

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 - 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. 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 450 | T16 (10 slice) | 9085 Support | T16 (all slices) |
| | T20 (13 slice) | | |
| F900 | T16 (10 slice) | 9085 Support | T16 (all slices) |
| | T16A (10 slice) | | |
| | T20 (13 slice) | | |

Build Sheet

High temperature

- 0.02 x 26 x 38 in. (0.76 x 660 x 965 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 (Tested with Natural ULTEM(TM) 9085 and T16 tip)

| Property | Test Method | Typical Values | |
|--------------------------------|--------------------------------|--|-------|
| | | XY | XZ/ZX |
| 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 (TAN) | ASTM E831 (-50C to 60C) | 44.45 µm/[m*°C] 24.69 µin/[in*°F] | |
| Mean CTE (TAN) | ASTM E831 (60C to 160C) | 32.31 µm/[m*°C] 17.95 µin/[in*°F] | |
| Mean CTE (TAN) | ASTM E831 (-50C to 80C) | 44.89 µm/[m*°C] (24.94 µin/[in*°F]) | |
| Mean CTE (TAN) | ASTM E831 (80C to 160C) | 31.35 µm/[m*°C] (17.42 µin/[in*°F]) | |
| Mean CTE (BLACK) | ASTM E831 (-50C to 30C) | 47.79 µm/[m*°C] 26.55 µin/[in*°F] | |
| Mean CTE (BLACK) | ASTM E831 (30C to 165C) | 38.55 µm/[m*°C] 21.42 µin/[in*°F] | |
| Mean CTE (BLACK) | ASTM E831 (-50C to 80C) | 51.88 µm/[m*°C] 28.82 µin/[in*°F] | |
| Mean CTE (BLACK) | ASTM E831 (80C to 160C) | 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 @0C | 0.2136 W/m*K 0.1234 BTU/(hr*ft*F) | |
| Thermal Conductivity | ASTM E1952 @30C | 0.2109 W/m*K 0.1219 BTU/(hr*ft*F) | |
| Thermal Conductivity | ASTM E1952 @60C | 0.2111 W/m*K 0.1220 BTU/(hr*ft*F) | |
| Thermal Conductivity | ASTM E1952 @90C | 0.2095 W/m*K 0.1211 BTU/(hr*ft*F) | |
| Thermal Diffusivity | ASTM E1952 @0C | 0.148 mm ² /s 2.29*10 ⁻⁴ in ² /s | |
| Thermal Diffusivity | ASTM E1952 @30C | 0.132 mm ² /s 2.05*10 ⁻⁴ in ² /s | |
| Thermal Diffusivity | ASTM E1952 @60C | 0.121 mm ² /s 1.88*10 ⁻⁴ in ² /s | |
| Thermal Diffusivity | ASTM E1952 @90C | 0.111 mm ² /s 1.72*10 ⁻⁴ in ² /s | |
| Specific Gravity | ASTM D792 @ 23C | 1.27 | |
| UL Flammability ⁽¹⁾ | ANSI/UL 746B | V0 – Blue Card #E345258 | |

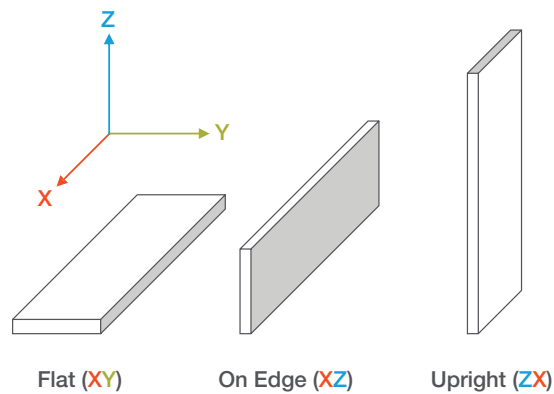
(1) Applies to the natural version of ULTEM™ 9085 resin only

Mechanical Properties

Samples, natural and black, were printed with 0.010 in. (0.254 mm) and 0.013 in. (0.330 mm) layer heights on the F900. For the full test procedure please see the Stratasys Materials Test Procedure on www.stratasys.com.

