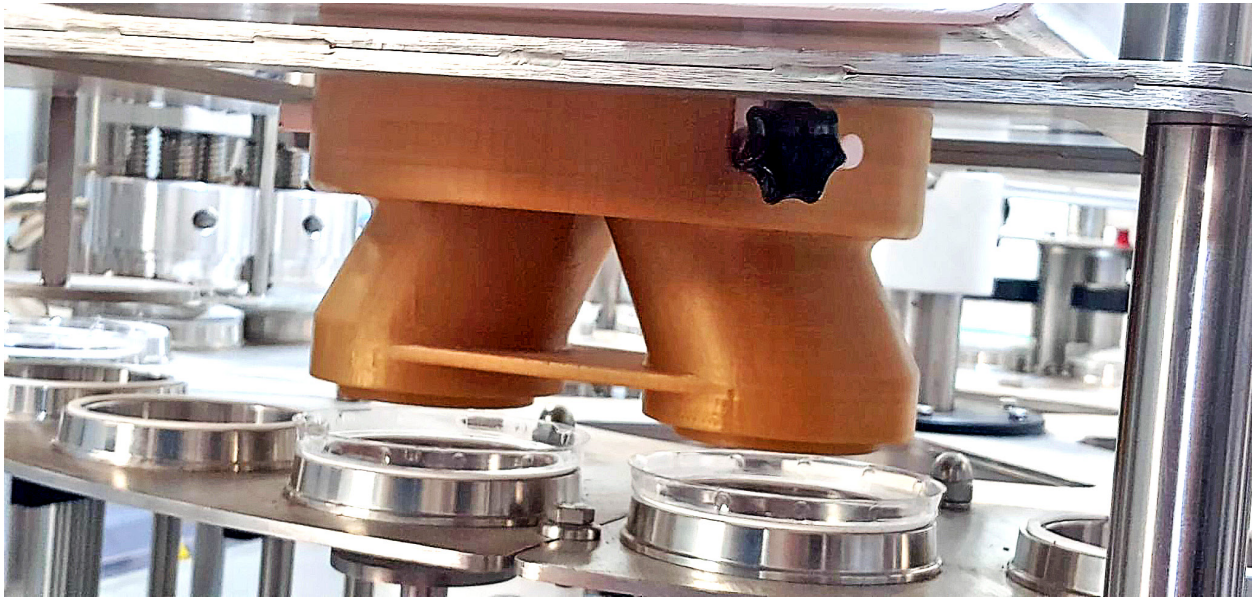


# ULTEM™ 1010 Resin



## 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. For special medical and food-related applications, ULTEM™ 1010 resin CG (certified grade) comes with additional documentation to demonstrate compliance with industry standards for ISO 10993 and USP Class VI biocompatibility, and NSF 51 food safety requirements.

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 (Slice)	Support Material	Support Tip (slice)
Fortus 450mc™	T14 (10 slice)	SUP9000B™ (breakaway)	T16 (10, 13 slice)
	T20 (13 slice)		
F900®	T14 (10 slice)	SUP9000B (breakaway)	T16 (10, 13 slice)
	T20 (13 slice)		
	T40A (20 slice)		

### Build Sheet

High Temperature

- 0.02 x 26 x 38 in. (0.51 x 660 x 965 mm)
- 0.02 x 16 x 18.5 in. (0.51 x 406 x 470 mm)

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

Part Number	Description
<b>Filament Canisters<sup>1 2</sup></b>	
355-02330	ULTEM™ 1010 resin, 92.3 cu in - Plus
355-02320	ULTEM™ 1010 resin CG, 92.3 cu in - Plus
312-22100	ULTEM™ 1010 resin, 92.3 cu in - Classic
312-22000	ULTEM™ 1010 resin CG, 92.3 cu in - Classic
355-03240	Support for ULTEM™ 1010 resin filament, 92.3 cu in. - Plus
310-31000	Support for ULTEM™ 1010 resin filament, 92.3 cu in. - Classic
<b>Printer Consumables</b>	
511-12000	T14 tip
511-10701	T20 tip
511-10750	T40A tip
511-10401	T16 tip
325-00275-S	High Temperature build sheet, 0.02x26x38 in. (0.51x660x965 mm)
325-00475-S	High Temperature build sheet, 0.02x16x18.5 in. (0.51x406x470 mm)
310-00300	High Temperature build sheet, 0.03x16x18.5 in. (0.76x406x470 mm)

<sup>1</sup> Classic canisters are compatible with 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.

