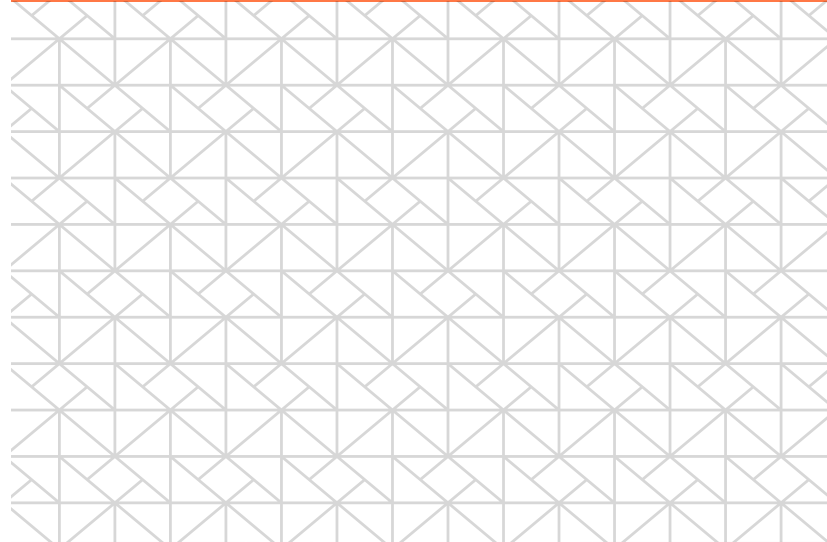


# ULTEM™ 9085 Resin

## 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.

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## 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 using a 0.254 mm (0.010 in.) layer height. ULTEM™ 9085 resin colors Red and Aircraft Gray are enabled at a layer height of 0.330 mm (0.013 in.) with the T20 tip on the F900 and Fortus 450mc.

### 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<sup>1</sup>

#### 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

<sup>1</sup>Contact your Stratasys representative for ordering information.


**Table 2: ULTEM™ 9085 Resin Ordering Information**

| Part Number                             | Description   |
|---|---|
| <b>Filament Canisters<sup>1,2</sup></b> |   |
| 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  |
| <b>Printer Consumables</b>              |   |
| 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 <sup>3</sup>                  | Fortus 900mc/F900 high temperature build sheet, 0.02 x 26 x 38 in. (0.51 x 660 x 965 mm)                  |
| 325-00275 <sup>4</sup>                  | 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 <sup>5</sup>                  | 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)   |
| <b>Print Heads</b>                      |   |
| 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   |

<sup>1</sup> Classic canisters are compatible with all Fortus 400mc™ and Fortus 900mc™ printers prior to s/n L502.

<sup>2</sup> Plus canisters are compatible with all Fortus 450mc, all Stratasys F900, and Fortus 900mc printers s/n L502 and up.

<sup>3</sup> Compatible with Stratasys F900 and Fortus 900mc.

<sup>4</sup> Compatible with Fortus 450mc, Stratasys F900 and Fortus 900mc.

<sup>5</sup> 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](http://www.stratasys.com) 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<br>Method B             | 178.2 °C (352.8 °F)                    | 178.4 °C (353.1 °F) |
| HDT @ 264 psi        | ASTM D648<br>Method B             | 170.2 °C (338.3 °F)                    | 172.6 °C (342.7 °F) |
| Molded HDT @ 66 psi  | ASTM D648<br>Method B             | 176.9 °C (350.4 °F)                    |                     |
| Molded HDT @ 264 psi | ASTM D648<br>Method B             | 172.9 °C (343.2 °F)                    |                     |
| Tg                   | ASTM D7426<br>Inflection Point    | 177.3 °C (351.2 °F)                    |                     |
| Mean CTE (TAN)       | ASTM E831<br>(-50 °C to 60 °C)    | 44.45 µm/[m*°C]<br>24.69 µin/[in*°F]   |                     |
| Mean CTE (TAN)       | ASTM E831<br>(60 °C to 160 °C)    | 32.31 µm/[m*°C]<br>17.95 µin/[in*°F]   |                     |
| Mean CTE (TAN)       | ASTM E831<br>(-50 °C to 80 °C)    | 44.89 µm/[m*°C]<br>(24.94 µin/[in*°F]) |                     |
| Mean CTE (TAN)       | ASTM E831<br>(80 °C to 160 °C)    | 31.35 µm/[m*°C]<br>(17.42 µin/[in*°F]) |                     |
| Mean CTE (BLACK)     | ASTM E831<br>(-50 °C to 30 °C)    | 47.79 µm/[m*°C]<br>26.55 µin/[in*°F]   |                     |
| Mean CTE (BLACK)     | ASTM E831<br>(30 °C to 165 °C)    | 38.55 µm/[m*°C]<br>21.42 µin/[in*°F]   |                     |
| Mean CTE (BLACK)     | ASTM E831<br>(-50 °C to 80 °C)    | 51.88 µm/[m*°C]<br>28.82 µin/[in*°F]   |                     |
| Mean CTE (BLACK)     | ASTM E831<br>(80 °C to 160 °C)    | 40.2 µm/[m*°C]<br>22.33 µin/[in*°F]    |                     |
| Volume Resistivity   | ASTM D257                         | > 6.89*10 <sup>15</sup> Ω·cm           |                     |
| Dielectric Constant  | ASTM D150<br>1 kHz test condition | 2.80                                   | 2.87                |
| Dielectric Constant  | ASTM D150<br>2 MHz test condition | 2.65                                   | 2.73                |
| Dissipation Factor   | ASTM D150<br>1 kHz test condition | 0.002                                  | 0.002               |
| Dissipation Factor   | ASTM D150<br>2 MHz test condition | 0.010                                  | 0.010               |
| Thermal Conductivity | ASTM E1952<br>@0 °C               | 0.2136 W/m*K<br>0.1234 BTU/(hr*ft*°F)  |                     |
| Thermal Conductivity | ASTM E1952<br>@30 °C              | 0.2109 W/m*K<br>0.1219 BTU/(hr*ft*°F)  |                     |
| Thermal Conductivity | ASTM E1952<br>@60 °C              | 0.2111 W/m*K<br>0.1220 BTU/(hr*ft*°F)  |                     |
| Thermal Conductivity | ASTM E1952<br>@90 °C              | 0.2095 W/m*K<br>0.1211 BTU/(hr*ft*°F)  |                     |



