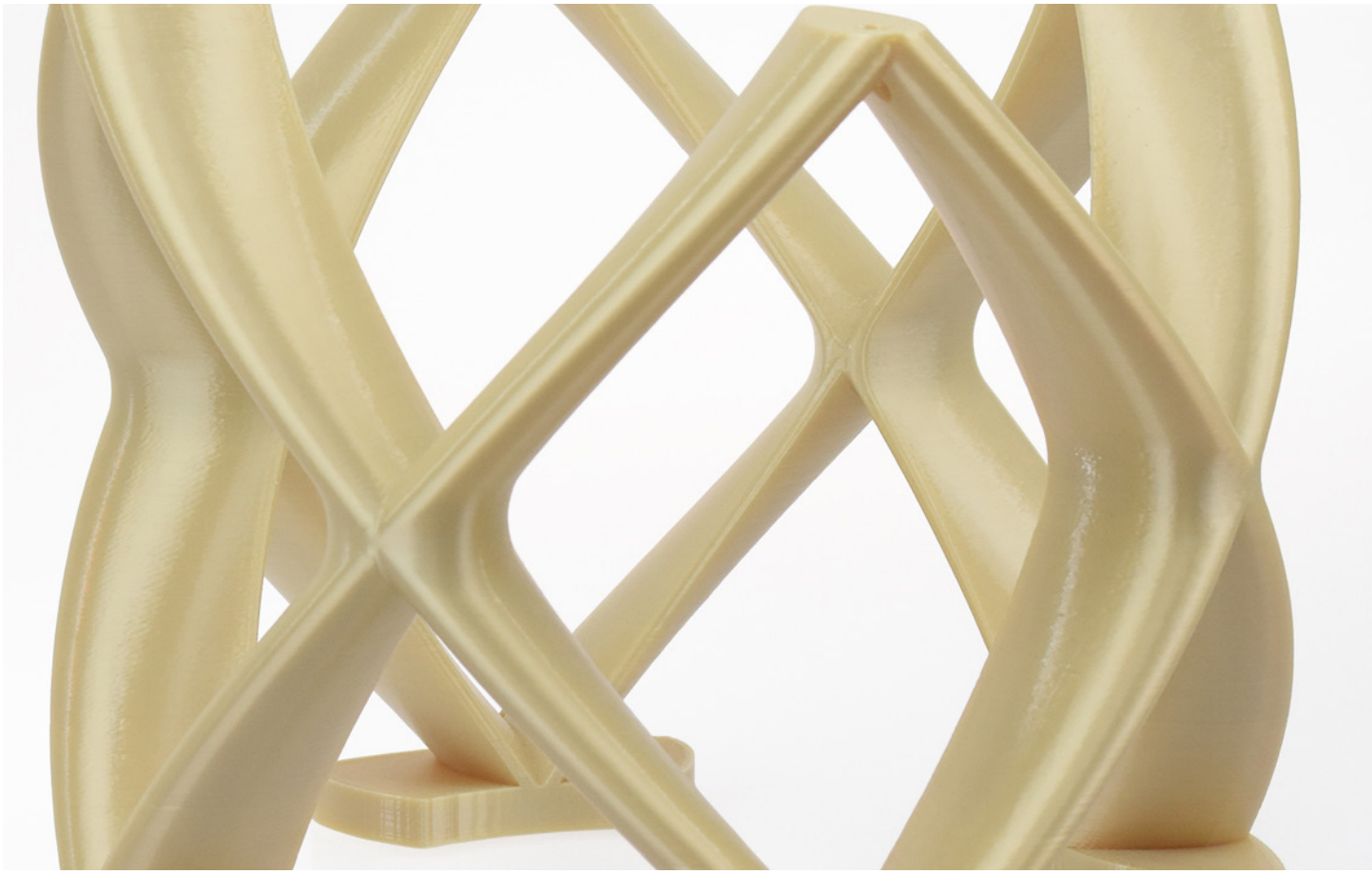
ULTEM™ 9085 Resin



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.

ULTEM™ 9085 resin CG (Certified Grade) 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. Available colors are natural and black.

