51 x 660 x 965 mm)
325-00275[4]	Fortus 900mc/F900 & Fortus 450mc high temperature build sheet, 0.02 x 16 x 18.5 in. (0.51 x 406 x 470 mm)
310-00300[5]	High Temperature build sheet, 0.03 x 16 x 18.5 in. (0.76 x 406 x 470 mm)
363-30200-S	F3300 Sheet Bundle, high temp, 0.02 x 26 x 28 in., 10
533-00410-S	FDM, N410 Support (0.25 mm/0.010 in. slice)
533-00500-S	FDM, N500 (0.25 mm/0.010 in. slice)
533-00750-S	FDM, N750 (0.50 mm/0.020 in. slice)
Print Heads	
821725-XXXX	Standard Fortus 450mc head (silver handle)
821726-XXXX	Hardened Fortus 450mc head (blue handle)
404210-XXXX	Standard F900 head (formed rod handle)
325-63500	Hardened F900 head (folded sheet metal handle)
533-10000-S	F3000 Series Extruder Drive

[1] Classic canisters are compatible with all Fortus 400mc™ and Fortus 900mc™ printers prior to s/n L502.
[2] Plus canisters are compatible with all Fortus 450mc, all Stratasys F900, and Fortus 900mc printers s/n L502 and up.
[3] Compatible with Stratasys F900 and Fortus 900mc.
[4] Compatible with Fortus 450mc, Stratasys F900 and Fortus 900mc.
[5] Compatible with Fortus 400mc.

Physical Properties

Values are measured as printed on the F900 with a 0.254 mm (0.010 in.) layer height. XY, XZ and ZX orientations were tested. For full details refer to the Stratasys Materials Test Procedure on www.stratasys.com. DSC and TMA curves can be found in the Appendix.

Table 3: ULTEM™ 9085 Resin Natural Physical Properties

Property	Test Method	Typical Values	
		XY	XZ/ZX
HDT @ 66 psi	ASTM D648 Method B	178.2 °C (352.8 °F)	178.4 °C (353.1 °F)
HDT @ 264 psi	ASTM D648 Method B	170.2 °C (338.3 °F)	172.6 °C (342.7 °F)
Molded HDT @ 66 psi	ASTM D648 Method B	176.9 °C (350.4 °F)	
Molded HDT @ 264 psi	ASTM D648 Method B	172.9 °C (343.2 °F)	
Tg	ASTM D7426 Inflection Point	177.3 °C (351.2 °F)	
Mean CTE (TAN)	ASTM E831 (-50 °C to 60 °C)		44.45 µm/[m*°C] 24.69 µin/[in*°F]
Mean CTE (TAN)	ASTM E831 (60 °C to 160 °C)		32.31µm/[m*°C] 17.95 µin/[in*°F]
Mean CTE (TAN)	ASTM E831 (-50 °C to 80 °C)	44.89 µm/[m*°C] (24.94 µin/[in*°F])	
Mean CTE (TAN)	ASTM E831 (80 °C to 160 °C)	31.35 µm/[m*°C] (17.42 µin/[in*°F])	
Mean CTE (BLACK)	ASTM E831 (-50 °C to 30 °C)		47.79 µm/[m*°C] 26.55 µin/[in*°F]
Mean CTE (BLACK)	ASTM E831 (30 °C to 165 °C)		38.55 µm/[m*°C] 21.42 µin/[in*°F]
Mean CTE (BLACK)	ASTM E831 (-50 °C to 80 °C)	51.88 µm/[m*°C] 28.82 µin/[in*°F]	
Mean CTE (BLACK)	ASTM E831 (80 °C to 160 °C)	40.2 µm/[m*°C] 22.33 µin/[in*°F]	
Volume Resistivity	ASTM D257	> $6.89*10^{15}$ Ω·cm	
Dielectric Constant	ASTM D150 1 kHz test condition	2.80	2.87
Dielectric Constant	ASTM D150 2 MHz test condition	2.65	2.73
Dissipation Factor	ASTM D150 1 kHz test condition	0.002	0.002
Dissipation Factor	ASTM D150 2 MHz test condition	0.010	0.010
Thermal Conductivity	ASTM E1952 @0 °C	0.2136 W/m*K 0.1234 BTU/(hr*ft*°F)	
Thermal Conductivity	ASTM E1952 @30 °C	0.2109 W/m*K 0.1219 BTU/(hr*ft*°F)	
Thermal Conductivity	ASTM E1952 @60 °C	0.2111 W/m*K 0.1220 BTU/(hr*ft*°F)	
Thermal Conductivity	ASTM E1952 @90 °C	0.2095 W/m*K 0.1211 BTU/(hr*ft*°F)	

Property	Test Method	Typical Values	
		XY	XZ/ZX
Thermal Diffusivity	ASTM E1952 @30 °C	0.132 mm^2/s 2.05*10^{-4} in^2/s	
Thermal Diffusivity	ASTM E1952 @60 °C	0.121 mm^2/s 1.88*10^{-4} in^2/s	
Thermal Diffusivity	ASTM E1952 @90 °C	0.111 mm^2/s 1.72*10^{-4} in^2/s	
Specific Gravity	ASTM D792 @23 °C	1.27	
UL Flammability[1]	ANSI/UL 746B	V0 – Blue Card #E345258	

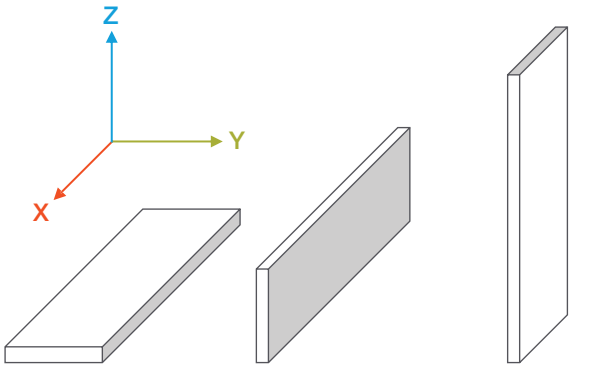
[1] Applies to the natural version of ULTEM™ 9085 resin only.

Mechanical Properties

Samples, natural and black, were printed with 0.254 mm (0.010 in.), 0.3302 mm (0.013 in.), and 0.508 mm (0.020 in.) layer heights on the F900 and Fortus 450mc. For the full test procedure please see the Stratasys Materials Test Procedure.

Print Orientation

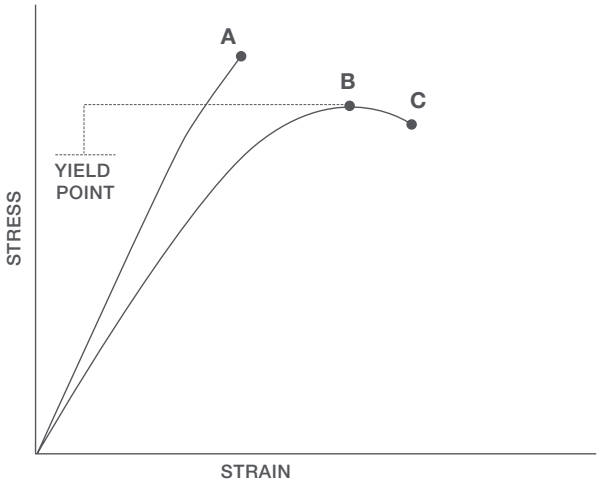
Parts created using FDM are anisotropic as a result of the printing process. Below is a reference of the different orientations used to characterize the material.