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

<sup>1</sup> 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 [Stratays 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.

STRESS

STRAIN

YIELD POINT

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

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

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

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

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

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

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

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

<sup>1</sup>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 <sup>1</sup> | ZX Orientation <sup>1</sup> |
|--------------------------------------|-----|-----------------------------|-----------------------------|
| <b>Tensile Properties: ASTM D638</b> |     |                             |                             |
| <b>Yield Strength</b>                | MPa | 76.5 (1.4)                  | No Yield                    |
|                                      | psi | 11,100 (200)                | No Yield                    |
| <b>Elongation at Yield</b>           | %   | 6.2 (0.2)                   | No Yield                    |
| <b>Strength at Break</b>             | MPa | 74.0 (2.0)                  | 41.6 (5.0)                  |
|                                      | psi | 10,700 (290)                | 6,030 (730)                 |
| <b>Elongation at Break</b>           | %   | 6.6 (0.49)                  | 2.6 (0.38)                  |
| <b>Modulus (Elastic)</b>             | GPa | 2.04 (0.048)                | 1.9 (0.032)                 |
|                                      | ksi | 295 (6.9)                   | 275 (4.6)                   |

<sup>1</sup> 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 [Impact of Temperature on High-Performance FDM Materials](#) white paper.

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

| Material             | Temperature |      | Strength at Break | Elongation at Break | Modulus |
|----------------------|-------------|------|-------------------|---------------------|---------|
|                      | (°F)        | (°C) |                   |                     |         |
| ULTEM™<br>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
- Toxic Gas Emission
- Heat Release Rate of Cabin Materials
- 15s Horizontal Burn
- Smoke Density

**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) |
|--|----------------------------------|----------------------------|-----------------------------------|
| <b>12 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(ii)</b>      |                                  |                            |                                   |
| 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)                      |
| <b>60 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(i)</b>       |                                  |                            |                                   |
| 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)                      |
| <b>Avg Burn Rate (in/min)</b>  |                                  |                            |                                   |
| <b>15 Second Horizontal Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(iv)(v)</b> |                                  |                            |                                   |
| 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 <sub>s</sub> (maximum) within 4 minutes, ( <sup>4</sup> D <sub>max</sub> ) |                     |                     |         |         |        |
|--|-------------|--|---------------------|---------------------|---------|---------|--------|
| <b>Smoke Density per BSS 7238, Rev. C</b>      |             |  |                     |                     |         |         |        |
| 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   |                     |                     |         |         |        |
| <b>Smoke Density per AIM 2.0007B, Issue 3</b>  |             |  |                     |                     |         |         |        |
| 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 <sub>2</sub> ppm | NO <sub>x</sub> ppm | HCN ppm | HCl ppm | HF ppm |
| <b>Toxic Gas Emission per BSS 7239, Rev. A</b> |             |  |                     |                     |         |         |        |
| 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 <sub>2</sub> ppm                 | NO <sub>x</sub> ppm                          | HCN ppm | HCl ppm | HF ppm |
|---|-------------|-------------------------------|-------------------------------------|--|---------|---------|--------|
| <b>Toxic Gas Emission per AIM 3.0005, Issue 2</b>                                     |             |                               |                                     |  |         |         |        |
| 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 <sup>2</sup> ) | Time to Peak Heat Release (seconds) | 2 Minute Total HRR (kW-min./m <sup>2</sup> ) |         |         |        |
| <b>Heat Release Rate of Cabin Materials per 14 CFR 25.853(d), Appendix F, Part IV</b> |             |                               |                                     |  |         |         |        |
| 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 <sup>1</sup>    |         |                              |           |
| 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     |                              |           |

