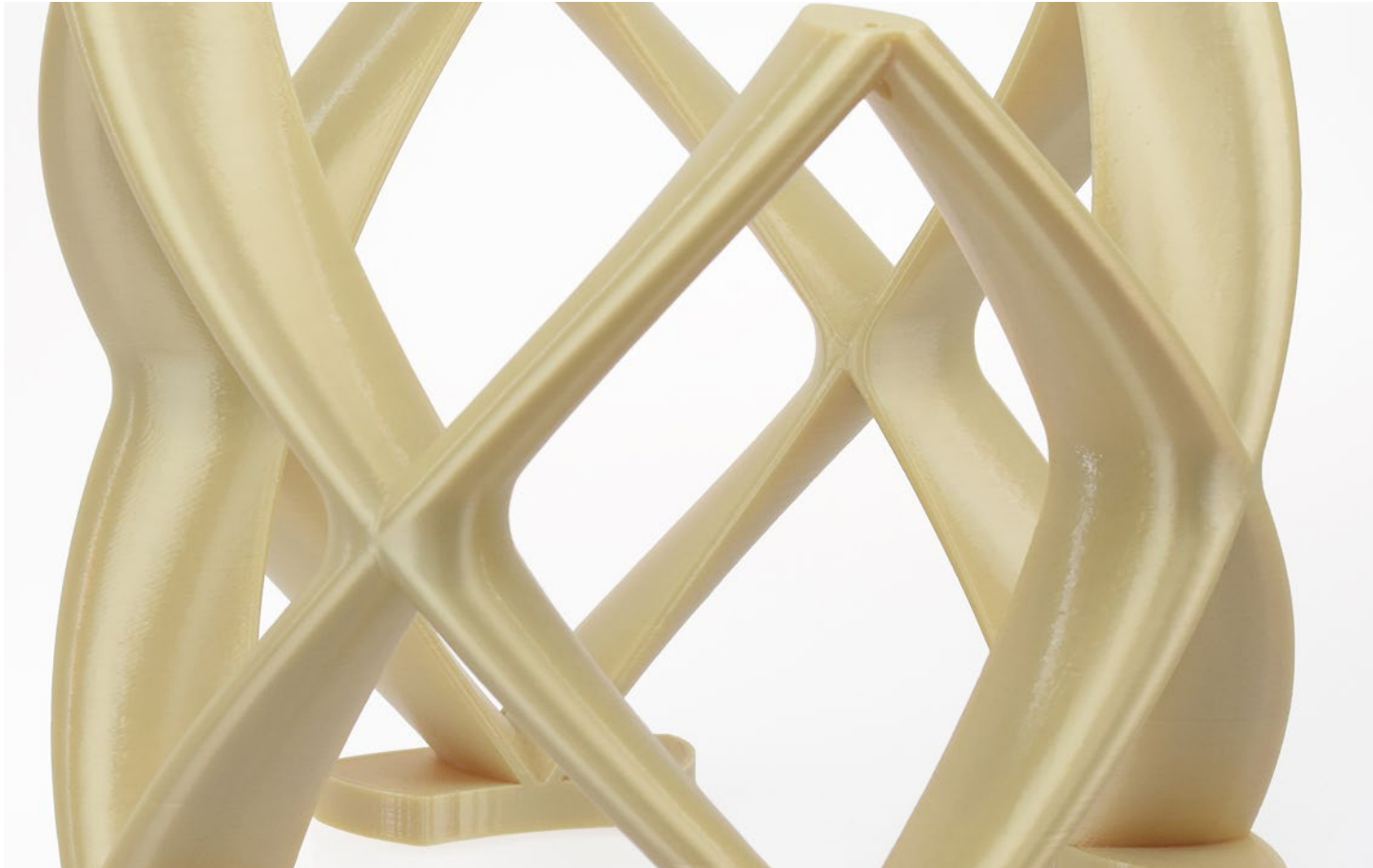


ULTEM™ 9085 Resin



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

3D Printer Compatibility

Fortus 450mc™

T16 tip

T20 tip (natural only)

Stratasys F900™ / Fortus 900mc™

T16 tip

T16A tip (natural CG only)

T20 tip

Support Material

ULTEM™ 9085 resin breakaway support system (BASS)

Build Sheets

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)

