

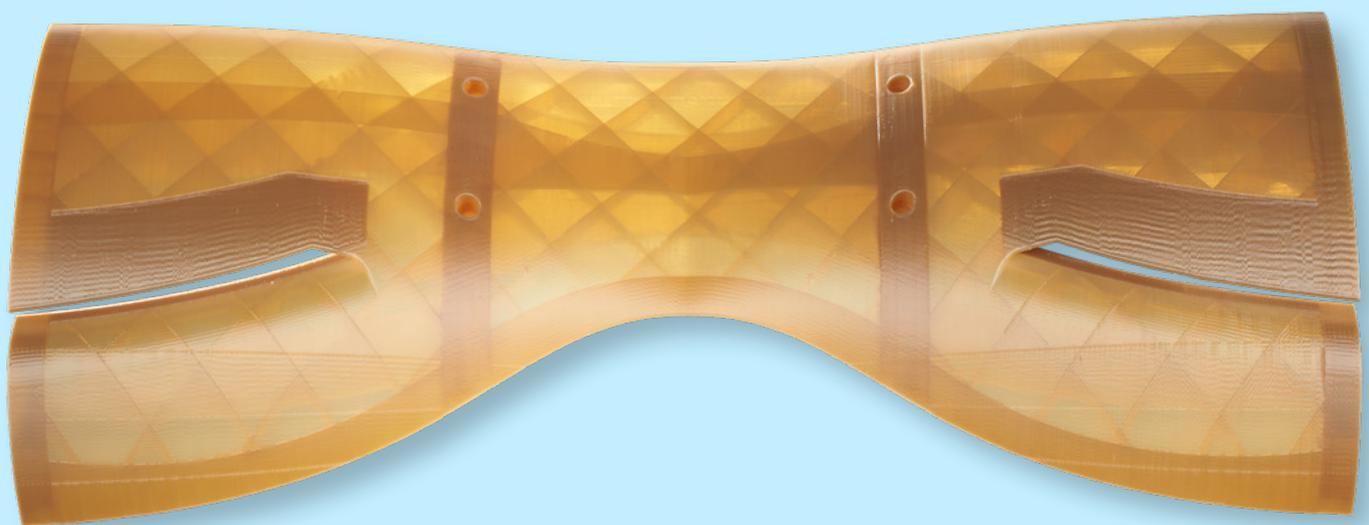


**MATERIAL DATA SHEET**  
FDM

# ULTEM™ 1010 Resin

FDM Thermoplastic Filament

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.