<sup>1</sup> 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.<br>Refer to NFPA 130 Table 8.4.1   | Is (flat) = 0<br>Is (upright) = 0   |   |  |  |   |
| ASTM E662  | 20 mm   | Depends on function of material.<br>Refer to NFPA 130 Table 8.4.1   | <table border="0"> <tr> <td>Flat, Non-flaming<br/>Ds (1.5) = 0<br/>Ds (4.0) = 0</td> <td>Flat, Flaming<br/>Ds (1.5) = 0<br/>Ds (4.0) = 12.3</td> </tr> <tr> <td>Upright, Non-flaming<br/>Ds (1.5) = 0<br/>Ds (4.0) = 0</td> <td>Upright, flaming<br/>Ds (1.5) = 0.7<br/>Ds (4.0) = 17</td> </tr> </table> | Flat, Non-flaming<br>Ds (1.5) = 0<br>Ds (4.0) = 0 | Flat, Flaming<br>Ds (1.5) = 0<br>Ds (4.0) = 12.3 | Upright, Non-flaming<br>Ds (1.5) = 0<br>Ds (4.0) = 0 | Upright, flaming<br>Ds (1.5) = 0.7<br>Ds (4.0) = 17 |
| Flat, Non-flaming<br>Ds (1.5) = 0<br>Ds (4.0) = 0    | Flat, Flaming<br>Ds (1.5) = 0<br>Ds (4.0) = 12.3    |   |   |   |  |  |   |
| Upright, Non-flaming<br>Ds (1.5) = 0<br>Ds (4.0) = 0 | Upright, flaming<br>Ds (1.5) = 0.7<br>Ds (4.0) = 17 |   |   |   |  |  |   |
| ASTM E1354   | 25 mm   | <p>Average Heat Release Rate &lt; 100 kW/m<sup>2</sup></p> <p>Average Smoke Extinction Area &lt; 500 m<sup>2</sup>/kg</p> | <p>Flat</p> <p>Average Heat Release Rate: 67.1 kW/m<sup>2</sup></p> <p>Average Smoke Extinction Area: 262.4 m<sup>2</sup>/kg</p> <hr/> <p>Upright</p> <p>Average Heat Release Rate: 61.4 kW/m<sup>2</sup></p> <p>Average Smoke Extinction Area: 372.3 m<sup>2</sup>/kg</p>                                |   |  |  |   |