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Ordering Information

Table 1. Printer and Support Material Compatibility

Printer	Model Tip	Support Material	Support Tip
Fortus 400	T16 T20	9085 Support	T16 (all slices)
Fortus 450	T16 T20	9085 Support	T16 (all slices)
Fortus 900mc	T16 T16A T20	9085 Support	T16 (all slices)
F900	T16 T16A T20	9085 Support	T16 (all slices)

Build Sheet

High temperature

0.03 x 26 x 38 in. (0.76 x 660 x 965 mm)

0.03 x 16 x 18.5 in. (0.76 x 406 x 470 mm)

0.02 x 16 x 18.5 in (0.51 x 406 x 470 mm)

Table 2. ULTEM™ 9085 Resin Ordering Information

Part Number	Description
Filament Canisters[1][2]	
355-02310	ULTEM™ 9085 resin natural, 92 cu in – Plus
355-08310	ULTEM™ 9085 resin natural, 184 cu in – Plus
355-23101	ULTEM™ 9085 resin CG, 92 cu in – Plus
355-02311	ULTEM™ 9085 resin black, 92 cu in – Plus
355-03220	ULTEM™ 9085 resin BASS, 92 cu in – Plus
312-20001	ULTEM™ 9085 resin CG, 92 cu in – Classic
312-20000	ULTEM™ 9085 resin natural, 92 cu in – Classic
312-20018	ULTEM™ 9085 resin natural, 184 cu in – Classic
312-20200	ULTEM™ 9085 resin black, 92 cu in – Classic
310-30600	ULTEM™ 9085 resin BASS, 92 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
325-00475[3]	900 high temperature build sheet, 0.02x26x38 in (0.51x660x965 mm)
325-00275[4]	900 & 450 high temperature build sheet, 0.02x16x18.5 in (0.51x406x470 mm)
310-00300[5]	High Temperature build sheet, 0.03x16x18.5 in. (0.76x406x470 mm)

(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. 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 Physical Properties

Property	Test Method	Typical Values
HDT @ 66psi	ASTM D648 Method B	176.9 °C (350.4 °F)
HDT @ 264psi	ASTM D648 Method B	172.9 °C (343.2 °F)
Tg	ASTM D7426 Inflection Point	177.32 °C (351.18 °F)
Mean CTE	ASTM E831 (-50C to 80C)	44.89 µm/[m·°C] (24.94 µin/[in·°F])
Mean CTE	ASTM E831 (80C to 160C)	31.35 µm/[m·°C] (17.42 µin/[in·°F])
Volume Resistivity	ASTM D257	> $6.89*10^{15}$ Ω·cm
Dielectric Constant	ASTM D150 1 kHz test condition	2.84
Dielectric Constant	ASTM D150 2 MHz test condition	2.69
Dissipation Factor	ASTM D150 1 kHz test condition	0.002
Dissipation Factor	ASTM D150 2 MHz test condition	0.010
Specific Gravity	ASTM D792 @ 23C	1.27
UL Flammability(1)	ANSI/UL 746B	V0 – Blue Card #E345258

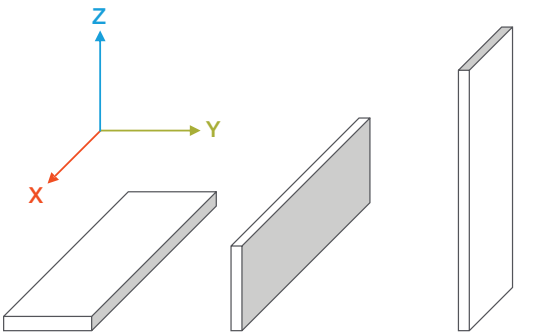
(1) Applies to the natural version of ULTEM™ 9085 resin only

Mechanical Properties

Samples, natural and black, were printed with 0.010 in. (0.254 mm) and 0.013 in. (0.330 mm) layer heights.
For the full test procedure please see the Stratasys Materials Test Procedure on www.stratasys.com.

Print Orientation

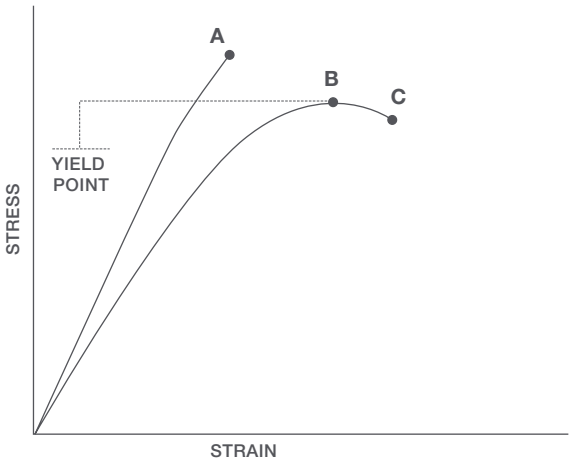
Parts created using FDM® are anisotropic as a result of the printing process. Below is a reference of the different orientations used to characterize the material.