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: ULTEM™ 9085 Resin Natural Mechanical Properties - F900 - T16 Tip

0.254 mm (0.010 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	69.2 (1.0)	No yield
	psi	10,000 (150)	No yield
Elongation at Yield	%	5.4 (0.50)	No yield
Strength at Break	MPa	68.1 (1.6)	39.4 (8.7)
	psi	9,870 (230)	5,710 (1,300)
Elongation at Break	%	5.4 (0.50)	1.9 (0.51)
Modulus (Elastic)	GPa	2.52 (0.062)	2.41 (0.15)
	ksi	365 (8.9)	350 (22)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	104 (2.2)	73.1 (13)
	psi	15,000 (320)	10,600 (1,900)
Strain at Break	%	No break	3.67 (0.55)
Modulus	GPa	2.40 (0.032)	2.13 (0.081)
	ksi	348 (4.6)	309 (12)
Compression Properties: ASTM D695			
Yield Strength	MPa	139 (9.4)	342 (27)
	psi	20,100 (1,400)	49,600 (390)
Modulus	GPa	2.22 (0.047)	2.28 (0.080)
	ksi	321 (6.8)	331 (12)
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	88.5 (21)	39.2 (4.3)
	ft*lb/in	1.66 (0.40)	0.735 (0.080)
Izod, Unnotched	J/m	647 (66)	187 (42)
	ft*lb/in	12.1 (1.2)	3.51 (0.79)

[1] Values in parentheses are standard deviations.

Table 5: ULTEM™ 9085 Resin Natural Mechanical Properties - F900 - T16A Tip

0.254 mm (0.010 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	76.2 (5.8)	54.2 (3.1)
	psi	11100 (850)	7870 (450)
Elongation at Yield	%	5.3 (0.2)	3.4 (0.9)
Strength at Break	MPa	73.9 (5.3)	55.3 (5.7)
	psi	10700 (760)	8020 (830)
Elongation at Break	%	5.8 (0.6)	3.5 (1.1)
Modulus (Elastic)	GPa	2.50 (0.15)	2.21 (0.22)
	ksi	363 (21.1)	321 (32.1)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	111 (3.2)	82.4 (4.6)
	psi	16100 (470)	11900 (670)
Strain at Break	%	No Break	4.4 (0.35)
Modulus	GPa	2.55 (0.064)	2.12 (0.054)
	ksi	370 (9.3)	308 (7.8)
Compression Properties: ASTM D695			
Yield Strength	MPa	89.3 (4.3)	94.9 (2.9)
	psi	12900 (310)	13800 (210)
Modulus	GPa	1.85 (0.031)	1.93 (0.022)
	ksi	269 (4.5)	280 (3.2)
Impact Properties: ASTM D256, ASTM D4812			
Notched	J/m	140 (65)	46.7 (7.4)
	ft*lb/in	2.63 (1.2)	0.87 (0.14)
Unnotched	J/m	1510 (190)	257 (49)
	ft*lb/in	28.4 (3.5)	4.81 (0.92)

[1] Values in parentheses are standard deviations.

Table 6: ULTEM™ 9085 Resin Natural Mechanical Properties - F900 - T20 Tip

0.3302 mm (0.013 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	78.7 (1.6)	48.7 (4.8)
	psi	11400 (240)	7100 (700)
Elongation at Yield	%	6.4 (0.2)	3.1 (0.4)
Strength at Break	MPa	72.8 (2.6)	48.0 (4.7)
	psi	10600 (370)	7000 (680)
Elongation at Break	%	8.7 (0.9)	3.1 (0.4)
Modulus (Elastic)	GPa	2.11 (0.052)	1.93 (0.059)
	ksi	306 (7.5)	279 (8.6)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	113 (1.9)	72.1 (5.0)
	psi	16400 (270)	10500 (720)
Strain at Break	%	No break	4.0 (0.4)
Modulus	GPa	2.61 (0.042)	2.00 (0.067)
	ksi	379 (6.1)	289 (9.7)
Compression Properties: ASTM D695			
Yield Strength	MPa	87.8 (3.5)	90.9 (2.13)
	psi	12700 (510)	13200 (310)
Modulus	GPa	1.83 (0.058)	1.75 (0.037)
	ksi	265 (8.43)	254 (5.3)
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	118 (43)	45.4 (12)
	ft*lb/in	2.21 (0.81)	0.851 (0.23)
Izod, Unnotched	J/m	1910 (240)	210 (40)
	ft*lb/in	35.8 (4.4)	3.94 (0.75)

[1] Values in parentheses are standard deviations.

Table 7: ULTEM™ 9085 Resin Natural Mechanical Properties - F900 - T40A Tip

0.508 mm (0.020 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	82.3 (1.4)	55.7 (1.7)
	psi	11900 (200)	8080 (250)
Elongation at Yield	%	6.1 (0.1)	4.0 (0.3)
Strength at Break	MPa	64.9 (15.8)	55.5 (2.0)
	psi	9410 (2200)	8050 (290)
Elongation at Break	%	7.4 (3.3)	4.0 (0.3)
Modulus (Elastic)	GPa	2.2 (0.1)	1.9 (0.1)
	ksi	321 (6)	273 (4)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	110.4 (3.3)	83.6 (1.6)
	psi	16000 (500)	12100 (200)
Strain at Break	%	No break	4.8 (0.2)
Modulus	GPa	2.60 (0.06)	2.05 (0.04)
	ksi	371 (9)	298 (5)
Compression Properties: ASTM D695			
Yield Strength	MPa	Not Available	Not Available
	psi	Not Available	Not Available
Modulus	GPa	Not Available	Not Available
	ksi	Not Available	Not Available

[1] Values in parentheses are standard deviations.

* ZX D638 coupons were water jetted from printed plaques. (Coupon dimensions: ~165 x 22 x 5 mm (6.500 x 0.875 x 0.200 in.))

**XZ D638 coupons for T40A tip were larger than standards Stratasys tensile coupons. (As printed coupon dimensions: ~165 x 22 x 5 mm (6.500 x 0.875 x 0.200 in.))

Table 8: ULTEM™ 9085 Resin Black Mechanical Properties - F900 - T16 Tip

0.254 mm (0.010 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	71.7 (1.6)	No yield
	psi	10,400 (240)	No yield
Elongation at Yield	%	5.5 (0.27)	No yield
Strength at Break	MPa	69.8 (1.7)	41.4 (9.0)
	psi	10,100 (240)	6,000 (1,300)
Elongation at Break	%	5.4 (0.65)	2.1 (0.58)
Modulus (Elastic)	GPa	2.54 (0.050)	2.42 (0.16)
	ksi	368 (7.2)	351 (23)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	107 (3.4)	72.1 (5.9)
	psi	15,500 (490)	10,500 (860)
Strain at Break	%	No break	3.78 (0.39)
Modulus	GPa	2.47 (0.059)	2.11 (0.039)
	ksi	358 (8.6)	305 (5.7)
Compression Properties: ASTM D695			
Yield Strength	MPa	142 (9.1)	349 (24)
	psi	20,600 (1,300)	50,600 (350)
Modulus	GPa	2.27 (0.043)	2.37 (0.097)
	ksi	329 (6.3)	343 (14)
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	94.8 (22)	37.0 (8.3)
	ft*lb/in	1.78 (0.4)	0.693 (0.16)
Izod, Unnotched	J/m	771 (140)	169 (54)
	ft*lb/in	14.4 (2.7)	3.16 (1.0)

[1] Values in parentheses are standard deviations.

Table 9: ULTEM™ 9085 Resin Black Mechanical Properties - F900 - T20 Tip

0.3302 mm (0.013 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	78.0 (2.2)	46.1 (4.8)
	psi	11300 (320)	6690 (690)
Elongation at Yield	%	6.4 (0.1)	2.7 (0.4)
Strength at Break	MPa	71.2 (3.8)	46.2 (4.8)
	psi	10300 (550)	6700 (690)
Elongation at Break	%	9.1 (0.1)	2.7 (0.4)
Modulus (Elastic)	GPa	2.13 (0.022)	2.06 (0.060)
	ksi	308 (3.2)	298 (8.8)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	114.6 (2.0)	74.9 (3.9)
	psi	16600 (290)	10900 (560)
Strain at Break	%	No break	4.0 (0.3)
Modulus	GPa	2.63 (0.040)	2.05 (75)
	ksi	381 (6.1)	297 (11)
Compression Properties: ASTM D695			
Yield Strength	MPa	89.2 (1.5)	93.9 (1.5)
	psi	12900 (1.5)	13600 (220)
Modulus	GPa	1.90 (0.059)	1.80 (0.033)
	ksi	275 (8.6)	261 (4.8)
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	109 (31)	46.9 (8.3)
	ft*lb/in	2.05 (0.58)	0.88 (0.16)
Izod, Unnotched	J/m	1910 (200)	199 (28)
	ft*lb/in	35.8 (3.7)	3.73 (0.52)

[1] Values in parentheses are standard deviations.