## 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<br>50 kW/m <sup>2</sup>                            | D <sub>s</sub> 4           | -      | -       | 38       | 57       |
|   | VOF <sub>4</sub>           | -      | -       | 62       | 94       |
|   | Dm                         | -      | -       | 228      | 231      |
| ISO 5659-2 + EN 45545-2<br>Appendix C<br>50 kW/m <sup>2</sup> | ITC 4 minutes              | -      | -       | 0.02     | 0.01     |
|   | ITC 8 minutes              | -      | -       | 0.08     | 0.06     |
| ISO 5660-1  | MAHRE (kW/m <sup>2</sup> ) | -      | -       | 24.1     | 19.9     |
| ISO 5658-2  | CFE (kW/m <sup>2</sup> )   | 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<br>25 kW/m <sup>2</sup> | D <sub>s</sub> (4) | 2           | 3       | 0          |
|                                    | VOF <sub>4</sub>   | 2           | 3       | 0          |
|                                    | D <sub>s</sub> max | 15          | 15      | 6          |
| NF X 70-100                        | CIT <sub>NLP</sub> | 0.8         | 0.69    | 0.6        |
| ISO4589-2                          | %O <sub>2</sub>    | 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<br>Annex VI                                  | Melting Behavior<br>Annex VII                                  | Vertical Burn<br>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 <sup>1</sup> | ZX Orientation <sup>1</sup> |
|--|-----|-----------------------------|-----------------------------|
| <b>Tensile Properties: ASTM D638</b>   |     |                             |                             |
| <b>Validated Material - ULTEM™ 9085 Resin Aircraft Gray, Fortus 450mc, T16</b> |     |                             |                             |
| <b>Yield Strength</b>  | MPa | 78.8 (0.57)                 | 56.4 (3.2)                  |
|  | psi | 11400 (82)                  | 8180 (460)                  |
| <b>Elongation @ Yield</b>  | %   | 6.2 (0.070)                 | 3.2 (0.35)                  |
| <b>Strength @ Break</b>  | MPa | 75.1 (1.6)                  | 55.9 (3.0)                  |
|  | psi | 10900 (230)                 | 8110 (440)                  |
| <b>Elongation @ Break</b>  | %   | 7.9 (0.34)                  | 3.1 (0.32)                  |
| <b>Modulus (Elastic)</b>   | GPa | 2.25 (0.026)                | 2.18 (0.026)                |
|  | ksi | 326 (3.8)                   | 316 (3.7)                   |
| <b>Validated Material - ULTEM™ 9085 Resin Aircraft Gray, F900, T16</b>         |     |                             |                             |
| <b>Yield Strength</b>  | MPa | 70.6 (2.4)                  | No yield                    |
|  | psi | 10200 (350)                 | No yield                    |
| <b>Elongation @ Yield</b>  | %   | 5.6 (0.13)                  | No yield                    |
| <b>Strength @ Break</b>  | MPa | 69.5 (2.2)                  | 56.0 (2.3)                  |
|  | psi | 10100 (310)                 | 8120 (340)                  |
| <b>Elongation @ Break</b>  | %   | 6.1 (0.26)                  | 3.3 (0.29)                  |
| <b>Modulus (Elastic)</b>   | GPa | 2.09 (0.042)                | 2.12 (0.018)                |
|  | ksi | 303 (6.1)                   | 308 (2.6)                   |
| <b>Validated Material - ULTEM™ 9085 Resin Gunship Gray, Fortus 450mc, T16</b>  |     |                             |                             |
| <b>Yield Strength</b>  | MPa | 81.0 (0.50)                 | 47.2 (9.6)                  |
|  | psi | 11700 (73)                  | 6850 (1400)                 |
| <b>Elongation @ Yield</b>  | %   | 6.2 (0.09)                  | 2.5 (0.65)                  |
| <b>Strength @ Break</b>  | MPa | 78.5 (3.2)                  | 48.7 (8.2)                  |
|  | psi | 11400 (460)                 | 7060 (1200)                 |
| <b>Elongation @ Break</b>  | %   | 7.1 (0.81)                  | 2.7 (0.58)                  |
| <b>Modulus (Elastic)</b>   | GPa | 2.27 (0.022)                | 2.19 (0.0096)               |
|  | ksi | 330 (3.2)                   | 318 (1.4)                   |

<sup>1</sup> Values in parentheses are standard deviations.



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

<sup>1</sup> Values in parentheses are standard deviations.





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

<sup>1</sup> Values in parentheses are standard deviations.



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

<sup>1</sup>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) |
|---|----------------------------------|----------------------------|-----------------------------------|
| <b>12 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(ii)</b> |                                  |                            |                                   |
| <b>ULTEM™ 9085 Resin, White, T16 Tip, Build XZ</b>  | 3.4                              | 1.9                        | 0 (no drips)                      |
| <b>ULTEM™ 9085 Resin, White, T16 Tip, Build ZX</b>  | 6                                | 2                          | 0 (no drips)                      |
| <b>ULTEM™ 9085 Resin, Jana White, T16 Tip, Build XZ</b>   | 4.4                              | 2                          | 0 (no drips)                      |
| <b>ULTEM™ 9085 Resin, Jana White, T16 Tip, Build ZX</b>   | 4.3                              | 2                          | 0 (no drips)                      |
| <b>ULTEM™ 9085 Resin, Aircraft Gray, T16 Tip, Build XZ</b>  | 1.8                              | 1.8                        | 0 (no drips)                      |



|  | Avg Time to Extinguish (seconds) | Avg Burned Length (inches) | Drip Time to Extinguish (seconds) |
|--|----------------------------------|----------------------------|-----------------------------------|
| <b>12 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(ii)</b>      |                                  |                            |                                   |
| 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)                      |
| <b>60 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(i)</b>       |                                  |                            |                                   |
| 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)                      |
| <b>Avg Burn Rate (inches/minute)</b>   |                                  |                            |                                   |
| <b>15 Second Horizontal Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(iv)(v)</b> |                                  |                            |                                   |
| 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, (4Dmax) |   |                     |         |         |        |
|---|-------------------------------|--|---|---------------------|---------|---------|--------|
| <b>Smoke Density per BSS 7238, Rev. C</b>   |                               |  |   |                     |         |         |        |
| 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 <sub>2</sub> ppm                         | NO <sub>x</sub> ppm | HCN ppm | HCl ppm | HF ppm |
| <b>Toxic Gas Emission per BSS 7239, Rev. A</b>  |                               |  |   |                     |         |         |        |
| 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 <sup>2</sup> ) | Time to Peak Heat Release (seconds)            | 2 Minute Total HRR (kW-min/m <sup>2</sup> ) |                     |         |         |        |
| <b>Heat Release Rate of Cabin Materials per 14 CFR 25.853(d), Appendix F, Part IV</b> |                               |  |   |                     |         |         |        |
| 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.