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 (T16 tip)

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	69.2 (1.0)	No yield
	psi	10000 (150)	No yield
Elongation @ Yield	%	5.4 (0.50)	No yield
Strength @ Break	MPa	68.1 (1.6)	39.4 (8.7)
	psi	9870 (230)	5710 (1300)
Elongation @ 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 @ Break	MPa	104 (2.2)	73.1 (13)
	psi	15000 (320)	10600 (1900)
Strain @ 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	20100 (1400)	49600 (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 (T16A tip)[1]

		XZ Orientation	ZX Orientation
Tensile Properties: ASTM D638			
Strength @ 0.2% offset yield	MPa	45.2	38.2
	psi	6560	5540
Ultimate Strength	MPa	77.1	59.0
	psi	11200	8600
Modulus (Elastic)	GPa	2.62	2.39
	ksi	377	347
Flexural Properties: ASTM D790, Procedure A			
Ultimate Strength	MPa	98.3	80.3
	psi	14300	11600
Modulus	GPa	2.63	2.26
	ksi	381	328
Compression Properties: ASTM D695			
Strength @ 0.2% offset yield	MPa	78.9	60.1
	psi	11400	8710
Modulus	GPa	2.98	266
	ksi	433	386
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	73.7	69.3
	ft*lb/in	1.4	1.3

(1) For full details refer to the Stratasys ULTEM™ 9085 resin report published on the NIAR website

Table 6. ULTEM™ 9085 Resin Natural Mechanical Properties (T20 tip)

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	68.5 (0.46)	No yield
	psi	9930 (67)	
Elongation @ Yield	%	5.8 (0.044)	No yield
Strength @ Break	MPa	67.8 (0.66)	38.9 (3.7)
	psi	9840 (95)	5640 (530)
Elongation @ Break	%	5.7 (0.32)	2.5 (0.35)
Modulus (Elastic)	GPa	2.31 (0.056)	1.98 (0.16)
	ksi	335 (8.1)	287 (23)
Flexural Properties: ASTM D790, Procedure A			
Strength @ Break	MPa	102 (1.0)	58.8 (8.8)
	psi	14800 (150)	8530 (1300)
Strain @ Break	%	No break	3.25 (0.57)
Modulus	GPa	2.39 (0.021)	1.93 (0.045)
	ksi	346 (3.1)	280 (6.5)
Compression Properties: ASTM D695			
Yield Strength	MPa	86.5 (2.8)	209 (6.6)
	psi	12500 (410)	30400 (960)
Modulus	GPa	1.60 (0.046)	2.00 (0.072)
	ksi	232 (6.7)	290 (10)
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	124 (35)	36.6 (7.6)
	ft*lb/in	2.31 (0.66)	0.685 (0.14)
Izod, Unnotched	J/m	952 (130)	141 (35)
	ft*lb/in	17.8 (2.4)	2.65 (0.66)

(1) Values in parentheses are standard deviations

Table 7. ULTEM™ 9085 Resin Black Mechanical Properties (T16 tip)

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	71.7 (1.6)	No yield
	psi	10,400 (240)	
Elongation @ Yield	%	5.5 (0.27)	No yield
Strength @ Break	MPa	69.8 (1.7)	41.4 (9.0)
	psi	10100 (240)	6000 (1300)
Elongation @ 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 @ Break	MPa	107 (3.4)	72.1 (5.9)
	psi	15500 (490)	10500 (860)
Strain @ 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	20600 (1300)	50600 (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

Flame, Smoke, and Toxicity

ULTEM™ 9085 resin, natural (T20 tip and T16A tip) and black (T16 tip), 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 done 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 8. 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 8. 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 8. 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 9. 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
EN-45545-2

ULTEM™ 9085 resin was printed with a T16A tip on the Stratasys F900 and tested per EN-45545-2. The testing establishes that this material meets requirements for:

- **R1 HL1/2/3 at 25 mm thick in XY and XZ orientations and 5 mm in XZ orientation**
- **R2 HL1/2/3 at 5 mm thick in XY orientation.**

Table 10. ULTEM™ 9085 Resin Fire Protection of Railway Vehicles Test Results

Test	Results	5mm XY	5mm XZ	25mm XY	25mm XZ
ISO 5659-2	Ds(4)	-	-	38	57
	VOF4	-	-	62	94
	Dm	-	-	228	231
ISO 5659-2 + EN 45545-2 Appendix C	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

Appendix

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

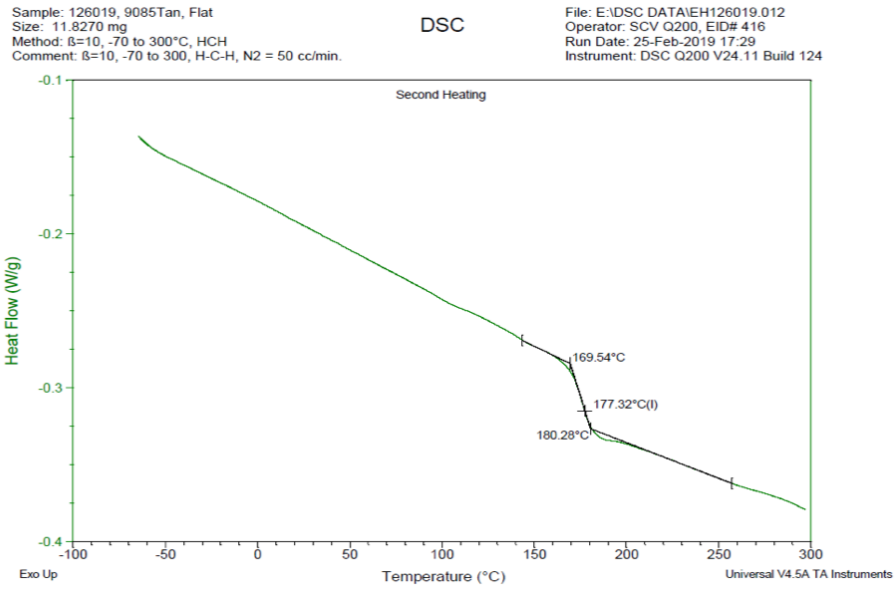


Figure 2. 2nd heating scan DSC data for ULTEM™ 9085 resin, black

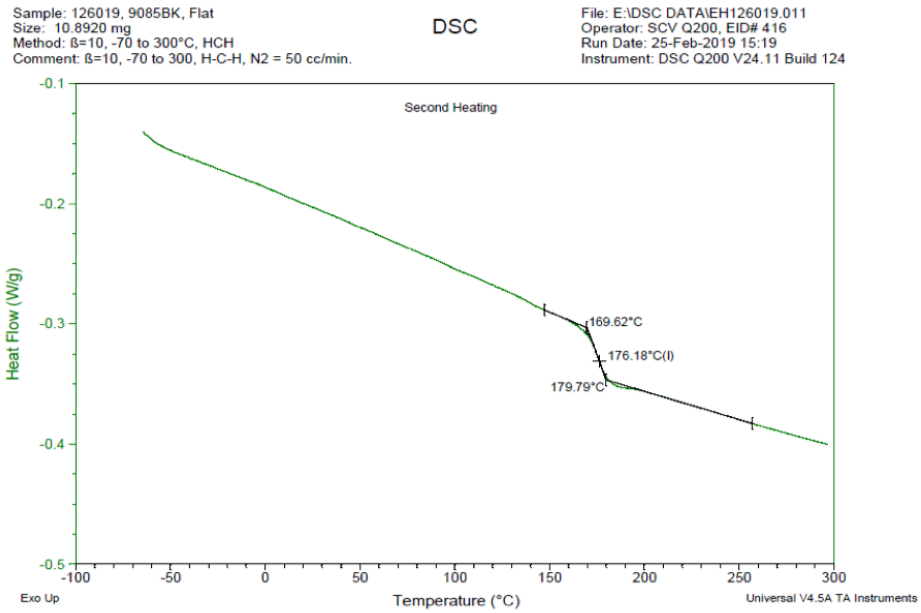


Figure 3. Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, flat (XY)