Table 10: ULTEM™ 9085 Resin Black Mechanical Properties - F900 - T40A Tip

0.508 mm (0.020 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	79.1 (0.8)	52.8 (2.8)
	psi	11500 (100)	7660 (410)
Elongation at Yield	%	6.2 (0.1)	3.6 (0.5)
Strength at Break	MPa	62.7 (9.9)	52.9 (2.8)
	psi	9100 (1440)	7670 (400)
Elongation at Break	%	8.9 (3.5)	3.6 (0.6)
Modulus (Elastic)	GPa	2.20 (0.04)	1.88 (0.04)
	ksi	315 (6)	272 (6)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	111.9 (2.7)	83.4 (3.5)
	psi	16200 (400)	12100 (500)
Strain at Break	%	No break	4.5 (0.4)
Modulus	GPa	2.6 (0.06)	2.05 (0.03)
	ksi	375 (9)	298 (5)
Compression Properties: ASTM D695			
Peak Strength	MPa	Not Available	Not Available
	psi	Not Available	Not Available
Modulus	GPa	Not Available	Not Available
	ksi	Not Available	Not Available

[1] Values in parentheses are standard deviations.

* ZX D638 coupons were water jetted from printed plaques. (Coupon dimensions: 6.500 x 0.875 x 0.200 inches (~165 x 22 x 5 mm))
** XZ D638 coupons for T40A tip were larger than standards Stratasys tensile coupons. (As printed coupon dimensions: 6.500 x 0.875 x 0.200 inches (~165 x 22 x 5 mm))

Table 11: ULTEM™ 9085 Resin Natural Mechanical Properties - Fortus 450mc - T16A Tip

0.254 mm (0.010 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	73.0 (2.2)	54.5 (4.1)
	psi	10,600 (320)	7,900 (590)
Elongation at Yield	%	5.8 (0.22)	3.1 (0.31)
Strength at Break	MPa	70.3 (2.3)	54.1 (4.1)
	psi	10,200 (330)	7,850 (590)
Elongation at Break	%	6.6 (0.59)	3.1 (0.31)
Modulus (Elastic)	GPa	2.11 (0.057)	2.11 (0.034)
	ksi	306 (8.2)	306 (5.00)
Flexural Properties: ASTM D790, Procedure A			
Strength at Break	MPa	No break	76.8 (6.5)
	psi	No break	11,100 (940)
Strength at 5% Strain	MPa	106 (3.9)	NA
	psi	15,400 (570)	NA
Strain at Break	%	No break	3.9 (0.4)
Modulus	GPa	2.45 (0.66)	2.19 (0.12)
	ksi	355 (9.6)	318 (17)
Compression Properties: ASTM D695			
Yield Strength	MPa	91.3 (1.9)	99.1 (2.9)
	psi	13,200 (270)	14,400 (420)
Modulus	GPa	1.89 (0.066)	1.94 (0.028)
	ksi	273 (9.6)	281 (4.1)
Impact Properties: ASTM D256, ASTM D4812			
Notched	J/m	106 (23)	53.0 (8.2)
	ft*lb/in	1.98 (0.42)	0.992 (0.15)
Unnotched	J/m	1,430 (110)	325 (88)
	ft*lb/in	26.8 (2.0)	6.09 (1.64)

[1] Values in parentheses are standard deviations.

Table 12: ULTEM™ 9085 Resin Black Mechanical Properties - Fortus 450mc - T20 Tip

0.3302 mm (0.013 in.) Layer Height		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	76.5 (1.4)	No Yield
	psi	11,100 (200)	No Yield
Elongation at Yield	%	6.2 (0.2)	No Yield
Strength at Break	MPa	74.0 (2.0)	41.6 (5.0)
	psi	10,700 (290)	6,030 (730)
Elongation at Break	%	6.6 (0.49)	2.6 (0.38)
Modulus (Elastic)	GPa	2.04 (0.048)	1.9 (0.032)
	ksi	295 (6.9)	275 (4.6)

[1] Values in parentheses are standard deviations.

UV Aging

ULTEM™ 9085 resin was tested before and after UV exposure. Ten ASTM D638 upright (ZX) dogbones were tested in tensile after UV exposure and an additional 10 ASTM D638 ZX dogbones were the control (no UV exposure). The UV exposed samples were cycled in the QUV chamber per ASTM G154 (Standard Practice for Operation Fluorescent UV Light Apparatus for Exposure of Nonmetallic Materials) for 1,000 hours, alternating for eight hours at 60 ˚C (140 ˚F) and four hours at 50 ˚C (122 ˚F) with humidity and condensation. The increase in stress at break is from the control samples. For more information see the Impact of UV Exposure on FDM Materials white paper.

Table 13: UV Aging of ULTEM™ 9085 Resin - Fortus F900 - T16A Tip

Material	Conditioning	Yield Strength		Stress at Break		Elongation at break	Increase in Stress at Break	Modulus	
		(psi)	(MPa)	(psi)	(MPa)	(%)	(%)	(ksi)	(GPa)
ULTEM™ 9085 resin	No UV Exposure	8130	56.0	8080	55.7	3.5	-	293	2.02
	UV Exposure	8060	55.5	8070	55.6	3.7	-0.1	302	2.08

Performance at Temperature

ULTEM™ 9085 resin was tested at various temperatures. Ten ASTM D638 upright (ZX) T16 dogbone coupons were tested in tensile. The percent change from the reported room temperature results are listed below.
For more information, see the Temperature Impact on FDM Strength Performance white paper.

Table 14: Performance of ULTEM™ 9085 Resin at Temperatures - T16 Tip

Material	Temperature (°F)	Temperature (°C)	Strength at Break	Elongation at Break	Modulus
ULTEM™ 9085 resin	-65	-54	157%	125%	137%
	-40	-40	156%	119%	147%
	120	49	122%	98%	137%
	180	82	102%	95%	121%
	220	104	87%	91%	100%
	270	132	70%	82%	100%
	300	149	55%	NA	NA

ULTEM™ 9085 resin was tested for Flame, Smoke, and Toxicity (FST), Outgassing, NFPA 130, EN 45545-2, and UN ECE Regulation 118. These tests were done to show that ULTEM™ 9085 resin 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 ULTEM™ 9085 resin will perform for a specific part.

Flame, Smoke and Toxicity

ULTEM™ 9085 resin, natural (T20 tip and T16A tip) and black (T16 tip), were printed on the Stratasys F900 and tested per 14 CFR 25.853, BSS 7238 and 7239, and AITM 2.0007B and 3.0005. The testing establishes that this material meets requirements for:

- 60s and 12s Vertical Burn
- 15s Horizontal Burn
- Toxic Gas Emission
- Smoke Density
- Heat Release Rate of Cabin Materials

Table 15: ULTEM™ 9085 Resin Flame, Smoke and Toxicity Test Results

	Avg Time to Extinguish (seconds)	Avg Burned Length (inches)	Drip Time to Extinguish (seconds)
12 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(ii)			
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ	1.6	0.2	0 (no drips)
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX	1.7	0.5	0 (no drips)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY	2.0	0.2	0 (no drips)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XZ	1.5	0.2	0 (no drips)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX	2.0	0.2	0 (no drips)
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ	1.1	0.3	0 (no drips)
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX	<1	0.4	0 (no drips)
60 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(i)			
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ	1.5	1.8	0 (no drips)
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX	<1	1.9	0 (no drips)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY	<1	0.4	0 (no drips)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XZ	3.6	0.6	0 (no drips)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX	<1	0.4	0 (no drips)
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ	<1	1.2	0 (no drips)
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX	<1	1.5	0 (no drips)
		Avg Burn Rate (in/min)	
15 Second Horizontal Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(iv)(v)			
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ		0	
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX		0	
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY		0	
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XZ		0	
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX		0	
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ		0	
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX		0	