Table 1. 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
312-20001	ULTEM™ 9085 resin CG, 184 cu in – Classic
355-02311	ULTEM™ 9085 resin black, 92 cu in – Plus
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
355-03220	ULTEM™ 9085 resin BASS, 92 cu in – Plus
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⁾	High temperature build sheet, 0.03 x 26 x 38 in. (0.76 x 660 x 965 mm)
325-00275 ⁽⁴⁾	High temperature build sheet, 0.03 x 16 x 18.5 in. (0.76 x 406 x 470 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

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 2. ULTEM™ 9085 Resin Physical Properties

Property	Test Method	Typical Values
HDT @ 66psi	ASTM D648 Method B	177 °C (350 °F)
HDT @ 264psi	ASTM D648 Method B	173 °C (343 °F)
Tg	ASTM D7426 Inflection Point	180 °C (356 °F)
Mean CTE	ASTM E831 (-50C to 80C)	45 $\mu\text{m}/[\text{m}\cdot^{\circ}\text{C}]$ (25 $\mu\text{in}/[\text{in}\cdot^{\circ}\text{F}]$)
Mean CTE	ASTM E831 (80C to 160C)	32 $\mu\text{m}/[\text{m}\cdot^{\circ}\text{C}]$ (18 $\mu\text{in}/[\text{in}\cdot^{\circ}\text{F}]$)
Volume Resistivity	ASTM D257	$> 6.89 \times 10^{15} \Omega \cdot \text{cm}$
Dielectric Constant	ASTM D150 1 kHz test condition	2.7
Dielectric Constant	ASTM D150 2 MHz test condition	2.8
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

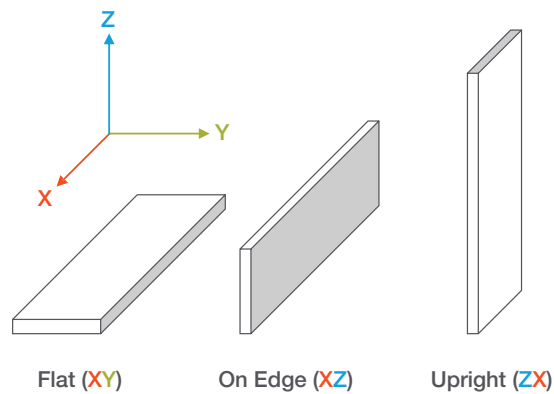
Mechanical Properties

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.

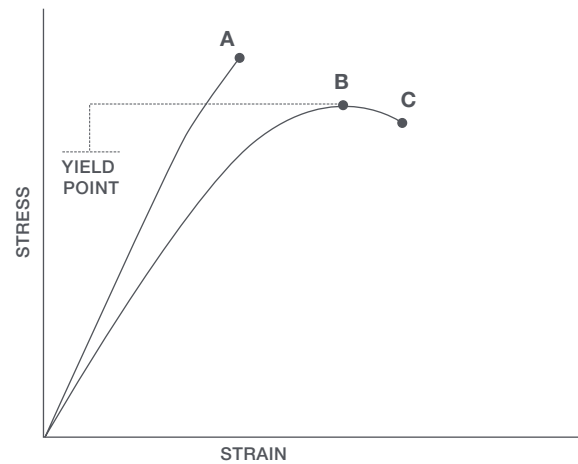
Print Orientation

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.



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 3. ULTEM™ 9085 Resin Natural Mechanical Properties (T16 tip)

		XZ Orientation ⁽¹⁾	ZX Orientation ⁽¹⁾
Tensile Properties: ASTM D638			
Yield Strength	MPa	70 (1)	No yield
	psi	10,000 (145)	No yield
Elongation @ Yield	%	5.3 (0.1)	No yield
Strength @ Break	MPa	68 (2)	49 (9)
	psi	9,870 (230)	5,700 (1,250)
Elongation @ Break	%	5.4 (0.5)	1.9 (0.5) %
Modulus (Elastic)	GPa	2.51 (0.06)	2.41 (0.15)
	ksi	365 (9)	350 (22)
Flexural Properties: ASTM D790, Procedure A			
Strength @ Break	MPa	No break	60 (8)
	psi	No break	8,530 (1,270)
Strength @ 5% Strain	MPa	100 (1)	-
	psi	14,740 (140)	-
Strain @ Break	%	No break	3.7 (0.6)
Modulus	GPa	2.40 (0.03)	2.12 (0.08)
	ksi	348 (5)	309 (12)
Compression Properties: ASTM D695			
Yield Strength	MPa	140 (9)	340 (30)
	psi	20,120 (1,370)	49,620 (3,870)
Modulus	GPa	2.21 (0.05)	2.28 (0.08)
	ksi	320 (7)	330 (12)
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	88 (21)	40 (4)
	ft*lb/in	1.7 (0.4)	0.77 (0.08)
Izod, Unnotched	J/m	650 (70)	187 (42)
	ft*lb/in	12.1 (1.2)	3.5 (0.8)