## Physical Properties

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

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

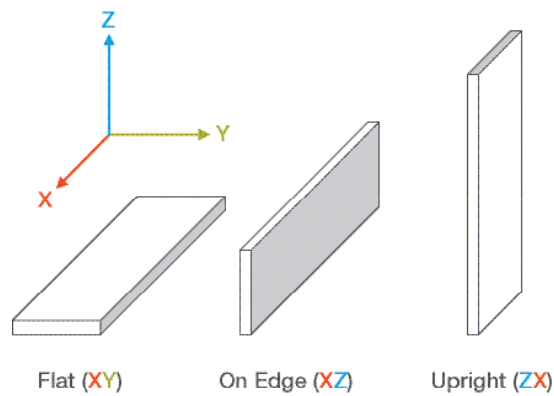
Property	Test Method	Typical Values	
		XY	XZ/ZX
HDT @ 66 psi	ASTM D648 Method B	216.9 °C (422.4 °F)	217.1 °C (422.8 °F)
HDT @ 264 psi	ASTM D648 Method B	215.1 °C (419.2 °F)	214.6 °C (418.3 °F)
Molded HDT @ 66 psi	ASTM D648 Method B	214.1 °C (417.3 °F)	
Molded HDT @ 264 psi	ASTM D648 Method B	212.2 °C (413.9 °F)	
Tg	ASTM D7426 Inflection Point	209.4°C (408.9 °F)	
Mean CTE	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])
Volume Resistivity	ASTM D257	>7.00*10 <sup>14</sup> Ω*cm	
Dielectric Constant	ASTM D150 1 kHz test condition	2.841	2.888
	ASTM D150 2 MHz test condition	3.089	3.156
Dissipation Factor	ASTM D150 1 kHz test condition	-0.002	-0.002
	ASTM D150 2 MHz test condition	0.000	0.000
Thermal Conductivity	ASTM E1952 @0 °C	0.2430 W/m*K 0.1404 BTU/(hr*ft*F)	
Thermal Conductivity	ASTM E1952 @30 °C	0.2420 W/m*K 0.1399 BTU/(hr*ft*F)	
Thermal Conductivity	ASTM E1952 @60 °C	0.2426 W/m*K 0.1399 BTU/(hr*ft*F)	
Thermal Conductivity	ASTM E1952 @90 °C	0.2417 W/m*K 0.1402 BTU/(hr*ft*F)	
Thermal Diffusivity	ASTM E1952 @0 °C	0.158 mm <sup>2</sup> /s	
		2.45*10 <sup>-4</sup> in <sup>2</sup> /s	
Thermal Diffusivity	ASTM E1952 @30 °C	0.141 mm <sup>2</sup> /s	
		2.19*10 <sup>-4</sup> in <sup>2</sup> /s	
Thermal Diffusivity	ASTM E1952 @60 °C	0.130 mm <sup>2</sup> /s	
		2.02*10 <sup>-4</sup> in <sup>2</sup> /s	
Thermal Diffusivity	ASTM E1952 @90 °C	0.121 mm <sup>2</sup> /s	
		1.88*10 <sup>-4</sup> in <sup>2</sup> /s	
Specific Gravity	ASTM D792 @23 °C	1.29	
UL Flammability	ANSI/UL 746B	V0- Blue Card <a href="#">#E345258</a>	

## Mechanical Properties

ULTEM™ 1010 resin samples were printed with a 0.010 in. (0.254 mm) layer height on the F900. For the full test procedure please see the [Stratasys Materials Test Procedure](#).