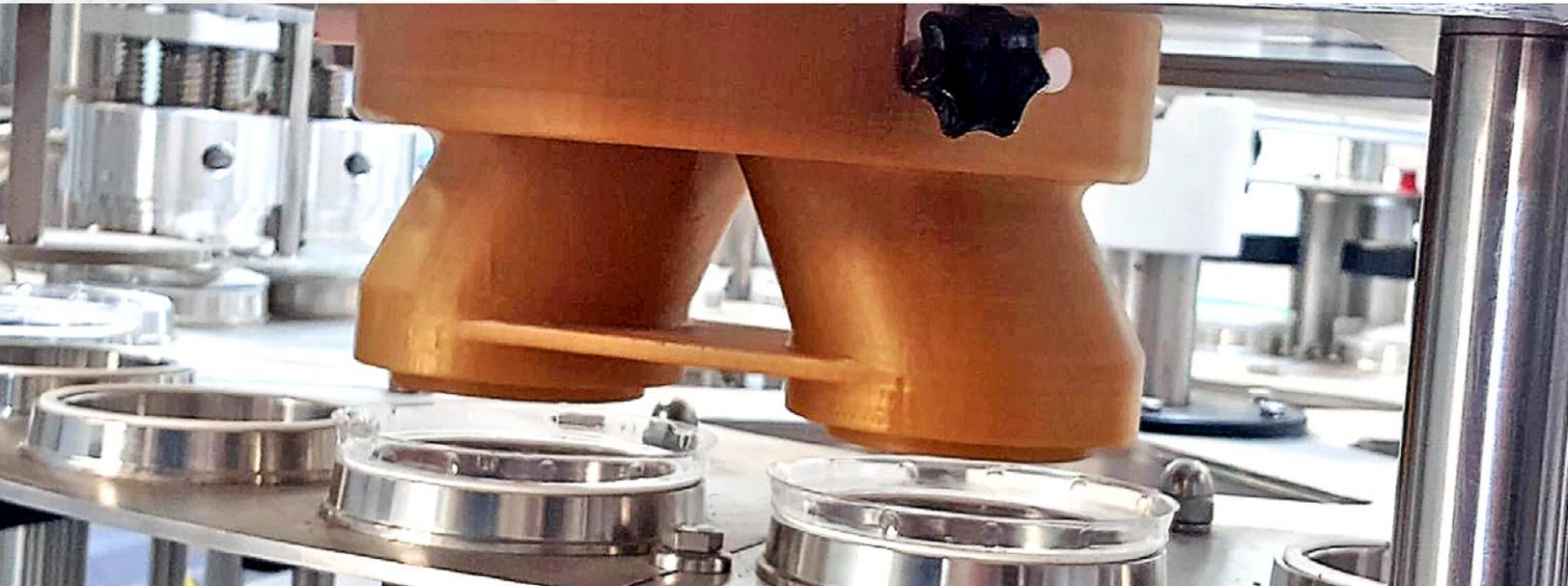
## Overview

ULTEM™ 1010 resin is a high-performance FDM® polyetherimide (PEI) thermoplastic. It exhibits high tensile strength in addition to broad chemical resistance and excellent thermal stability. Its high heat resistance makes it autoclave-capable for applications involving sterilization and composite lay-up tooling.

This material is available in both general-purpose and certified grades (CG). ULTEM™ 1010 resin is used with breakaway support material and is available in natural color.

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## Ordering Information

**Table 1: Printer and Support Material Compatibility**

Printer	Model Tip	Layer Height	Support Material	Support Tip
Fortus 450mc™	T14	0.25 mm (0.010 in.)	SUP9000B	T16
	T20	0.33 mm (0.013 in.)		
F900®	T14	0.25 mm (0.010 in.)	SUP9000B	T16
	T20	0.33 mm (0.013 in.)		T20
	T40A	0.51 mm (0.020 in.)		T20
F3300®	N500	0.25 mm (0.010 in.)	SUP9000B	N410S

### 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

- Standard Fortus 450mc head
- ULTEM™ 1010 resin material license (included if new system)
- Fortus FDC™ (enables use of XTEND™ 250 Fortus® Plus spool)

F900

- Standard F900 head
- ULTEM™ 1010 resin material licens
- Fortus FDC (enables use of XTEND 250 Fortus Plus spool)

F3300

- F3000 Series Extruder Drive
- Standard Hot End
- No material license required

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


**Table 2: ULTEM™ 1010 Resin Ordering Information**

Part Number	Description	System Compatibility
<b>Filament Canisters</b>		
<b>Fortus Plus Canister (black snout)</b>		
<b>355-02330</b>	ULTEM™ 1010 resin, 92.3 cu in - Plus	
<b>355-02320</b>	ULTEM™ 1010 resin CG, 92.3 cu in - Plus	Fortus 450mc, F900, Fortus 900mc (S/N L502 and up)
<b>355-03240</b>	SUP9000B Support, 92.3 cu in. - Plus	
<b>Fortus Spools</b>		
<b>361-00550</b>	XTEND™ 250 Fortus® Plus ULTEM™ 1010 resin	Fortus 450mc and F900 equipped with a Fortus FDC™
<b>Fortus Classic Canister (gray snout)</b>		
<b>312-22000</b>	ULTEM™ 1010 resin, 92.3 cu in - Classic	
<b>355-03240</b>	ULTEM™ 1010 resin CG, 92.3 cu in - Classic	Fortus 900mc (S/N prior to L502)
<b>310-31000</b>	SUP9000B Support, 92.3 cu in. - Classic	
<b>F3000 Series Spools</b>		
<b>363-00550</b>	MTRL, F3000 SERIES, (M), ULTEM™ 1010 resin, 4100 CC	F3300
<b>363-00740</b>	MTRL, F3000 SERIES, (S), SUP9000B, 4100 CC	
<b>Printer Consumables</b>		
<b>Fortus</b>		
<b>511-12000</b>	T14 tip	
<b>511-10701</b>	T16 tip	Fortus 450mc, F900, Fortus 900mc
<b>511-10750</b>	T20 tip	
<b>511-10401</b>	T40A tip	F900, Fortus 900mc
<b>325-00275-S</b>	High Temperature build sheet, 0.02x16x18.5 in. (0.51 x 406 x 470 mm), 20 pack	Fortus 450mc, F900, Fortus 900mc
<b>325-00475-S</b>	High Temperature build sheet, 0.02 x 26 x 38 in. (0.51 x 660 x 965 mm), 10 pack	F900, Fortus 900mc
<b>F3000 Series</b>		
<b>533-00500-S</b>	FDM, N500 Hot End (0.25 mm/0.010 in. layer height)	
<b>533-00420-S</b>	FDM, N410S Support Hot End (0.25 mm/0.010 in. layer height)	F3300
<b>363-30200-S</b>	F3300 Sheet Bundle, high temp, 0.02 x 26 x 28 in., 10 pack	
<b>Print Heads</b>		
<b>Fortus</b>		
<b>821725-XXXX</b>	Standard Fortus 450mc head (silver handle)	Fortus 450mc
<b>380-30300-S</b>	OpenAM Standard Fortus 450mc head (silver handle, additional sticker)	
<b>404210-XXXX</b>	Standard F900 head (formed rod handle)	F900
<b>380-63600-S</b>	OpenAM Standard F900 head (formed rod handle, additional sticker)	
<b>F3000 Series</b>		
<b>533-10000-S</b>	F3000 Series Extruder Drive	F3300