(1) Values in parentheses are standard deviations

Table 4. ULTEM™ 9085 Resin Natural Mechanical Properties (T16A tip)⁽¹⁾

		XZ Orientation	ZX Orientation
Tensile Properties: ASTM D638			
Strength @ 0.2% offset yield	MPa	45	38
	psi	6,560	5,540
Ultimate Strength	MPa	77	58
	psi	1,180	8,550
Modulus (Elastic)	GPa	2.61	2.41
	ksi	380	350
Flexural Properties: ASTM D790, Procedure A			
Ultimate Strength	MPa	130	90
	psi	18,940	13,130
Modulus	GPa	2.27	2.62
	ksi	330	380
Compression Properties: ASTM D695			
Strength @ 0.2% offset yield	MPa	63	78
	psi	9,180	11,340
Modulus	GPa	2.62	2.96
	ksi	380	430
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 5. ULTEM™ 9085 Resin Natural Mechanical Properties (T20 tip)

		XZ Orientation ⁽¹⁾	ZX Orientation ⁽¹⁾
Tensile Properties: ASTM D638			
Yield Strength	MPa	68 (1)	No yield
	psi	9,930 (67)	No yield
Elongation @ Yield	%	5.8 (0.1)	No yield
Strength @ Break	MPa	68 (1)	40 (4)
	psi	9,840 (95)	5,645 (535)
Elongation @ Break	%	5.7 (0.3)	2.5 (0.3)
Modulus (Elastic)	GPa	2.31 (0.06)	1.98 (0.16)
	ksi	335 (8)	290 (22)
Flexural Properties: ASTM D790, Procedure A			
Strength @ Break	MPa	No break	60 (8)
	psi	No break	8,530 (1,270)
Strength @ 5% Strain	MPa	100 (1)	-
	psi	14,740	-
Strain @ Break	%	No break	3.2 (0.6)
Modulus	GPa	2.38 (0.02)	1.93 (0.04)
	ksi	345 (3)	280 (6)
Compression Properties: ASTM D695			
Yield Strength	MPa	85 (3)	210 (6)
	psi	12,540 (410)	30,360 (70)
Modulus	GPa	1.55 (0.26)	2.28 (0.08)
	ksi	225 (40)	290 (10)
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	10 (3)	2.98 (0.68)
	ft*lb/in	2.3 (0.7)	0.67 (0.15)
Izod, Unnotched	J/m	80 (10)	12 (3)
	ft*lb/in	18 (2)	2.6 (0.7)

(1) Values in parentheses are standard deviations

Table 6. ULTEM™ 9085 Resin Black Mechanical Properties (T16 tip)

		XZ Orientation ⁽¹⁾	ZX Orientation ⁽¹⁾
Tensile Properties: ASTM D638			
Yield Strength	MPa	70 (2)	No yield
	psi	10,400 (240)	No yield
Elongation @ Yield	%	5.5 (0.3)	No yield
Strength @ Break	MPa	70 (2)	40 (9)
	psi	10,120 (240)	6,000 (1,300)
Elongation @ Break	%	5.4 (0.7)	2.1 (0.6)
Modulus (Elastic)	GPa	2.53 (0.05)	2.41 (0.16)
	ksi	370 (8)	350 (20)
Flexural Properties: ASTM D790, Procedure A			
Strength @ Break	MPa	No break	70 (6)
	psi	No break	10,460 (860)
Strength @ 5% Strain	MPa	105 (3)	-
	psi	15,450 (490)	-
Strain @ Break	%	No break	3.8 (0.4)
Modulus	GPa	2.47 (0.06)	2.10 (0.04)
	ksi	360 (9)	305 (6)
Compression Properties: ASTM D695			
Yield Strength	MPa	140 (9)	350 (24)
	psi	20,550 (1,316)	50,560 (3,468)
Modulus	GPa	2.27 (0.04)	2.36 (0.09)
	ksi	330 (6)	340 (14)
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	95 (22)	37 (8)
	ft*lb/in	1.6 (0.4)	0.69 (0.16)
Izod, Unnotched	J/m	770 (144)	168 (54)
	ft*lb/in	14 (3)	3.6 (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 7. 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 7. ULTEM™ 9085 Resin Flame, Smoke, and Toxicity Test Results