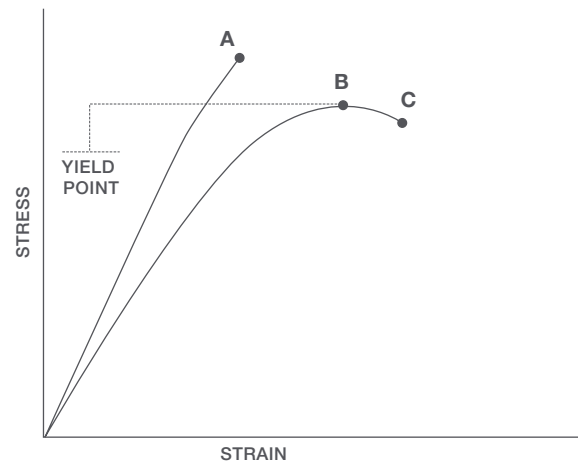
Print Orientation

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 4. ULTEM™ 9085 Resin Natural Mechanical Properties (F900 - 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 (F900 - 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 (F900 - 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 (F900 - 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, (°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 AIM 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-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 NFPA 130

ULTEM™ 9085 CG resin 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 11. ULTEM 9085 CG Resin 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 Upright, Non-flaming Ds (1.5) = 0 Ds (4.0) = 0 |
| 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 CG

ULTEM™ 9085 CG resin 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 25mm thick in XY and XZ orientations
- R2, R3, R17: HL1/2/3 at 5mm thick in XY orientation
- Not classified at 5mm thick in XZ orientation
- R22: HL1/2 at 0.508 mm thick in XY orientation
- R22: HL1/2/3, 1mm to 10.5mm in XY orientation
- R23: HL1/2/3, 0.508mm 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 12. ULTEM™ 9085 CG Resin Fire Protection of Railway Vehicles Test Results for R1 requirement set

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

Table 13. ULTEM™ 9085 CG Resin Fire Protection of Railway Vehicles Test Results for R22/23 requirement set

| Test | Results | 0.508mm XY | 1mm XY | 10.5mm XY |
|------------------------------------|--------------------|------------|--------|-----------|
| ISO 5659-2 25 kW/m ² | 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 CG

ULTEM™ 9085 CG resin 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 14. ULTEM 9085 CG Resin 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 0mm/min. | No drop is formed that ignites the cotton wool during testing. | The tested samples do not ignite, the burning rate is 0mm/min. |