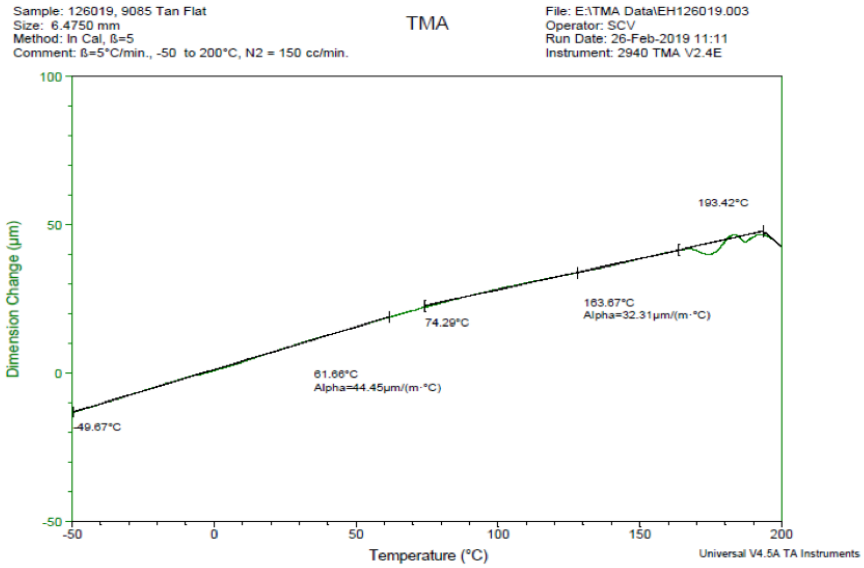


Figure 4. Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, upright (XZ)

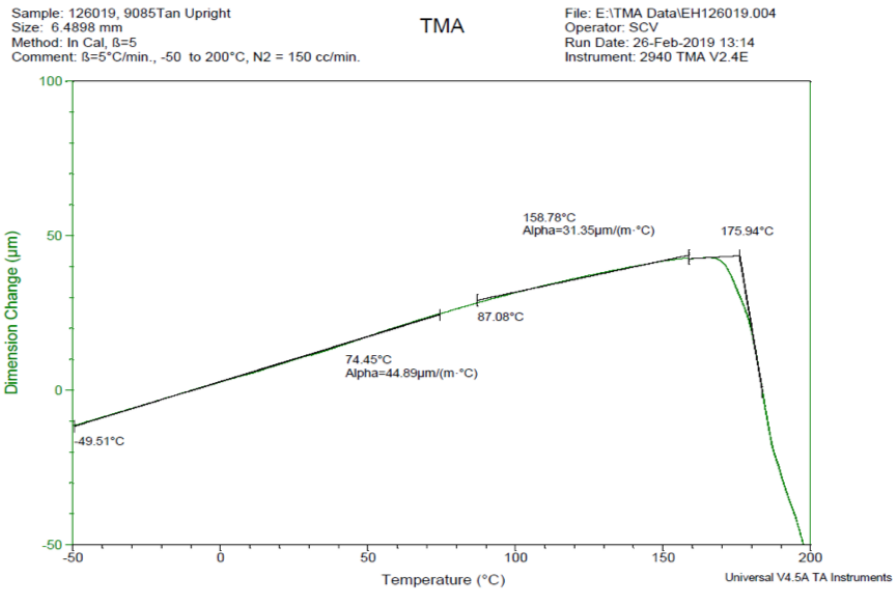


Figure 5. Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, flat (XY)