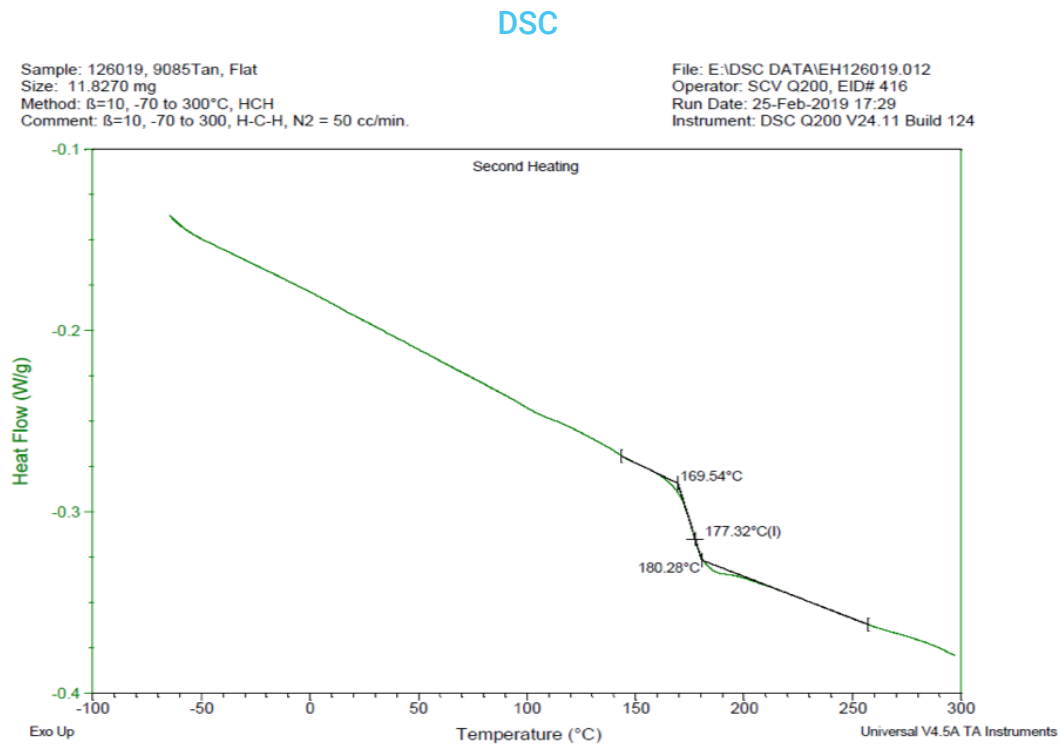


Figure 2: 2nd heating scan DSC data for ULTEM™ 9085 resin, black.