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



## Physical Properties

Values are measured and tested as molded and printed in the XY and XZ orientations. For full details refer to the [Stratasys Materials Test Report](#). DSC and TMA curves can be found in the Appendix.

**Table 3: ULTEM™ 1010 Resin Physical Properties**

Physical Properties - Printed			
Property	Test Method	XY	XZ
<b>HDT @ 66 psi</b>	ASTM D648 Method B	216.88 °C (422.39 °F)	217.12 °C (422.82 °F)
<b>HDT @ 264 psi</b>	ASTM D648 Method B	215.12 °C (419.22 °F)	214.51 °C (418.12 °F)
<b>Mean CTE</b>	ASTM E831 (-50 °C to 60 °C)	36.08 µm/[m*°C] (20.04 µin/[in*°F])	-
	ASTM E831 (60 °C to 205 °C)	29.81 µm/[m*°C] (16.56 µin/[in*°F])	-
	ASTM E831 (-50 °C to 110 °C)	-	32.50 µm/[m*°C] (18.06 µin/[in*°F])
	ASTM E831 (110 °C to 165 °C)	-	16.19 µm/[m*°C] (8.995 µin/[in*°F])
	ASTM E831 (165 °C to 200 °C)	-	4.291 µm/[m*°C] (2.384 µin/[in*°F])
<b>Dielectric Constant</b>	ASTM D150 1 kHz test condition	2.841	2.888
	ASTM D150 2 MHz test condition	3.089	3.156
<b>Dissipation Factor</b>	ASTM D150 1 kHz test condition	-0.002	-0.002
	ASTM D150 2 MHz test condition	0	0
Physical Properties - Non Printed			
Property	Test Method	Molded Plaques	
<b>Tg</b>	ASTM D7426 Inflection Point	209.37 °C (408.87 °F)	
<b>Volume Resistivity</b>	ASTM D257	>7.00*10 <sup>14</sup> Ω*cm	
<b>Thermal Conductivity</b>	ASTM E1952 @0 °C	0.2430 W/m*K 0.1404 BTU/(hr*ft*F)	
<b>Thermal Conductivity</b>	ASTM E1952 @30 °C	0.2420 W/m*K 0.1399 BTU/(hr*ft*F)	
<b>Thermal Conductivity</b>	ASTM E1952 @60 °C	0.2426 W/m*K 0.1399 BTU/(hr*ft*F)	
<b>Thermal Conductivity</b>	ASTM E1952 @90 °C	0.2417 W/m*K 0.1402 BTU/(hr*ft*F)	
<b>Thermal Diffusivity</b>	ASTM E1952 @0 °C	0.158 mm <sup>2</sup> /s 2.45*10 <sup>-4</sup> in <sup>2</sup> /s	
<b>Thermal Diffusivity</b>	ASTM E1952 @30 °C	0.141 mm <sup>2</sup> /s 2.19*10 <sup>-4</sup> in <sup>2</sup> /s	
<b>Thermal Diffusivity</b>	ASTM E1952 @60 °C	0.130 mm <sup>2</sup> /s 2.02*10 <sup>-4</sup> in <sup>2</sup> /s	
<b>Thermal Diffusivity</b>	ASTM E1952 @90 °C	0.121 mm <sup>2</sup> /s 1.88*10 <sup>-4</sup> in <sup>2</sup> /s	
<b>Specific Gravity</b>	ASTM D792 @23 °C	1.290	