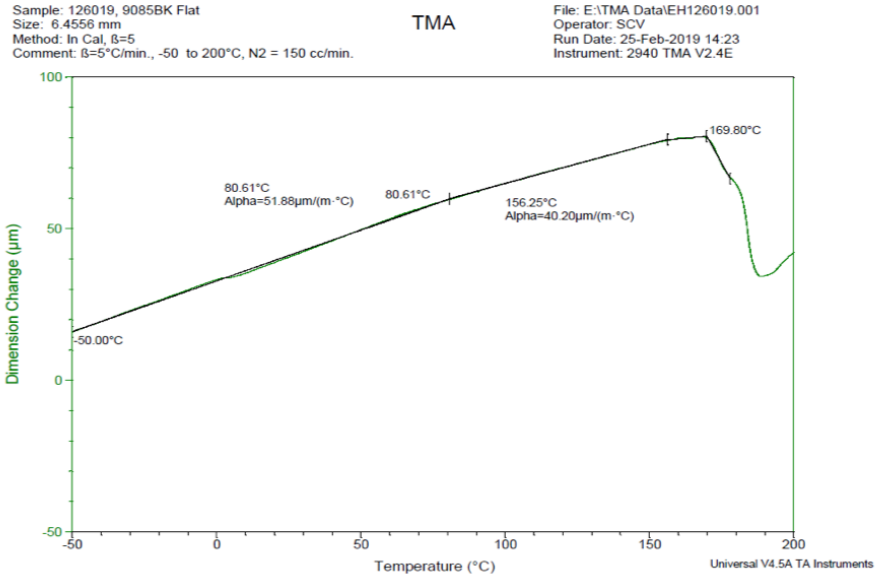


Figure 6. Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, upright (XZ)

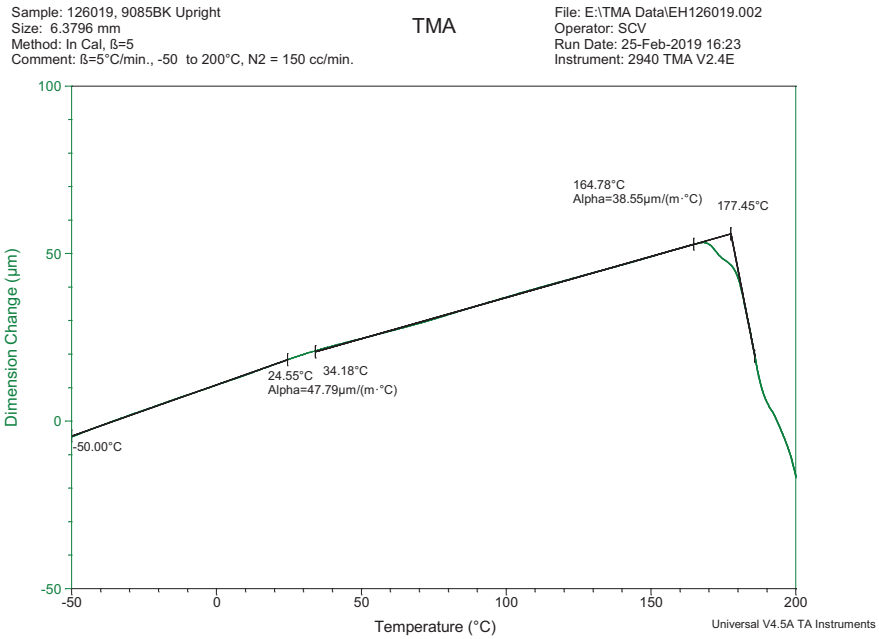
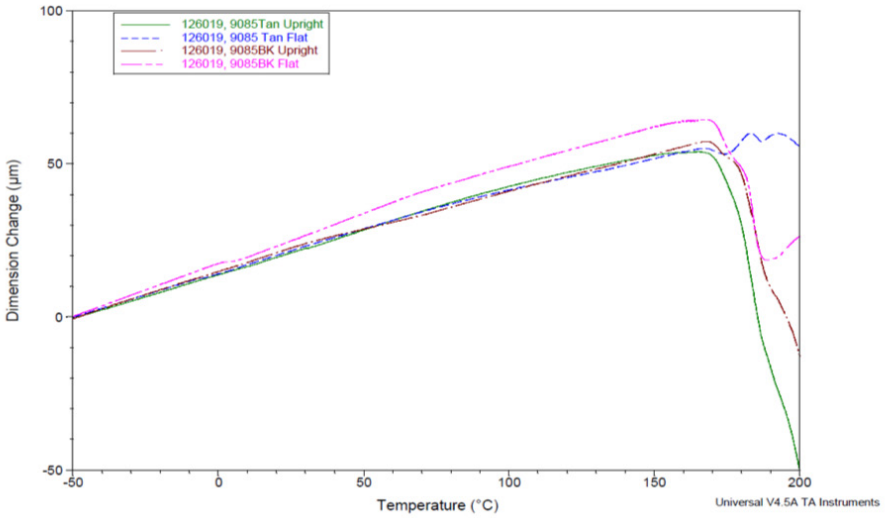


Figure 7. Overlay of the dimension change data for all the ULTEM™ 9085 resin samples



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