Appendix

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

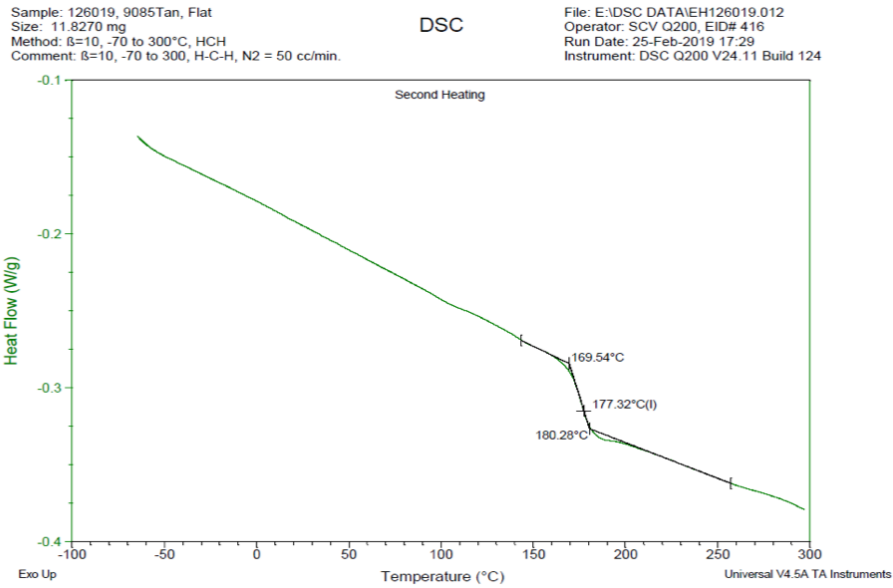


Figure 2. 2nd heating scan DSC data for ULTEM™ 9085 resin, black

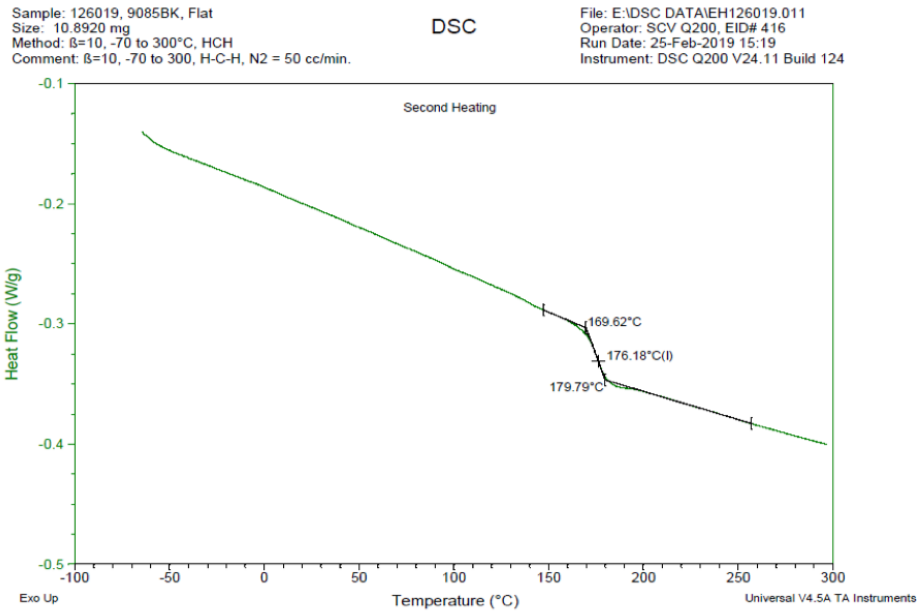


Figure 3. Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, flat (XY)

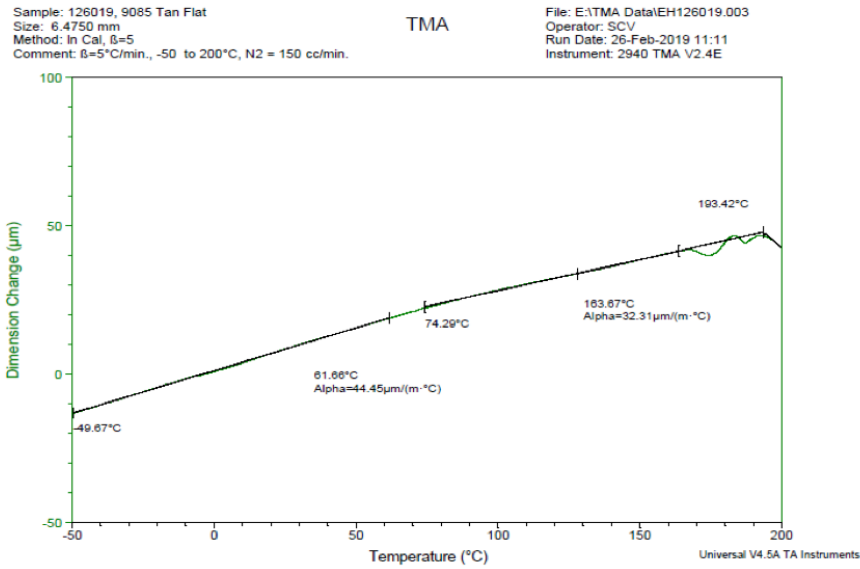


Figure 4. Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, upright (XZ)

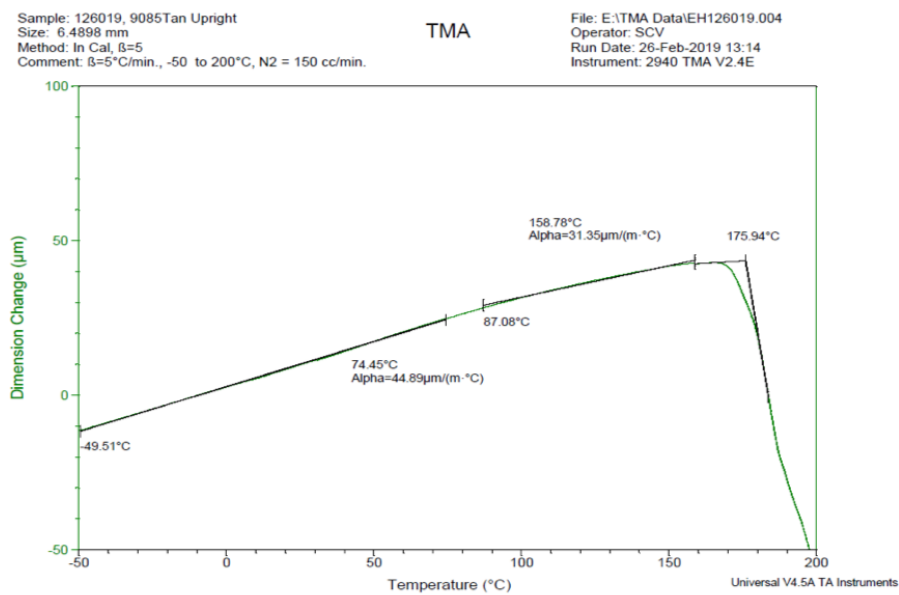


Figure 5. Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, flat (XY)