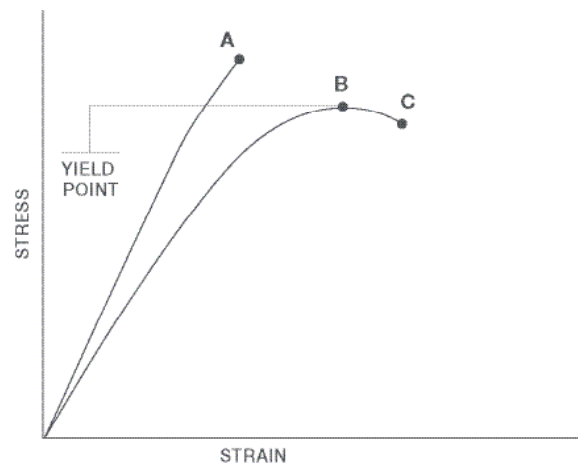
### Print Orientation

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)**

		XZ Orientation <sup>1</sup>	ZX Orientation <sup>1</sup>
<b>Tensile Properties: ASTM D638</b>			
Yield Strength	MPa	No yield	No yield
	psi		
Elongation @ Yield	%	No yield	No yield
Strength @ Break	MPa	79.2 (4.9)	28.2 (8.8)
	psi	11500 (710)	4080 (1300)
Elongation @ Break	%	4.0 (0.42)	1.1 (0.45)
Modulus (Elastic)	GPa	3.04 (0.18)	3.00 (0.45)
	ksi	441 (27)	435 (65)
<b>Flexural Properties: ASTM D790, Procedure A</b>			
Strength @ Break	MPa	No break	81.6 (13)
	psi	No break	11800 (1900)
Strength @ 5% Strain	MPa	128 (1.8)	-
	psi	18600 (270)	-
Strain @ Break	%	No break	3.19 (0.53)
Modulus	GPa	2.91 (0.049)	2.64 (0.13)
	ksi	422 (7.0)	383 (19)
<b>Compression Properties: ASTM D695</b>			
Yield Strength	MPa	245 (50)	438 (31)
	psi	35600 (7200)	63500 (4500)
Modulus	GPa	2.93 (0.14)	3.23 (0.57)
	ksi	425 (20)	468 (83)
<b>Impact Properties: ASTM D256, ASTM D4812</b>			
Notched	J/m	26.6 (3.5)	21.7 (4.7)
	ft*lb/in.	0.498 (0.065)	0.407 (0.089)
Unnotched	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.

## Outgassing

ULTEM™ 1010 resin, natural, was printed with a T14 tip on a Stratasys Fortus 450mc and tested per ASTM E595-15. Full report available upon request.

**Table 5. 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
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		

(1) Observations apply to all tested samples

## UV Aging

Natural ULTEM™ 1010 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 Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Non-Metallic Materials) for 1000 hours, alternating for 8 hours at 60 °C (140 °F) and 4 hours at 50 °C (122°F) with humidity and condensation. The increase in stress in break is from the control samples. For more information see the [Impact of UV Exposure on FDM Materials](#) white paper.

**Table 6: ULTEM™ 1010 Resin UV Exposure Test Results**

Material	Conditioning	Yield Strength		Stress at Break		Elongation at break	Increase in Stress at Break	Modulus	
		(psi)	(MPa)	(psi)	(MPa)	%	%	(ksi)	(Gpa)
ULTEM™ 1010 resin	No UV Exposure	8280	57.1	8570	59.1	2.6		375	2.59
	UV Exposure	9630	66.4	9530	65.7	2.9	11.20	378	2.61

ULTEM™ 1010 resin coupons were built on the Fortus F900 using the T14 tip.