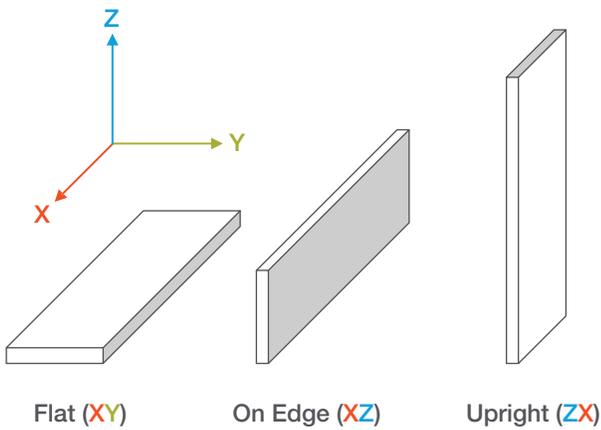


## Mechanical Properties

ULTEM™ 1010 resin samples were printed with a 0.25 mm (0.010 in.) layer height on the F900 and the F3300. For the full test procedure please see the [Stratasys Materials Test Procedure](#).

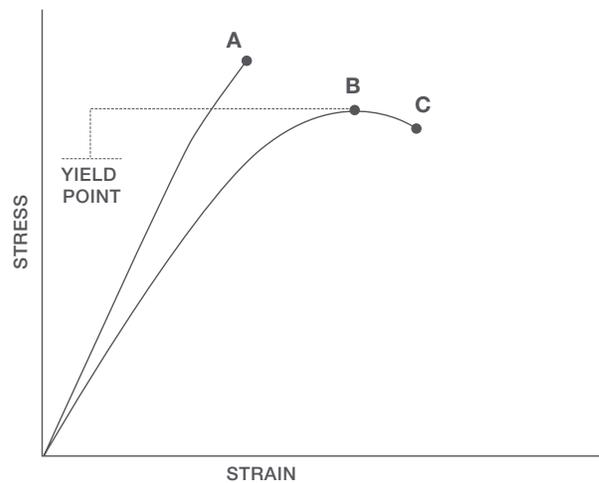
### Print Orientation

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



### 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™ 1010 Resin Mechanical Properties - F900 - T14 Tip**

0.25 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	No yield	No yield
	psi		
<b>Elongation @ Yield</b>	%	No yield	No yield
<b>Strength @ Break</b>	MPa	79.2 (4.9)	28.2 (8.8)
	psi	11,500 (710)	4,080 (1,300)
<b>Elongation @ Break</b>	%	4.0 (0.42)	1.1 (0.45)
<b>Modulus (Elastic)</b>	GPa	3.04 (0.18)	3.00 (0.45)
	ksi	441 (27)	435 (65)
<b>Flexural Properties: ASTM D790, Procedure A</b>			
<b>Strength @ Break</b>	MPa	No break	81.6 (13)
	psi	No break	11,800 (1,900)
<b>Strength @ 5% Strain</b>	MPa	128 (1.8)	-
	psi	18,600 (270)	-
<b>Strain @ Break</b>	%	No break	3.19 (0.53)
<b>Modulus</b>	MPa	2.91 (0.049)	2.64 (0.13)
	ksi	422 (7.0)	383 (19)
<b>Compression Properties: ASTM D695</b>			
<b>Yield Strength</b>	MPa	245 (50)	438 (31)
	psi	35,600 (7,200)	63,500 (4,500)
<b>Modulus</b>	GPa	2.93 (0.14)	3.23 (0.57)
	ksi	425 (20)	468 (83)
<b>Impact Properties: ASTM D256, ASTM D4812</b>			
<b>Notched</b>	J/m	26.6 (3.5)	21.7 (4.7)
	ft*lb/in.	0.498 (0.065)	0.407 (0.089)
<b>Unnotched</b>	J/m	260 (57)	68.0 (29.8)
	ft*lb/in.	4.87 (1.1)	1.27 (0.56)