	Test Mode	Average D _s (maximum) within 4 minutes, (°D _{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 7. 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/m²)	Time to Peak Heat Release (seconds)		2 Minute Total HRR (kW-min./m²)			
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 8. 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 9. 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

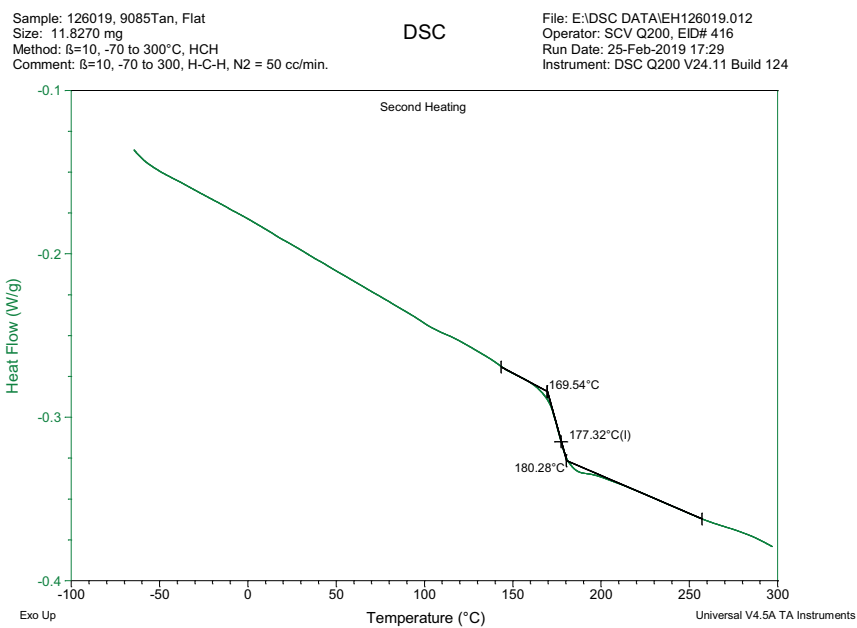


Figure 2. 2nd heating scan DSC data for ULTEM™ 9085 resin, black

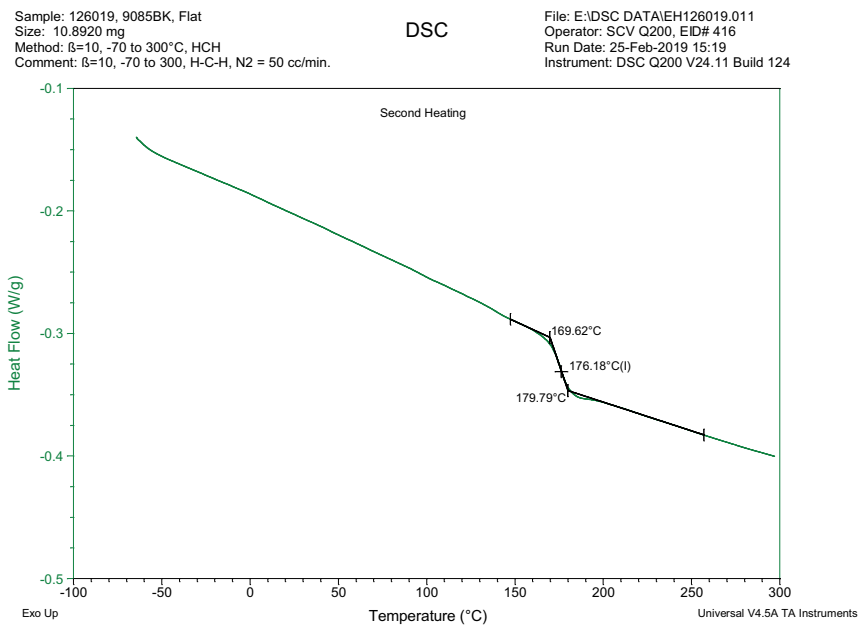


Figure 3. Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, flat (XY)