Table 16: ULTEM™ 9085 Resin Flame, Smoke and Toxicity Test Results

	Test Mode	Average D_S (maximum) within 4 minutes, ($^4D_{max}$)
Smoke Density per BSS 7238, Rev. C		
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ	Flaming	4
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX	Flaming	5
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY	Flaming	4
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX	Flaming	4
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ	Flaming	10
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX	Flaming	15
Smoke Density per AITM 2.0007B, Issue 3		
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ	Flaming	5
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX	Flaming	5
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ	Non-Flaming	0
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX	Non-Flaming	0
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY	Flaming	5
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX	Flaming	6
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY	Non-Flaming	0
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX	Non-Flaming	0
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ	Flaming	12
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX	Flaming	14
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ	Non-Flaming	0
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX	Non-Flaming	0

	Test Mode	CO ppm	SO_2 ppm	NO_x ppm	HCN ppm	HCl ppm	HF ppm
Toxic Gas Emission per BSS 7239, Rev. A							
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ	Flaming	50	0 (NI)	2	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX	Flaming	50	0 (NI)	2	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY	Flaming	50	0 (NI)	2	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX	Flaming	50	0 (NI)	2	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ	Flaming	100	0 (NI)	1	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX	Flaming	75	0 (NI)	1	0 (NI)	0 (NI)	0 (NI)

Table 17: ULTEM™ 9085 Resin Flame, Smoke and Toxicity Test Results

	Test Mode	CO ppm	SO_2 ppm	NO_x ppm	HCN ppm	HCl ppm	HF ppm
Toxic Gas Emission per AITM 3.0005, Issue 2							
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ	Flaming	92	0	2.8	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX	Flaming	102	0	4	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ	Non-Flaming	2.6	0	0	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX	Non-Flaming	2.2	0	0	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY	Flaming	61	0	2.3	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX	Flaming	78	0	3.2	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY	Non-Flaming	4	0	0	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX	Non-Flaming	5	0	0	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ	Flaming	93	0	1	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX	Flaming	103	0	3	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ	Non-Flaming	2	0	0	0 (NI)	0 (NI)	0 (NI)
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX	Non-Flaming	2	0	0	0 (NI)	0 (NI)	0 (NI)

	Peak HRR (kW/m^2)	Time to Peak Heat Release (seconds)	2 Minute Total HRR ($kW\text{-}min./m^2$)
Heat Release Rate of Cabin Materials per 14 CFR 25.853(d), Appendix F, Part IV			
ULTEM™ 9085 Resin, Natural, T20 Tip, Build XZ	54.5	73	35.5
ULTEM™ 9085 Resin, Natural, T20 Tip, Build ZX	48.2	66	41.0
ULTEM™ 9085 Resin, Natural, T16A Tip, Build XY	57.0	57	43.7
ULTEM™ 9085 Resin, Natural, T16A Tip, Build ZX	56.6	57	52.8
ULTEM™ 9085 Resin, Black, T16 Tip, Build XZ	55.4	48	32.7
ULTEM™ 9085 Resin, Black, T16 Tip, Build ZX	41.8	51	34.1

Outgassing

ULTEM™ 9085 resin, natural and black, was printed with a T20 and T16 tip on the Stratasys F900 and tested per ASTM E595. Full report available upon request.

Table 18: ULTEM™ 9085 Resin Outgassing Test Results

Sample	TML (%)	CVCM (%)	WVR (%)
ULTEM™ 9085 Resin, Natural, T20 Tip	0.34	0.02	0.35
ULTEM™ 9085 Resin, Natural, T16A Tip	0.37	< 0.01	0.38
ULTEM™ 9085 Resin, Black, T16 Tip	0.33	< 0.01	0.22
Testing Observations[1]			
Visible Condensate	No	Opaque	N/A
Percent Covered	0%	Interference Fringes	N/A
Thin	N/A	Colored Fringes	N/A
Heavy	N/A	Sample appearance after test	No change
Transparent	N/A		

[1] Observations apply to all tested samples.

Fire Protection of Railway Vehicles

NFPA 130

ULTEM™ 9085 resin CG was printed with a T16A tip on the Stratasys F900 using single contour and +45/-45 solid rasters, which are typical default settings and tested per NFPA 130.

* It should be noted that products with other wall thicknesses and/or printed at different machines and with different settings (orientation/filling/tip size) may perform differently.
* Further testing should be done by the customer to make sure the material fits their final application.

Table 19: ULTEM™ 9085 Resin CG NFPA 130 Fixed Guideway Transit and Passenger Transit Systems Test Results

Test	Thickness	Performance Criteria	Result	
ASTM E162	12.7 mm	Depends on function of material. Refer to NFPA 130 Table 8.4.1	Is (flat) = 0 Is (upright) = 0	
ASTM E662	20 mm	Depends on function of material. Refer to NFPA 130 Table 8.4.1	Flat, Non-flaming Ds (1.5) = 0 Ds (4.0) = 0	Flat, Flaming Ds (1.5) = 0 Ds (4.0) = 12.3
			Upright, Non-flaming Ds (1.5) = 0 Ds (4.0) = 0	Upright, flaming Ds (1.5) = 0.7 Ds (4.0) = 17
ASTM E1354	25 mm	Average Heat Release Rate < 100 kW/m^2 Average Smoke Extinction Area < 500 m^2/kg	Flat Average Heat Release Rate: 67.1 kW/m^2 Average Smoke Extinction Area: 262.4 m^2/kg	
			Upright Average Heat Release Rate: 61.4 kW/m^2 Average Smoke Extinction Area: 372.3 m^2/kg	

Fire Protection of Railway Vehicles
EN 45545-2

ULTEM™ 9085 resin CG was printed with a T16A tip on the Stratasys F900 using single contour and +45/-45 solid rasters, which are typical default settings and tested per EN 45545-2.

The limited testing done establishes that this material meets requirements for:

- R1, R2, R3, R6, R7, R17: HL1/2/3 at 25 mm thick in XY and XZ orientations
- R2, R3, R17: HL1/2/3 at 5 mm thick in XY orientation
- Not classified at 5 mm thick in XZ orientation
- R22: HL1/2 at 0.508 mm thick in XY orientation
- R22: HL1/2/3, 1 mm to 10.5 mm in XY orientation
- R23: HL1/2/3, 0.508 mm to 10.5 mm in XY orientation

* Additional tests are in progress. Please consult Stratasys Application Engineers to learn more.
* It should be noted that products with other wall thicknesses and/or printed at different machines and with different settings (orientation/filling/tip size) may perform differently.
* Further testing should be done by the customer to make sure the material fits their final application.

Table 20: ULTEM™ 9085 Resin CG Fire Protection of Railway Vehicles Test Results for R1 Requirement Set

Test	Results	5mm XY	5 mm XZ	25 mm XY	25 mm XZ
ISO 5659-2 50 kW/m²	D_s4	-	-	38	57
	VOF_4	-	-	62	94
	Dm	-	-	228	231
ISO 5659-2 + EN 45545-2 Appendix C 50 kW/m²	ITC 4 minutes	-	-	0.02	0.01
	ITC 8 minutes	-	-	0.08	0.06
ISO 5660-1	MAHRE (kW/m²)	-	-	24.1	19.9
ISO 5658-2	CFE (kW/m²)	16.5	12.5	29.9	28.6

Table 21: ULTEM™ 9085 Resin CG Fire Protection of Railway Vehicles Test Results for R22/23 Requirement Set

Test	Results	0.508 mm XY	1 mm XY	10.5 mm XY
ISO 5659-2 25 kW/m²	$D_s(4)$	2	3	0
	VOF_4	2	3	0
	$D_s max$	15	15	6
NF X 70-100	CIT_{NLP}	0.8	0.69	0.6
ISO4589-2	$\%O_2$	37.6	42.5	49

Fire Protection of Buses
UN ECE Regulation 118

ULTEM™ 9085 resin CG was printed with a T16 tip on the Stratasys F900 using single contour and +45/-45 solid rasters, which are typical default settings and tested per EN-45545-2.

- Orientation: Flat XY
- Sample thickness: 3mm

Table 22: ULTEM™ 9085 Resin CG Fire Protection of Buses Test Results

Horizontal Burning Annex VI	Melting Behavior Annex VII	Vertical Burn Annex VIII
Passed	**Passed**	**Passed**
The tested samples do not ignite, the burning rate is 0 mm/min.	No drop is formed that ignites the cotton wool during testing.	The tested samples do not ignite, the burning rate is 0 mm/min.