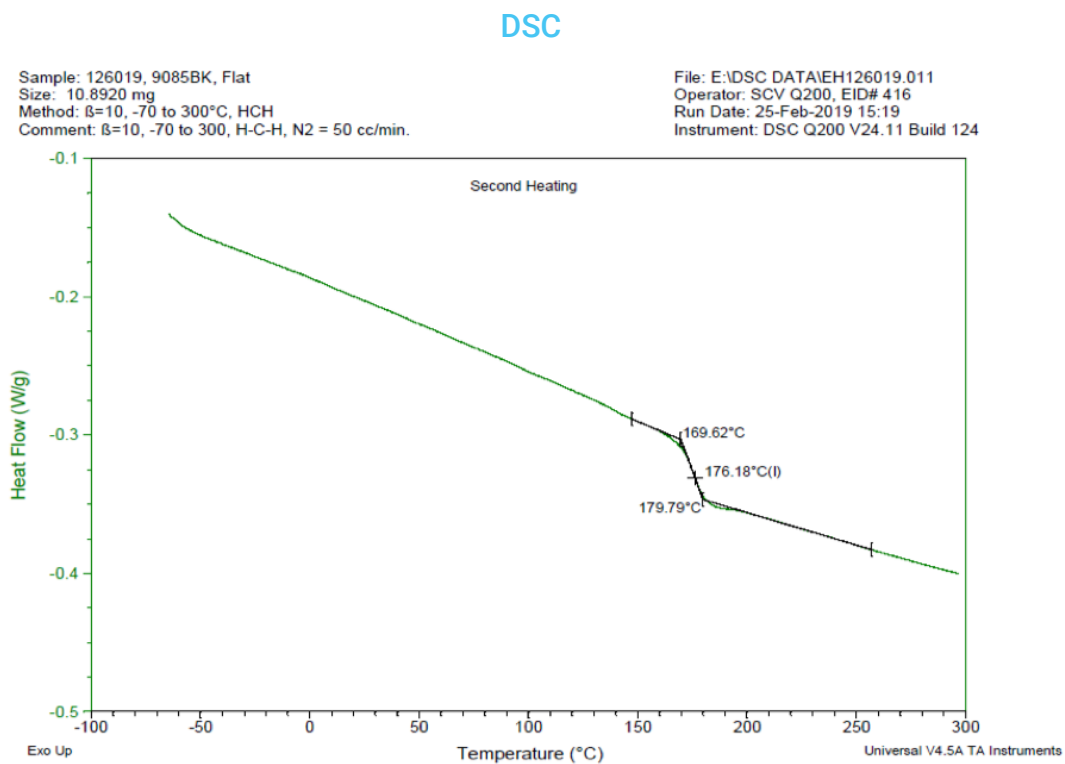




Figure 3: Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, flat (XY).

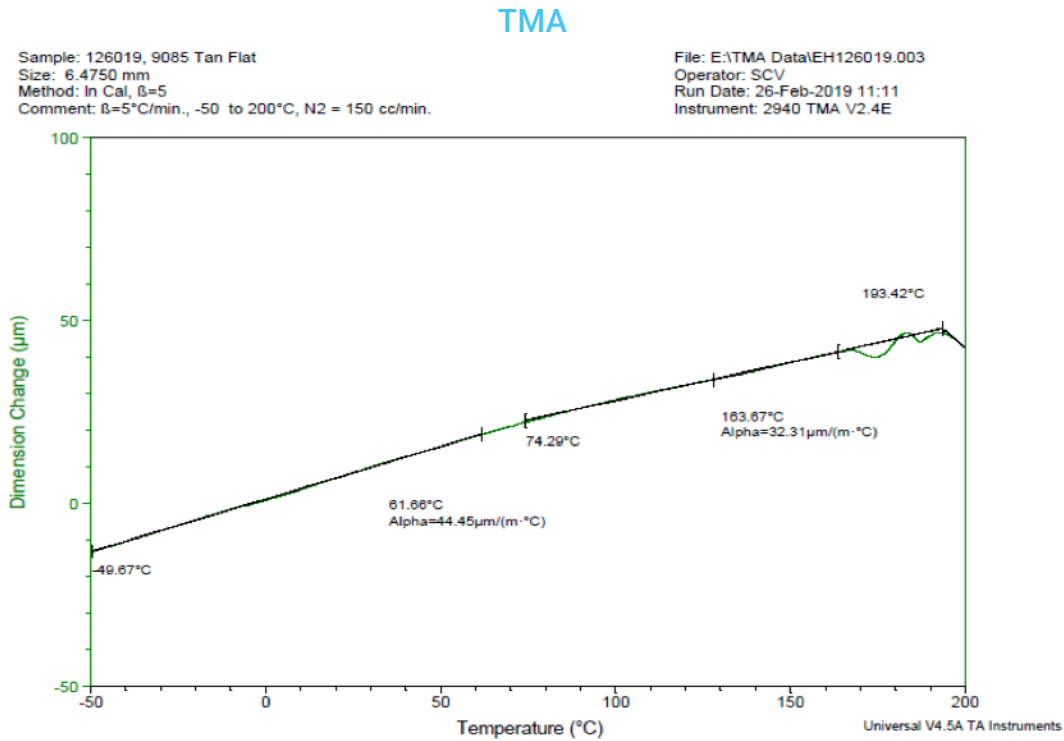


Figure 4: Dimension change data as a function of temperature for ULTEM™ 9085 resin, natural, upright (XZ).