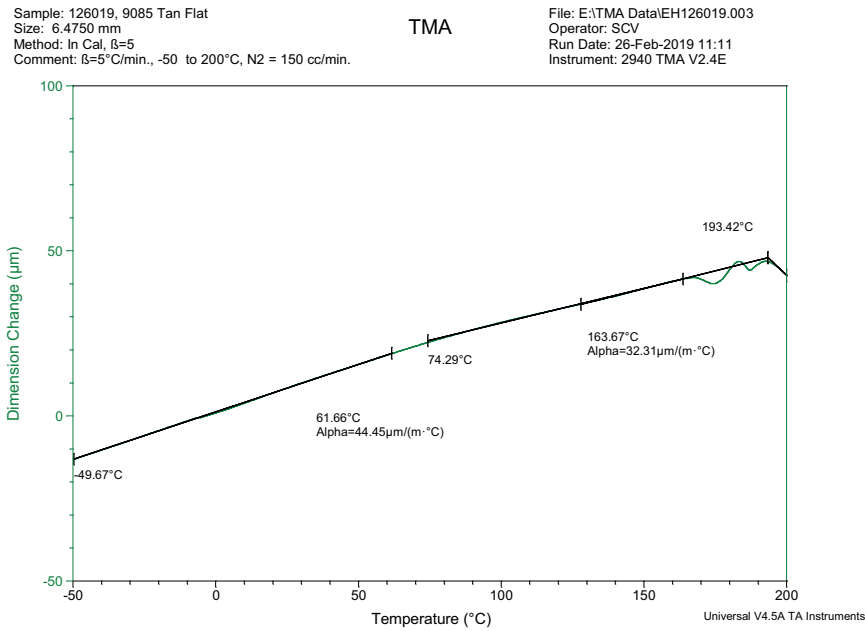


Figure 4. Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, upright (XZ)

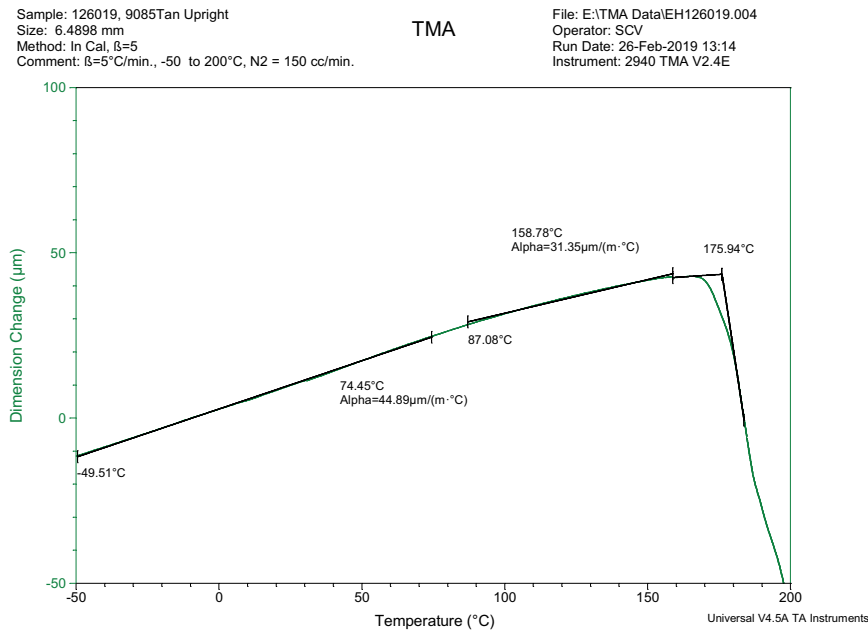


Figure 5. Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, flat (XY)

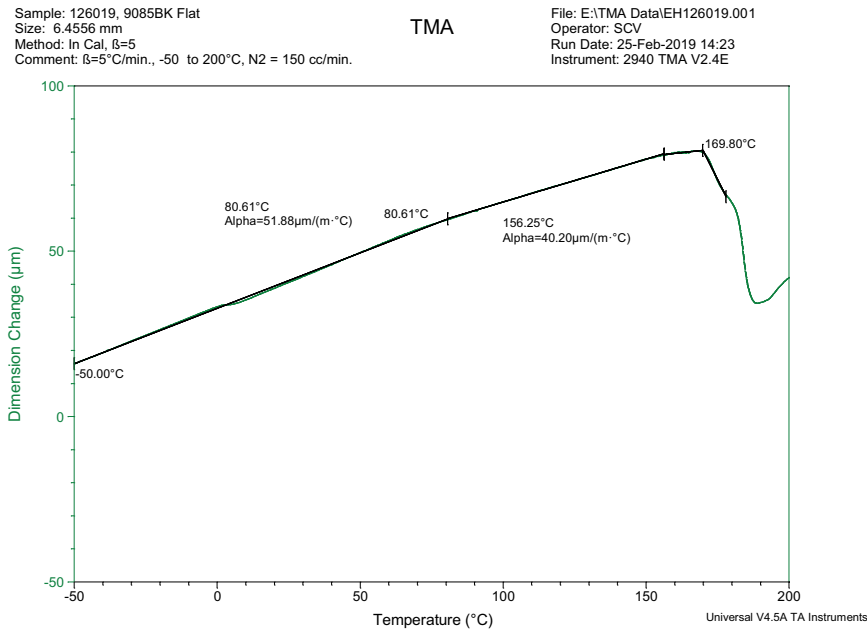


Figure 6. Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, upright (XZ)