Appendix

Validated Materials

Stratasys Validated Materials are developed by Stratasys or a third-party provider, meet Stratasys quality standards, and have received basic reliability testing for use with Stratasys FDM printers.

Table 23: Colored ULTEM™ 9085 Resin Validated Materials

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Validated Material - ULTEM™ 9085 Resin Aircraft Gray, Fortus 450mc, T16			
Yield Strength	MPa	78.8 (0.57)	56.4 (3.2)
	psi	11400 (82)	8180 (460)
Elongation @ Yield	%	6.2 (0.070)	3.2 (0.35)
Strength @ Break	MPa	75.1 (1.6)	55.9 (3.0)
	psi	10900 (230)	8110 (440)
Elongation @ Break	%	7.9 (0.34)	3.1 (0.32)
Modulus (Elastic)	GPa	2.25 (0.026)	2.18 (0.026)
	ksi	326 (3.8)	316 (3.7)
Validated Material - ULTEM™ 9085 Resin Aircraft Gray, F900, T16			
Yield Strength	MPa	70.6 (2.4)	No yield
	psi	10200 (350)	No yield
Elongation @ Yield	%	5.6 (0.13)	No yield
Strength @ Break	MPa	69.5 (2.2)	56.0 (2.3)
	psi	10100 (310)	8120 (340)
Elongation @ Break	%	6.1 (0.26)	3.3 (0.29)
Modulus (Elastic)	GPa	2.09 (0.042)	2.12 (0.018)
	ksi	303 (6.1)	308 (2.6)
Validated Material - ULTEM™ 9085 Resin Gunship Gray, Fortus 450mc, T16			
Yield Strength	MPa	81.0 (0.50)	47.2 (9.6)
	psi	11700 (73)	6850 (1400)
Elongation @ Yield	%	6.2 (0.09)	2.5 (0.65)
Strength @ Break	MPa	78.5 (3.2)	48.7 (8.2)
	psi	11400 (460)	7060 (1200)
Elongation @ Break	%	7.1 (0.81)	2.7 (0.58)
Modulus (Elastic)	GPa	2.27 (0.022)	2.19 (0.0096)
	ksi	330 (3.2)	318 (1.4)

[1] Values in parentheses are standard deviations.

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Validated Material - ULTEM™ 9085 Resin Gunship Gray, F900, T16			
Yield Strength	MPa	69.9 (2.3)	No yield
	psi	10100 (330)	No yield
Elongation @ Yield	%	5.7 (0.13)	No yield
Strength @ Break	MPa	68.8 (2.2)	55.6 (2.9)
	psi	9970 (320)	8070 (430)
Elongation @ Break	%	6.2 (0.28)	3.4 (0.37)
Modulus (Elastic)	GPa	2.08 (0.055)	4.17 (0.035)
	ksi	302 (7.9)	605 (5.1)
Validated Material - ULTEM™ 9085 Resin White 7362 (AIC 12.16), Fortus 450mc, T16			
Yield Strength	MPa	76.6 (1.4)	36.8 (3.2)
	psi	11100 (200)	5340 (470)
Elongation @ Yield	%	5.8 (0.22)	1.9 (0.23)
Strength @ Break	MPa	75.1 (1.4)	36.4 (6.2)
	psi	10900 (200)	5270 (900)
Elongation @ Break	%	6.1 (0.34)	1.9 (0.40)
Modulus (Elastic)	GPa	2.22 (0.033)	2.26 (0.066)
	ksi	322 (4.8)	328 (9.6)
Validated Material - ULTEM™ 9085 Resin White 7362 (AIC 12.16), F900, T16			
Yield Strength	MPa	64.4 (2.6)	No yield
	psi	9340 (380)	No yield
Elongation @ Yield	%	5.1 (0.19)	No yield
Strength @ Break	MPa	63.5 (2.6)	40.2 (2.1)
	psi	9210 (380)	5830 (300)
Elongation @ Break	%	5.5 (0.40)	2.3 (0.18)
Modulus (Elastic)	GPa	2.04 (0.055)	2.10 (0.042)
	ksi	296 (8.0)	304 (6.1)

[1] Values in parentheses are standard deviations.

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Validated Material - ULTEM™ 9085 Resin Dream Gray (AIC 2.49), Fortus 450mc, T16			
Yield Strength	MPa	73.2 (0.75)	39.1 (6.2)
	psi	10600 (110)	5680 (900)
Elongation @ Yield	%	5.5 (0.20)	2.0 (0.39)
Strength @ Break	MPa	72.1 (0.73)	40.2 (5.1)
	psi	10500 (110)	5830 (740)
Elongation @ Break	%	5.9 (0.41)	2.1 (0.34)
Modulus (Elastic)	GPa	2.22 (0.051)	2.30 (0.29)
	ksi	321 (7.4)	334 (41)
Validated Material - ULTEM™ 9085 Resin Dream Gray (AIC 2.49), F900, T16			
Yield Strength	MPa	63.9 (2.5)	46.6 (2.8)
	psi	9270 (360)	6770 (410)
Elongation @ Yield	%	5.6 (0.21)	2.7 (0.23)
Strength @ Break	MPa	63.9 (2.5)	26.0 (2.8)
	psi	9270 (360)	3770 (410)
Elongation @ Break	%	5.6 (0.21)	2.7 (0.23)
Modulus (Elastic)	GPa	1.98 (0.051)	2.11 (0.024)
	ksi	288 (7.3)	307 (3.4)
Validated Material - ULTEM™ 9085 Resin Jana White (AIC 12.36), Fortus 450mc, T16			
Yield Strength	MPa	77.4 (0.44)	40.2 (5.7)
	psi	11200 (63)	5830 (830)
Elongation @ Yield	%	6.2 (0.09)	2.1 (0.41)
Strength @ Break	MPa	75.3 (2.1)	40.2 (5.7)
	psi	10900 (310)	5830 (830)
Elongation @ Break	%	7.0 (0.37)	2.1 (0.41)
Modulus (Elastic)	GPa	2.30 (0.053)	2.27 (0.068)
	ksi	334 (7.7)	329 (9.9)
Validated Material - ULTEM™ 9085 Resin Jana White (AIC 12.36), F900, T16			
Yield Strength	MPa	65.9 (2.8)	No yield
	psi	9550 (410)	No yield
Elongation @ Yield	%	5.3 (0.18)	No yield
Strength @ Break	MPa	64.7 (2.8)	56.0 (2.3)
	psi	9390 (400)	8120 (340)
Elongation @ Break	%	5.8 (0.40)	3.3 (0.29)
Modulus (Elastic)	GPa	2.06 (0.051)	2.12 (0.018)
	ksi	299 (7.3)	308 (2.6)

[1] Values in parentheses are standard deviations.

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Validated Material - ULTEM™ 9085 Resin Red, Fortus 450mc, T16			
Yield Strength	MPa	74.7 (3.3)	53.3 (4.1)
	psi	10800 (480)	7730 (600)
Elongation @ Yield	%	6.0 (0.21)	3.1 (0.35)
Strength @ Break	MPa	72.7 (4.0)	53.7 (4.0)
	psi	10500 (580)	7790 (580)
Elongation @ Break	%	6.7 (0.55)	3.1 (0.33)
Modulus (Elastic)	GPa	2.15 (0.037)	2.12 (0.028)
	ksi	312 (5.4)	307 (4.1)
Validated Material - ULTEM™ 9085 Resin Red, F900, T16			
Yield Strength	MPa	68.9 (2.2)	No yield
	psi	9990 (320)	No yield
Elongation @ Yield	%	5.7 (0.11)	No yield
Strength @ Break	MPa	67.1 (2.1)	53.3 (2.8)
	psi	9730 (310)	7730 (400)
Elongation @ Break	%	6.6 (0.37)	3.0 (0.25)
Modulus (Elastic)	GPa	2.06 (0.048)	2.15 (0.035)
	ksi	299 (6.9)	311 (5.1)

[1] Values in parentheses are standard deviations.

Flame, Smoke, and Toxicity

ULTEM™ 9085 resin White, Jana White, Aircraft Gray, Dream Gray, Gunship Gray, and Red were all printed on the Stratasys F900 with the T16 tip. For more information or for a detailed test report please contact a Stratasys representative.