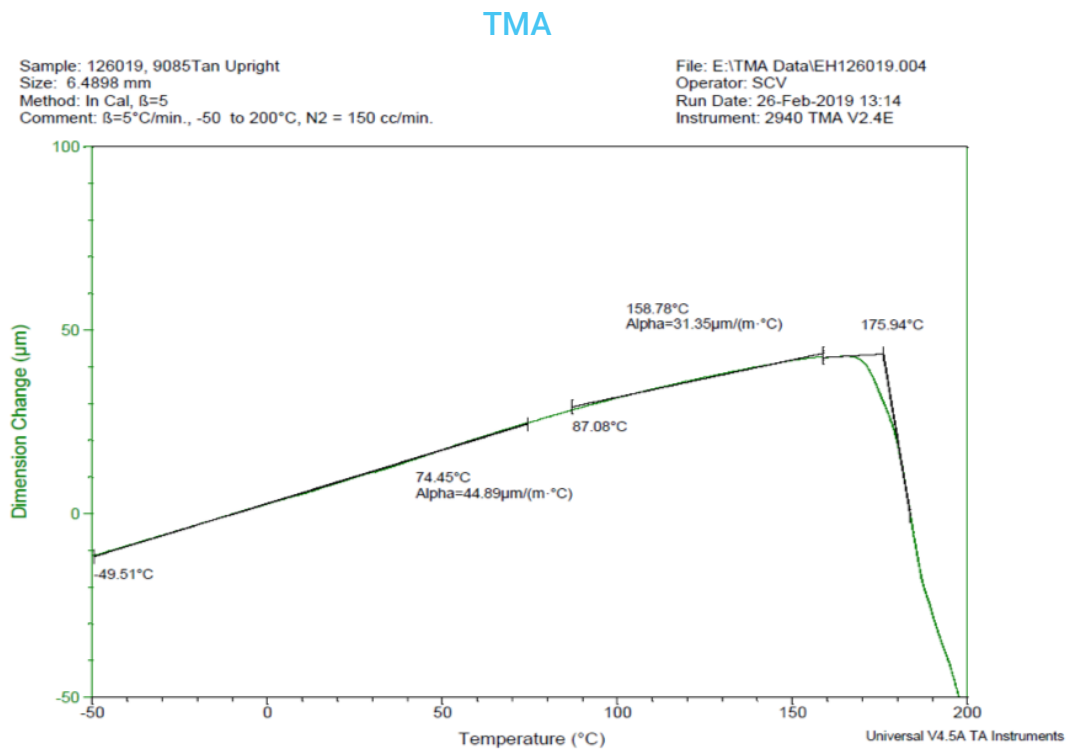




Figure 6: Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, upright (XZ).

### TMA

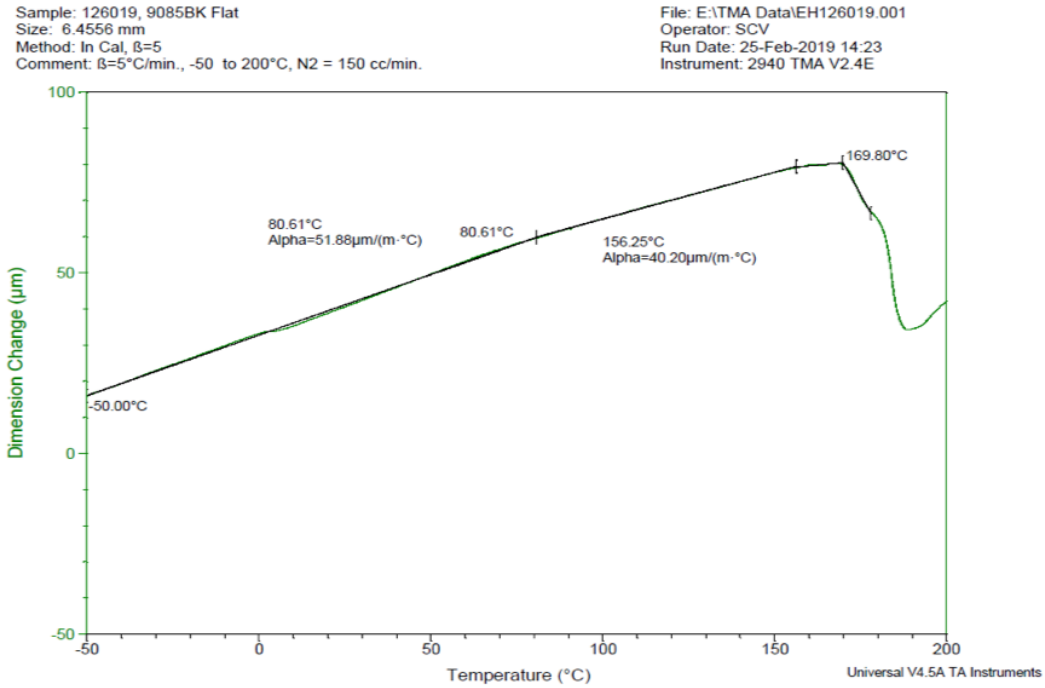


Figure 6: Dimension change data as a function of temperature for ULTEM™ 9085 resin, black, upright (XZ).