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


**Table 5: ULTEM™ 1010 Resin Mechanical Properties - F3300 - N500 Hot End**

0.25 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	92.8 (4)	35.3 (6.4)
	psi	13,500 (580)	5,130 (930)
<b>Elongation @ Yield</b>	%	4.2 (0.35)	1.4 (0.29)
<b>Strength @ Break</b>	MPa	91.6 (4.6)	36.7 (6.9)
	psi	13,300 (670)	5,320 (1,000)
<b>Elongation @ Break</b>	%	4.1 (0.38)	1.5 (0.32)
<b>Modulus (Elastic)</b>	GPa	2.92 (0.048)	2.64 (0.13)
	ksi	424 (7)	383 (19)
<b>Flexural Properties: ASTM D790, Procedure A</b>			
<b>Strength @ Break</b>	MPa	144 (2.2)	71.5 (12)
	psi	21,000 (320)	10,400 (1,700)
<b>Strain @ Break</b>	%	No break	2.9 (0.71)
<b>Modulus</b>	GPa	3.26 (0.056)	2.33 (0.3)
	ksi	473 (8.2)	338 (43)
<b>Compression Properties: ASTM D695</b>			
<b>0.2% Offset Yield<sup>2</sup></b>	MPa	77.7 (3.3)	88.1 (2)
	psi	11,300 (480)	12,800 (300)
<b>1.0% Offset Yield<sup>2</sup></b>	MPa	104 (3.5)	120 (2)
	ksi	15,100 (510)	17,300 (280)
<b>Modulus</b>	GPa	2.42 (0.06)	2.54 (0.055)
	ksi	352 (8.7)	368 (8)
<b>Impact Properties: ASTM D256, ASTM D4812 (sample thickness 0.125 inches)</b>			
<b>Notched</b>	J/m	36.3 (4.8)	27.2 (2.4)
	ft*lb/in.	0.68 (0.09)	0.509 (0.045)
<b>Unnotched</b>	J/m	406 (65)	116 (41)
	ft*lb/in.	7.61 (1.2)	2.17 (0.77)

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

<sup>2</sup> An updated method for compression testing of FDM parts improves consistency by using offset yield values and an earlier test-termination point to better capture reliable material properties.



## Outgassing

ULTEM™ 1010 resin, natural, was printed with a 0.25 mm (0.010 in.) layer height on a Stratasys Fortus 450mc and tested per ASTM E595-15. Full report available upon request.

**Table 6: ULTEM™ 1010 Resin Outgassing Test Results**

Sample	TML (%)	CVCM (%)	WVR (%)
ULTEM™ 1010 Resin, Natural, T14 tip, Flat (XY)	0.55	0.02	0.39
ULTEM™ 1010 Resin, Natural, T14 tip, Upright (ZX)	0.58	0.03	0.33
<b>Testing Observations<sup>1</sup></b>			
<b>Visible Condensate</b>	No	Opaque	N/A
<b>Percent Covered</b>	0%	Interference Fringes	N/A
<b>Thin</b>	N/A	Colored Fringes	N/A
<b>Heavy</b>	N/A	Sample appearance after test	No change
<b>Transparent</b>	N/A		

<sup>1</sup>Observations apply to all tested samples

## Fire Protection for Devices and Appliances UL Blue Card

ULTEM™ 1010 resin was printed on the Fortus 400mc, Fortus 450mc, Fortus 900mc, and the F900 printers with a T14, T20, and T40A model tip. For more information reference file number E345258 on the [iq.ulprospector.com](http://iq.ulprospector.com) website (login required).

**Table 7: ULTEM™ 1010 resin UL Blue Card Overview**

Build Direction	Layer Height	Model Tip	Minimum Sample Thickness	Rating	Printer
<b>Horizontal</b>	0.25 mm (0.010 in.)	T14	1.5 mm (0.059 in.)	V-0	Fortus 400mc
	0.330 mm (0.013 in.)	T20	3.0 mm (0.118 in.)	V-0	Fortus 400mc, Fortus 450mc
	0.508 mm (0.020 in.)	T40A	1.0 mm (0.039 in.)	V-0	Fortus 900mc, F900
<b>Vertical</b>	0.25 mm (0.010 in.)	T14	1.0 mm (0.039 in.)	V-0	Fortus 400mc, Fortus 900mc, F900
	0.330 mm (0.013 in.)	T20	1.5 mm (0.059 in.)	V-0	Fortus 400mc, Fortus 450mc
	0.508 mm (0.020 in.)	T40A	1.0 mm (0.039 in.)	V-0	Fortus 900mc, F900



## Appendix

Figure 1: 2nd heating scan DSC data for the ULTEM™ 1010 resin Flat (XY) sample.