Table 24: ULTEM™ 9085 Flame, Smoke, and Toxicity Test Results

	Avg Time to Extinguish (seconds)	Avg Burned Length (inches)	Drip Time to Extinguish (seconds)
12 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(ii)			
ULTEM™ 9085 Resin, White, T16 Tip, Build XZ	3.4	1.9	0 (no drips)
ULTEM™ 9085 Resin, White, T16 Tip, Build ZX	6	2	0 (no drips)
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build XZ	4.4	2	0 (no drips)
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build ZX	4.3	2	0 (no drips)
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build XZ	1.8	1.8	0 (no drips)

	Avg Time to Extinguish (seconds)	Avg Burned Length (inches)	Drip Time to Extinguish (seconds)
12 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(ii)			
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build ZX	2.2	1.7	0 (no drips)
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build XZ	3.8	2	0 (no drips)
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build ZX	3.8	1.9	0 (no drips)
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build XZ	1.9	1.9	0 (no drips)
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build ZX	1.3	1.6	0 (no drips)
ULTEM™ 9085 Resin, Red, T16 Tip, Build XZ	4.6	2.1	0 (no drips)
ULTEM™ 9085 Resin, Red, T16 Tip, Build ZX	3.1	2.1	0 (no drips)
60 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(i)			
ULTEM™ 9085 Resin, White, T16 Tip, Build XZ	0	3.5	0 (no drips)
ULTEM™ 9085 Resin, White, T16 Tip, Build ZX	0	4.1	0 (no drips)
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build XZ	0	3.7	0 (no drips)
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build ZX	0	4	0 (no drips)
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build XZ	0	3	0 (no drips)
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build ZX	1.5	3.8	0 (no drips)
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build XZ	0	3.5	0 (no drips)
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build ZX	0	4.1	0 (no drips)
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build XZ	0	2.9	0 (no drips)
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build ZX	0	4	0 (no drips)
ULTEM™ 9085 Resin, Red, T16 Tip, Build XZ	0	3.3	0 (no drips)
ULTEM™ 9085 Resin, Red, T16 Tip, Build ZX	0	4.4	0 (no drips)
		Avg Burn Rate (inches/minute)	
15 Second Horizontal Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(iv)(v)			
ULTEM™ 9085 Resin, White, T16 Tip, Build XZ		0	
ULTEM™ 9085 Resin, White, T16 Tip, Build ZX		0	
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build XZ		0	
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build ZX		0	
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build XZ		0	
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build ZX		0	
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build XZ		0	
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build ZX		0	
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build XZ		0	
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build ZX		0	
ULTEM™ 9085 Resin, Red, T16 Tip, Build XZ		0	
ULTEM™ 9085 Resin, Red, T16 Tip, Build ZX		0	

	Test Mode	Average Ds (maximum) within 4 minutes, ([4]Dmax)
Smoke Density per BSS 7238, Rev. C		
ULTEM™ 9085 Resin, White, T16 Tip, Build XZ	Flaming	10.6 (14.5)
ULTEM™ 9085 Resin, White, T16 Tip, Build ZX	Flaming	12.4 (14.9)
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build XZ	Flaming	18.1 (21.3)
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build ZX	Flaming	12.5 (19.3)
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build XZ	Flaming	9.7 (11.5)
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build ZX	Flaming	11.0 (12.7)
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build XZ	Flaming	12.8 (15.3)
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build ZX	Flaming	9.1 (12.0)
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build XZ	Flaming	9.9 (11.8)
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build ZX	Flaming	8.6 (9.8)
ULTEM™ 9085 Resin, Red, T16 Tip, Build XZ	Flaming	18.3 (23.3)
ULTEM™ 9085 Resin, Red, T16 Tip, Build ZX	Flaming	22.9 (27.7)

	Test Mode	CO ppm	SO_2 ppm	NO_X ppm	HCN ppm	HCl ppm	HF ppm
Toxic Gas Emission per BSS 7239, Rev. A							
ULTEM™ 9085 Resin, White, T16 Tip, Build XZ	Flaming	82	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, White, T16 Tip, Build ZX	Flaming	61	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build XZ	Flaming	66	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build ZX	Flaming	76	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build XZ	Flaming	52	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build ZX	Flaming	79	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build XZ	Flaming	75	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build ZX	Flaming	63	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build XZ	Flaming	53	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build ZX	Flaming	60	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Red, T16 Tip, Build XZ	Flaming	74	<5	<5	<5	<5	<5
ULTEM™ 9085 Resin, Red, T16 Tip, Build ZX	Flaming	99	<5	<5	<5	<5	<5

	Peak HRR (kW/m^2)	Time to Peak Heat Release (seconds)	2 Minute Total HRR ($kW\text{-}min/m^2$)
Heat Release Rate of Cabin Materials per 14 CFR 25.853(d), Appendix F, Part IV			
ULTEM™ 9085 Resin, White, T16 Tip, Build XZ	39.6	53	36.1
ULTEM™ 9085 Resin, White, T16 Tip, Build ZX	39.6	55	35.5
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build XZ	36.3	51	29.7
ULTEM™ 9085 Resin, Jana White, T16 Tip, Build ZX	35.3	53	32.6
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build XZ	38.6	55	29.6
ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build ZX	38.3	52	30
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build XZ	36.2	55	34.1
ULTEM™ 9085 Resin, Dream Gray, T16 Tip, Build ZX	37.5	55	30.9
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build XZ	31.7	115	24
ULTEM™ 9085 Resin, Gunship Gray, T16 Tip, Build ZX	33.7	52	28.2
ULTEM™ 9085 Resin, Red, T16 Tip, Build XZ	41.9	54	41.2
ULTEM™ 9085 Resin, Red, T16 Tip, Build ZX	46.6	59	45.9

Figure 1: 2nd heating scan DSC data for ULTEM™ 9085 resin, natural.

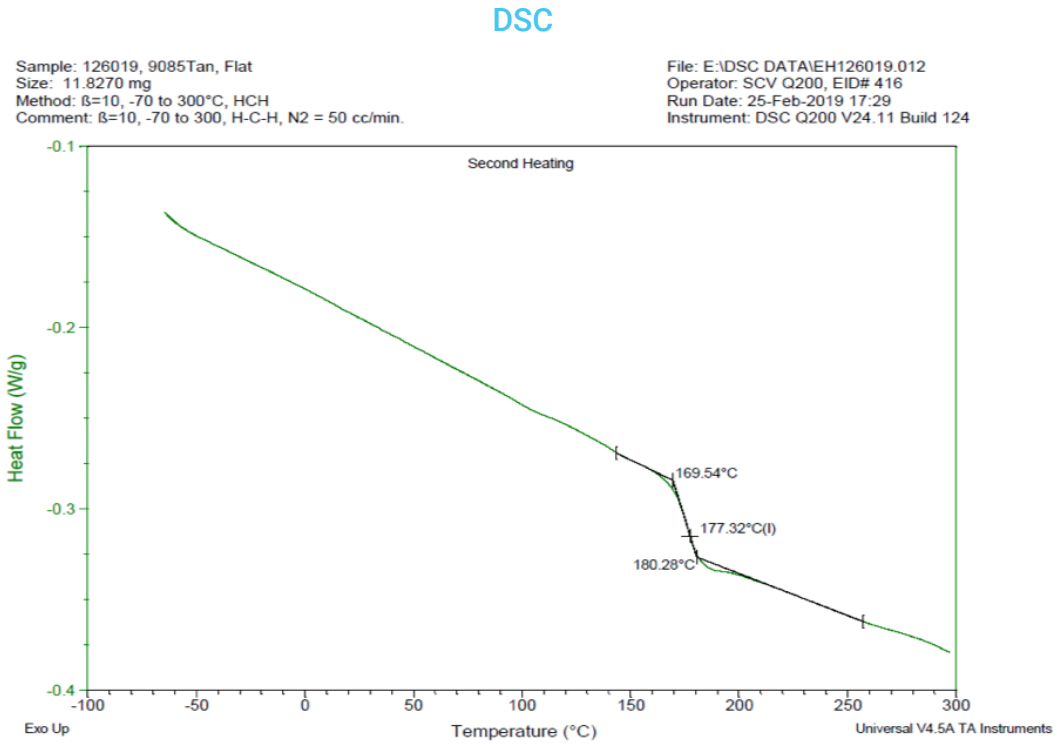


Figure 2: 2nd heating scan DSC data for ULTEM™ 9085 resin, black.