### TMA

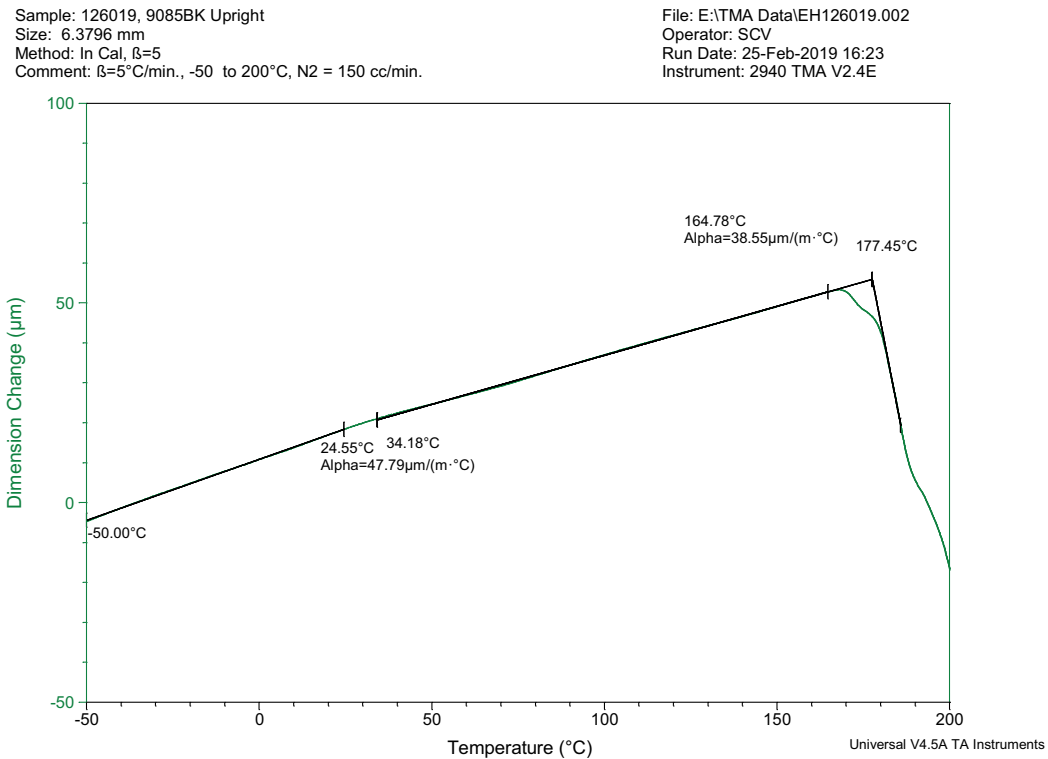
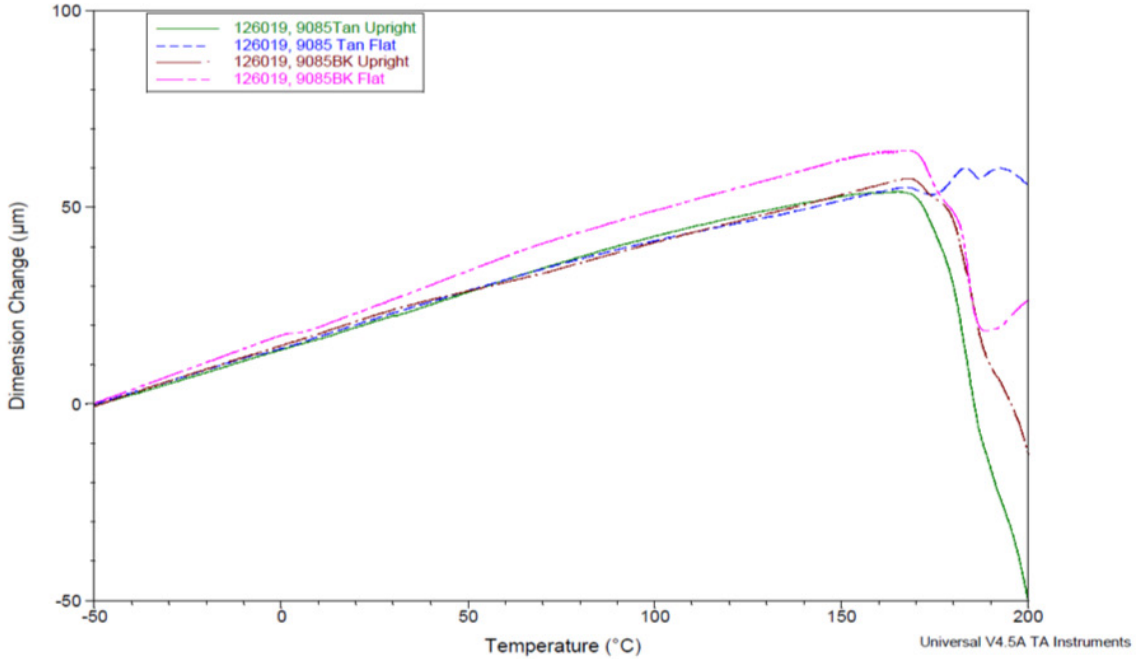




Figure 7: Overlay of the dimension change data for all the ULTEM™ 9085 resin samples.



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**MATERIAL DATA SHEET**  
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