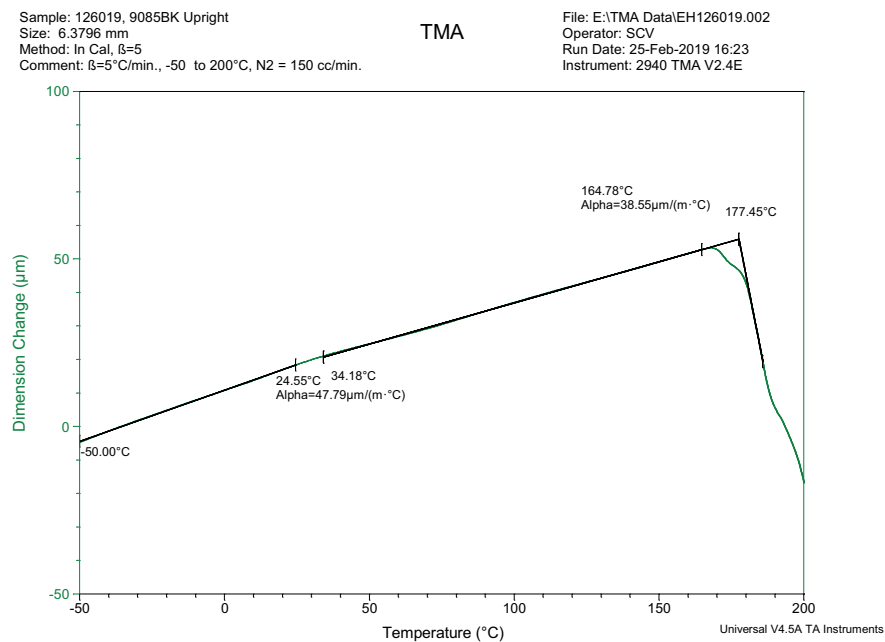
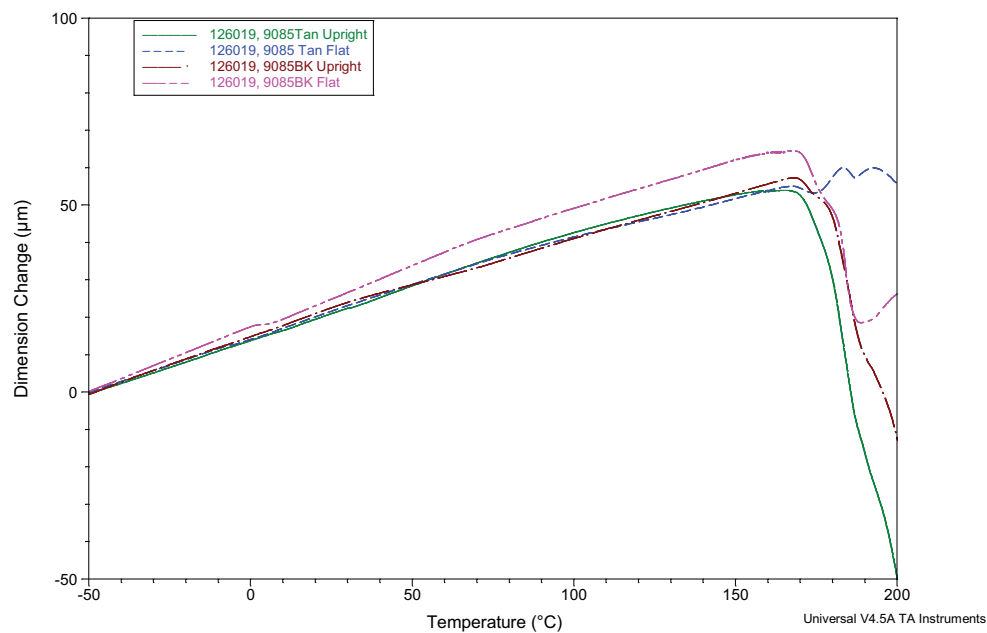


Figure 7. Overlay of the dimension change data for all the ULTEM™ 9085 resin samples



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