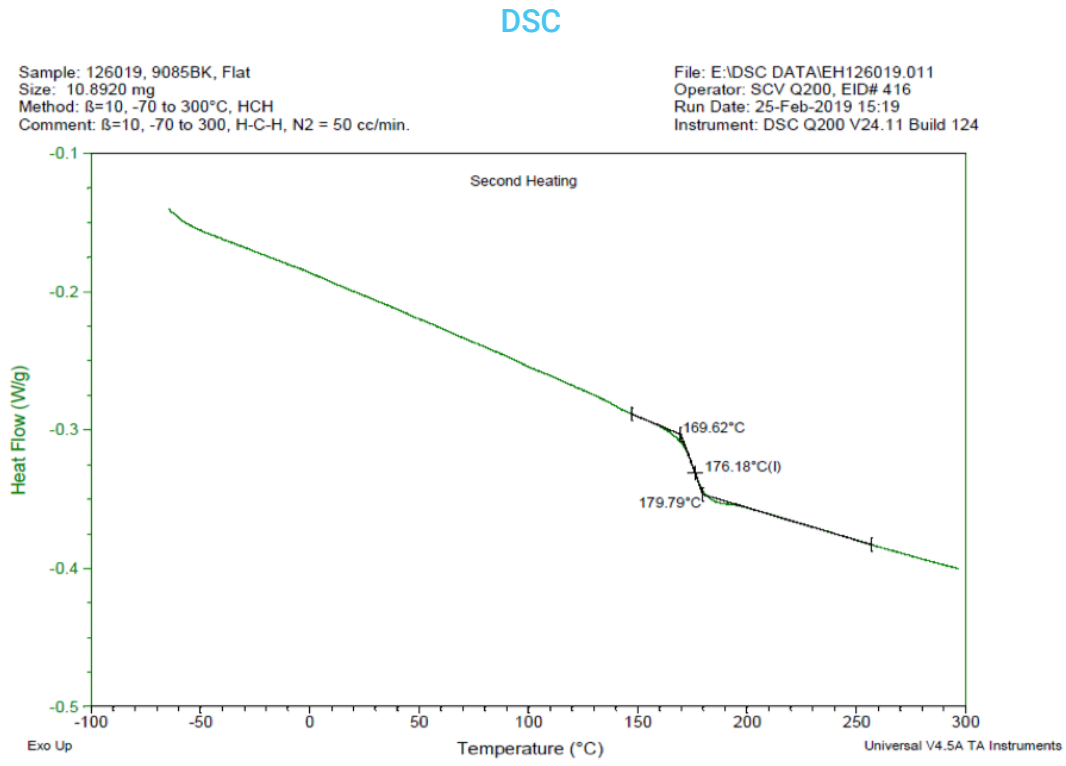


Figure 3: Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, flat (XY).

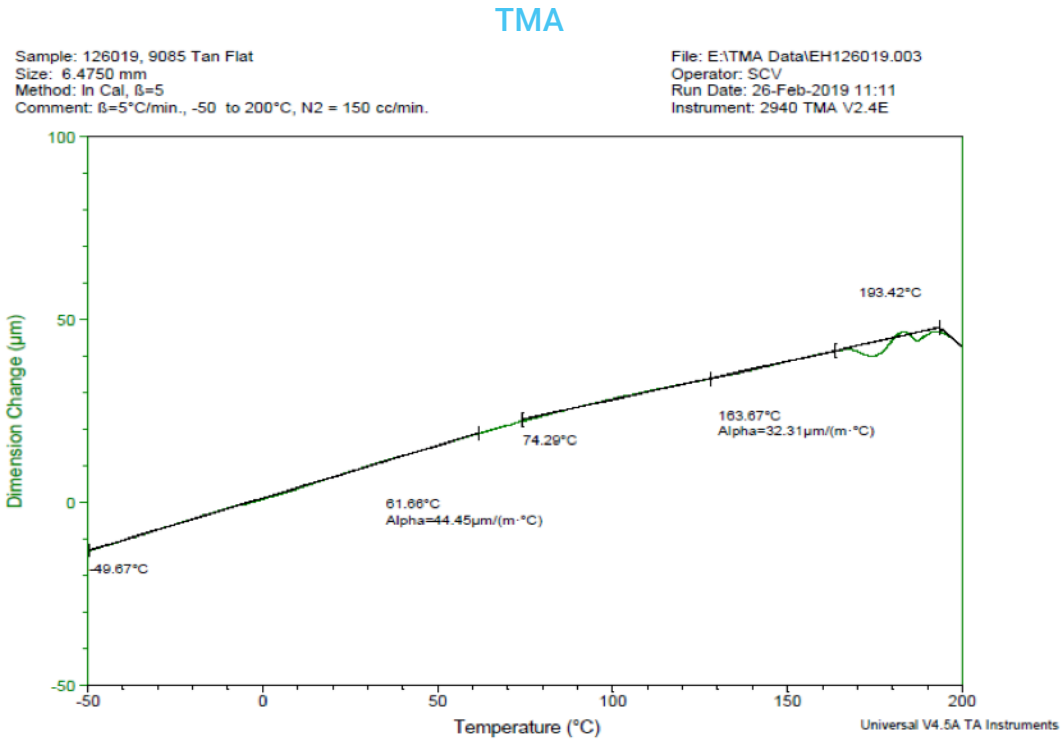


Figure 4: Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, upright (XZ).

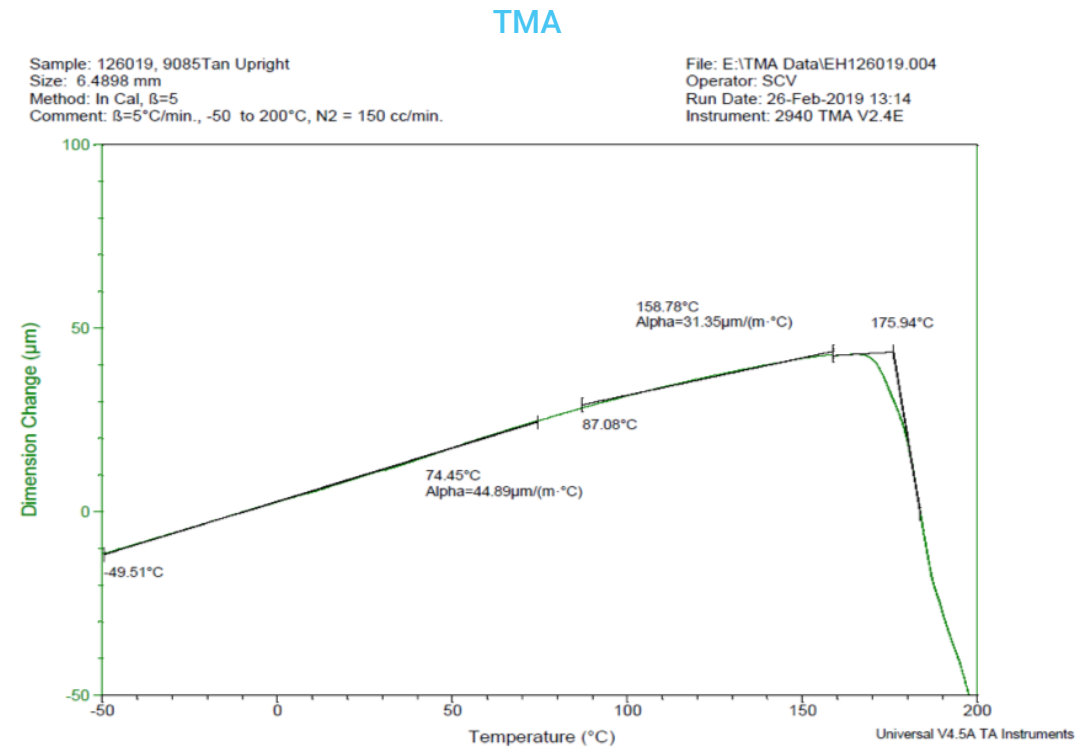


Figure 6: Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, upright (XZ).