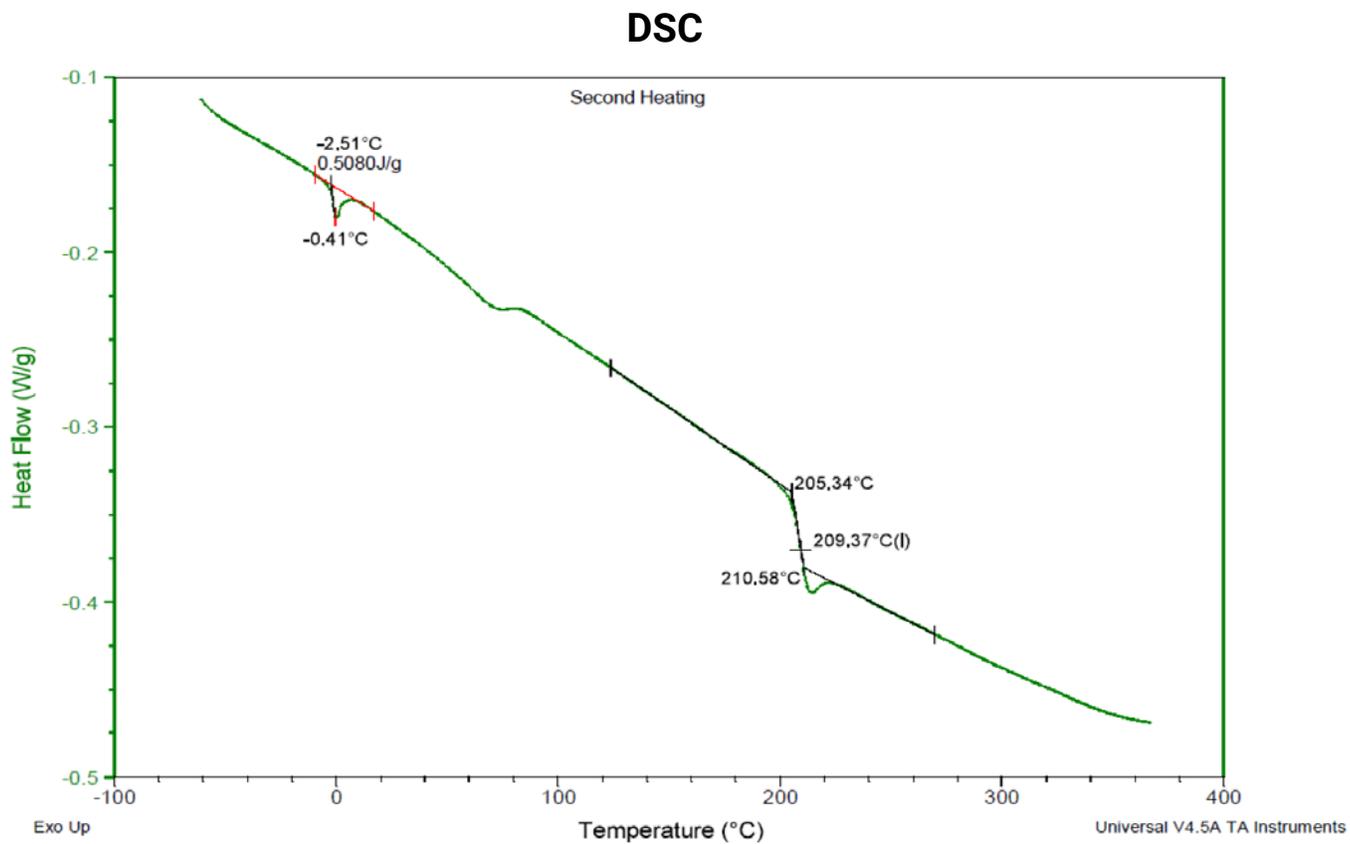




Figure 2: Dimension change data as a function of temperature for the ULTEM™ 1010 resin Flat (XY) sample.