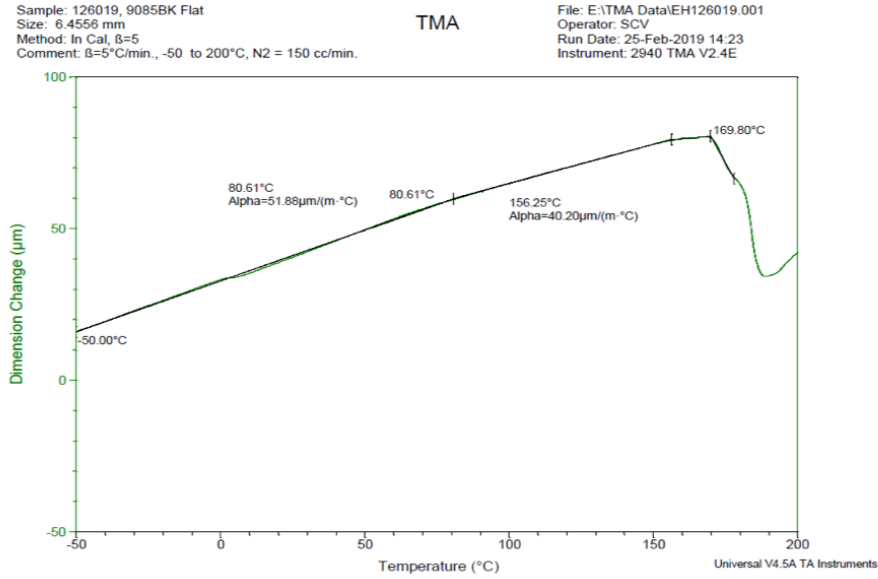


Figure 6. Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, upright (XZ)

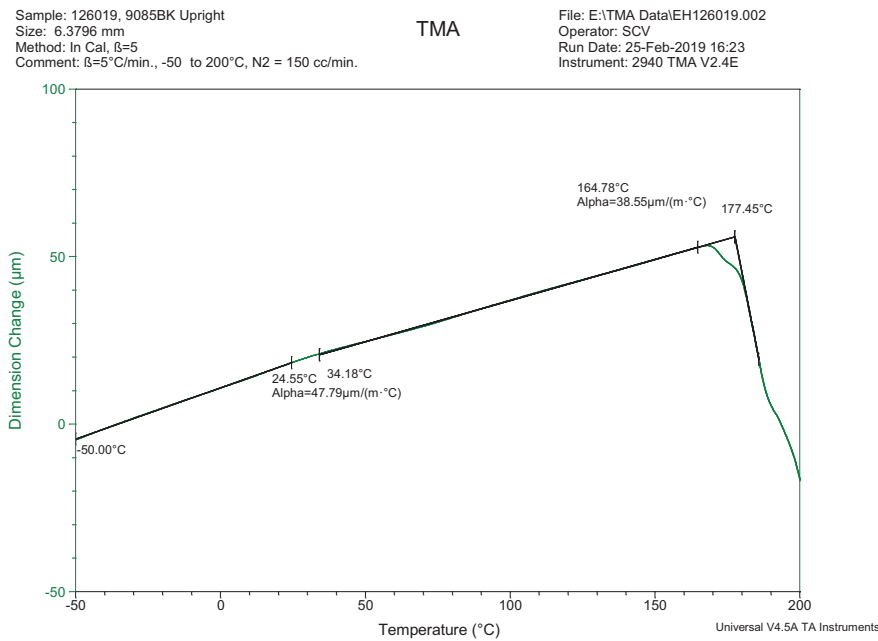
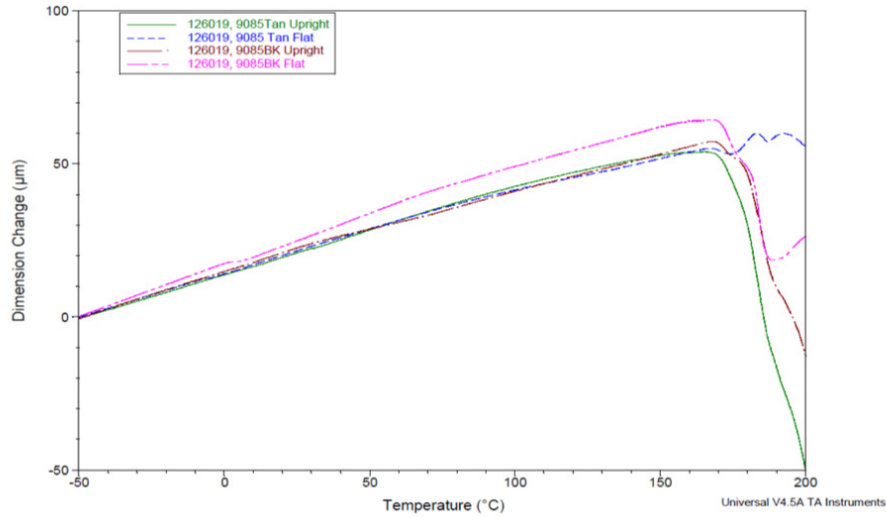


Figure 7. Overlay of the dimension change data for all the ULTEM™ 9085 resin samples



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