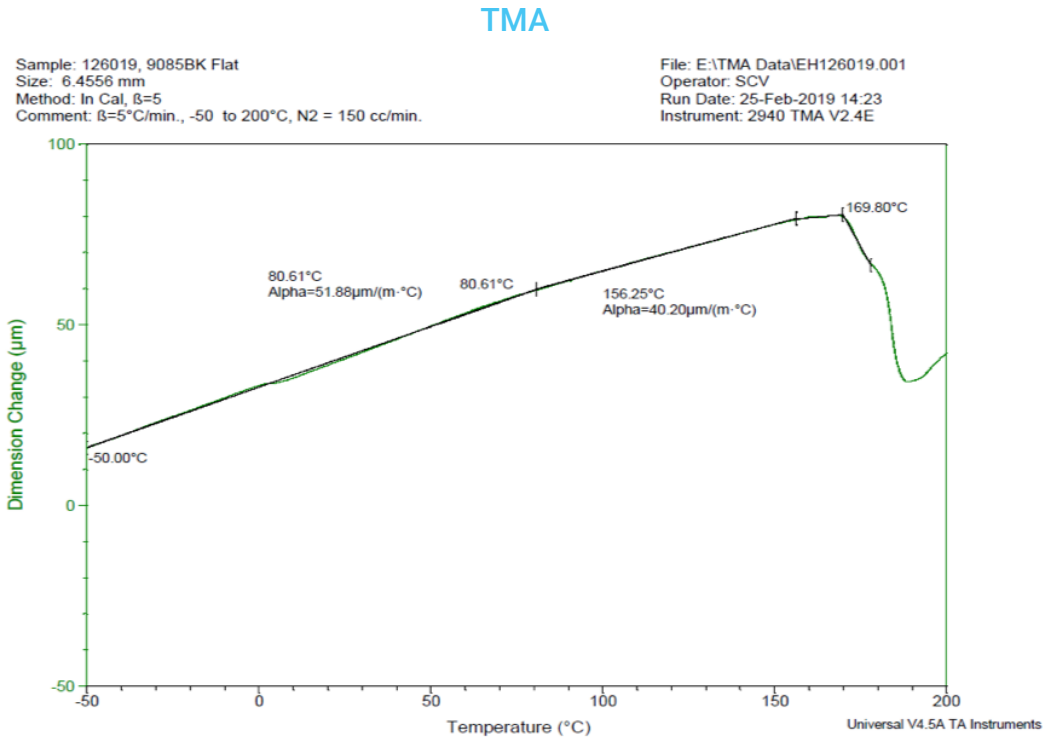


Figure 6: Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, upright (XZ).

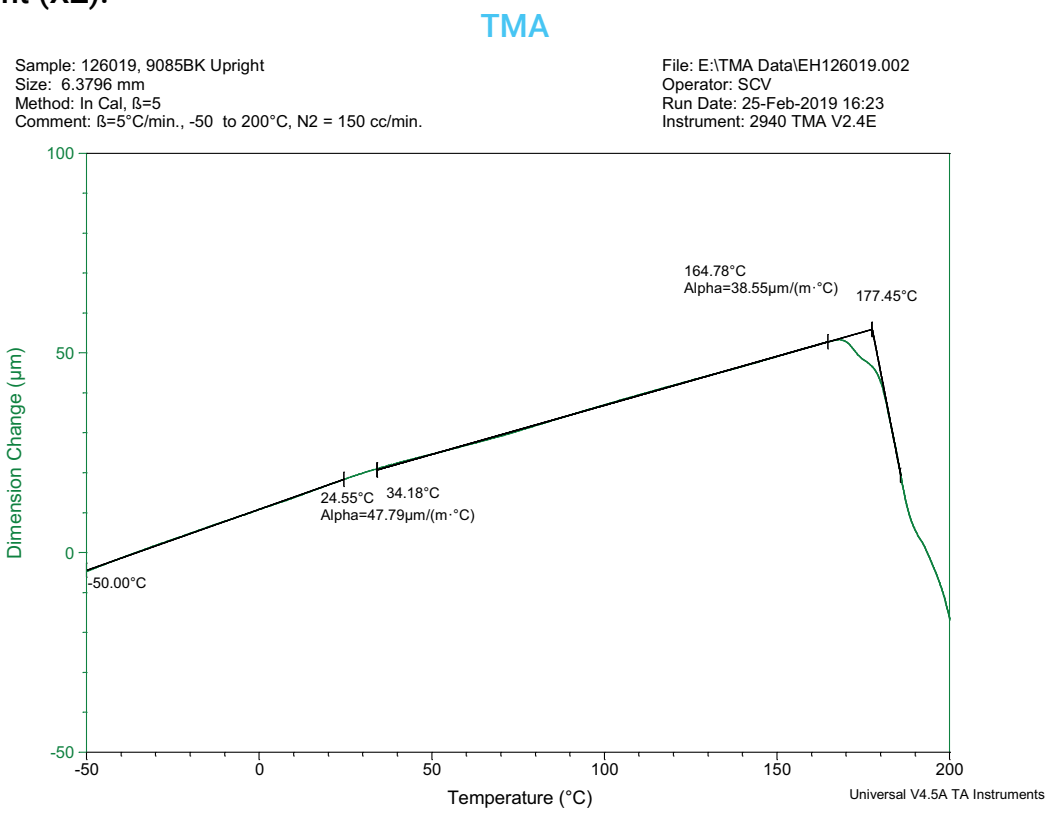
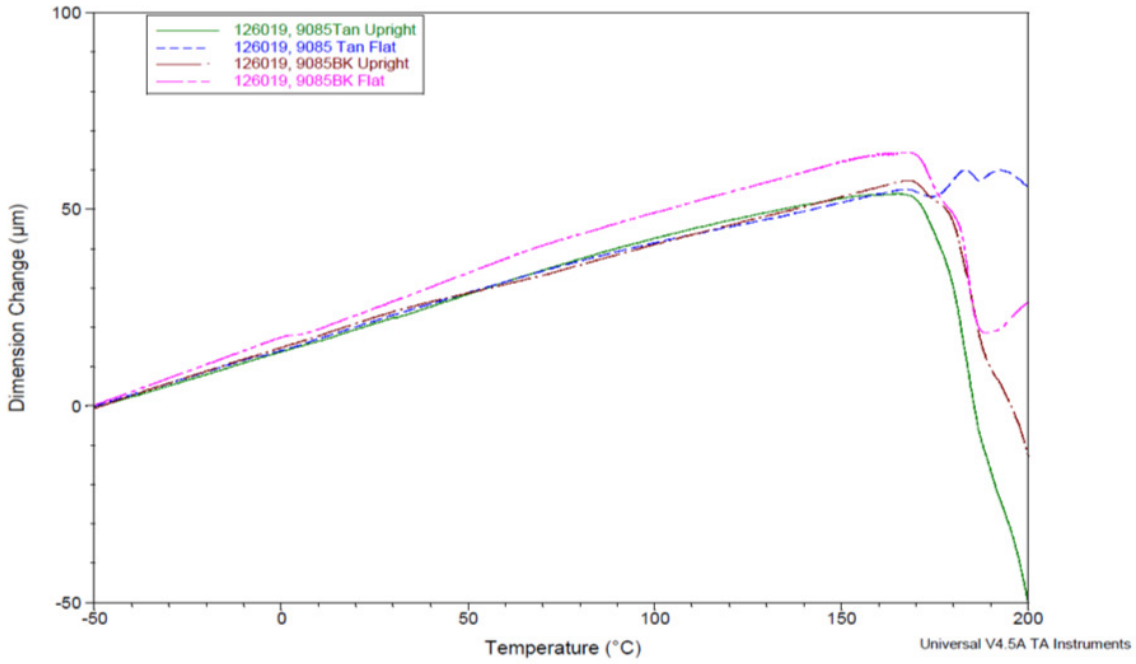


Figure 7: Overlay of the dimension change data for all the ULTEM™ 9085 resin samples.



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