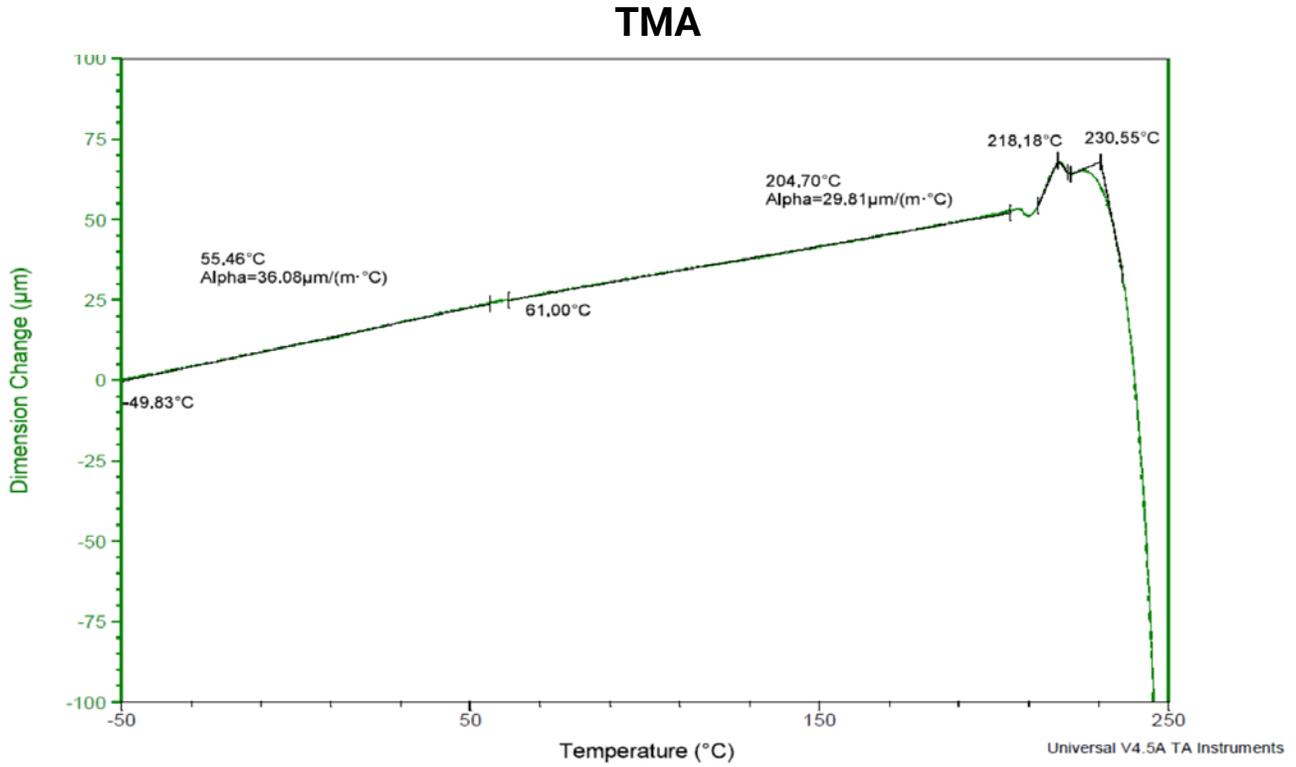


Figure 3: Dimension change data as a function of temperature for the ULTEM™ 1010 resin On Edge (XZ) sample.

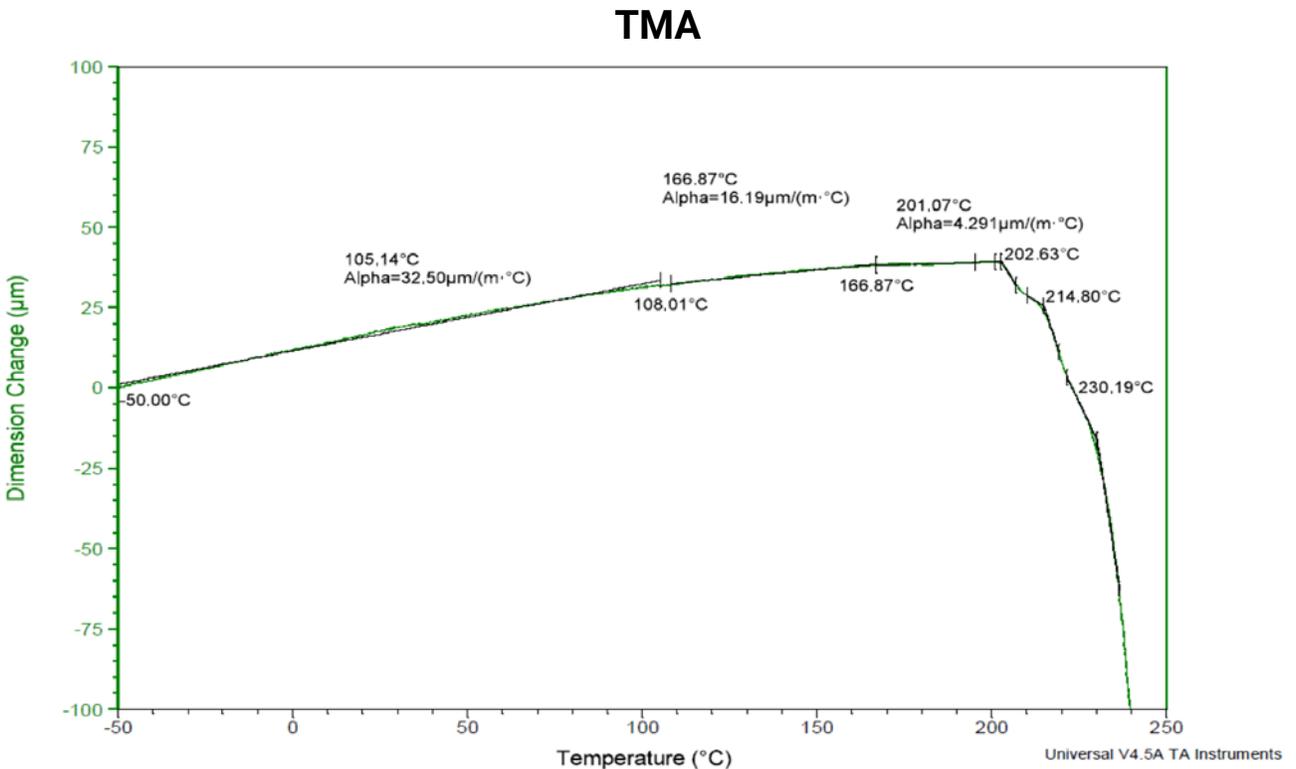
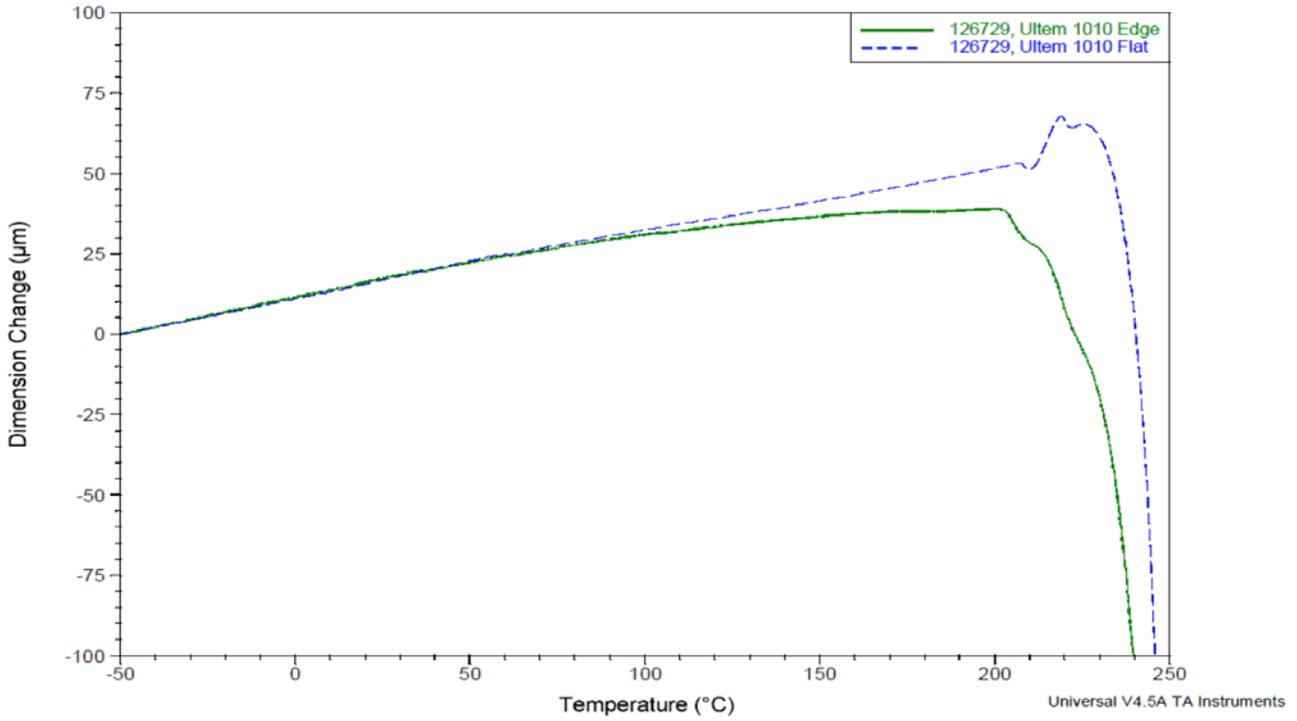




Figure 4: Overlay of the dimension change data for the Flat (XY) and On Edge (XZ) ULTEM™ 1010 resin samples.



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**MATERIAL DATA SHEET**  
FDM

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