## Appendix

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

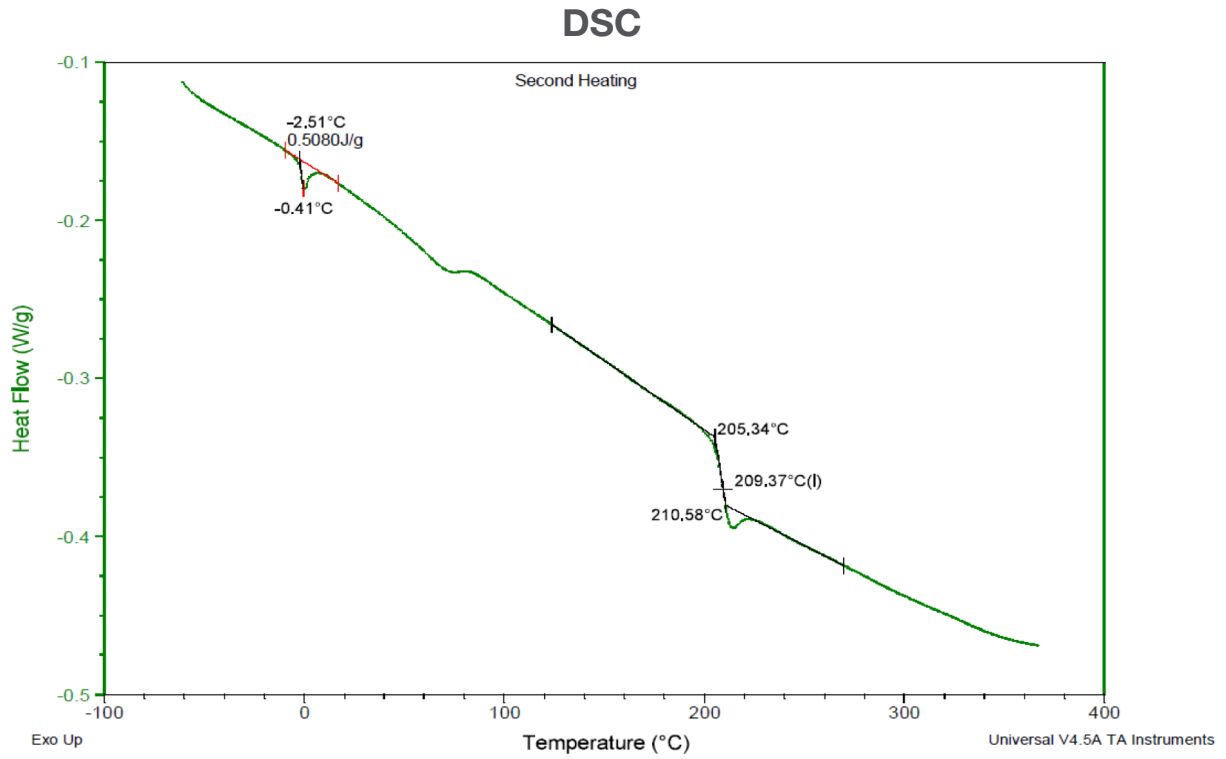




Figure 2. – Dimension change data as a function of temperature for the ULTEM™ 1010 resin Flat (XY) sample.

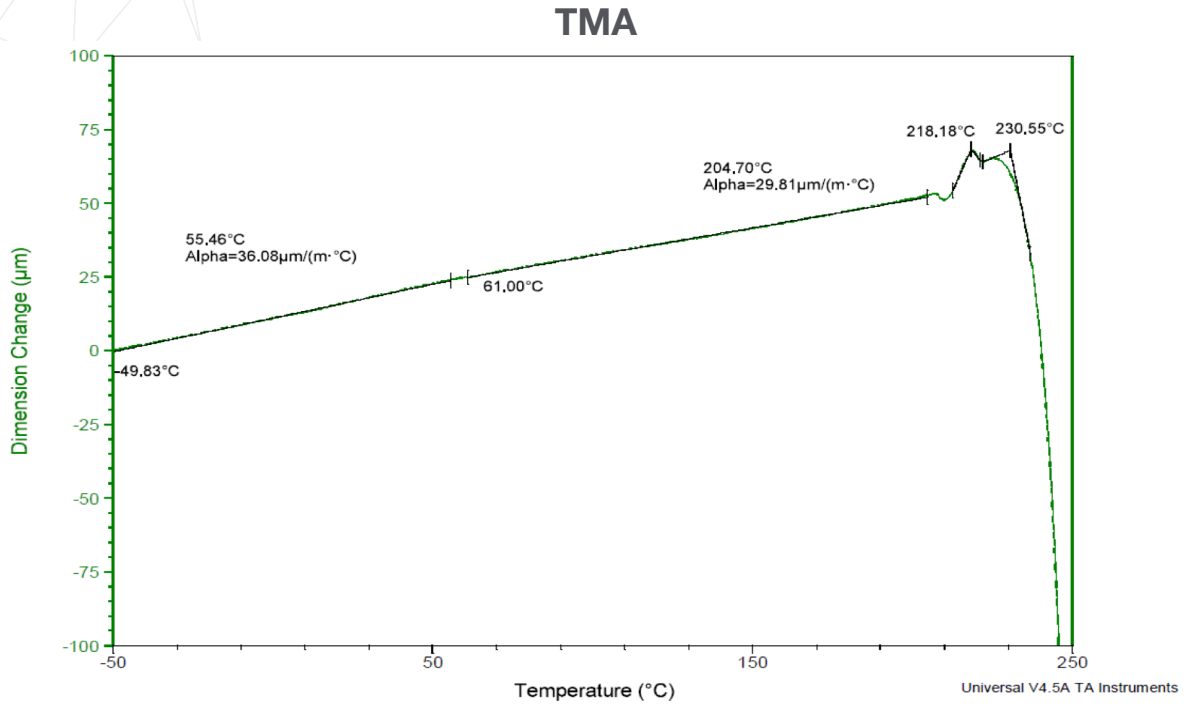


Figure 3. Dimension change data as a function of temperature for the ULTEM™ 1010 resin On Edge (XZ) sample.

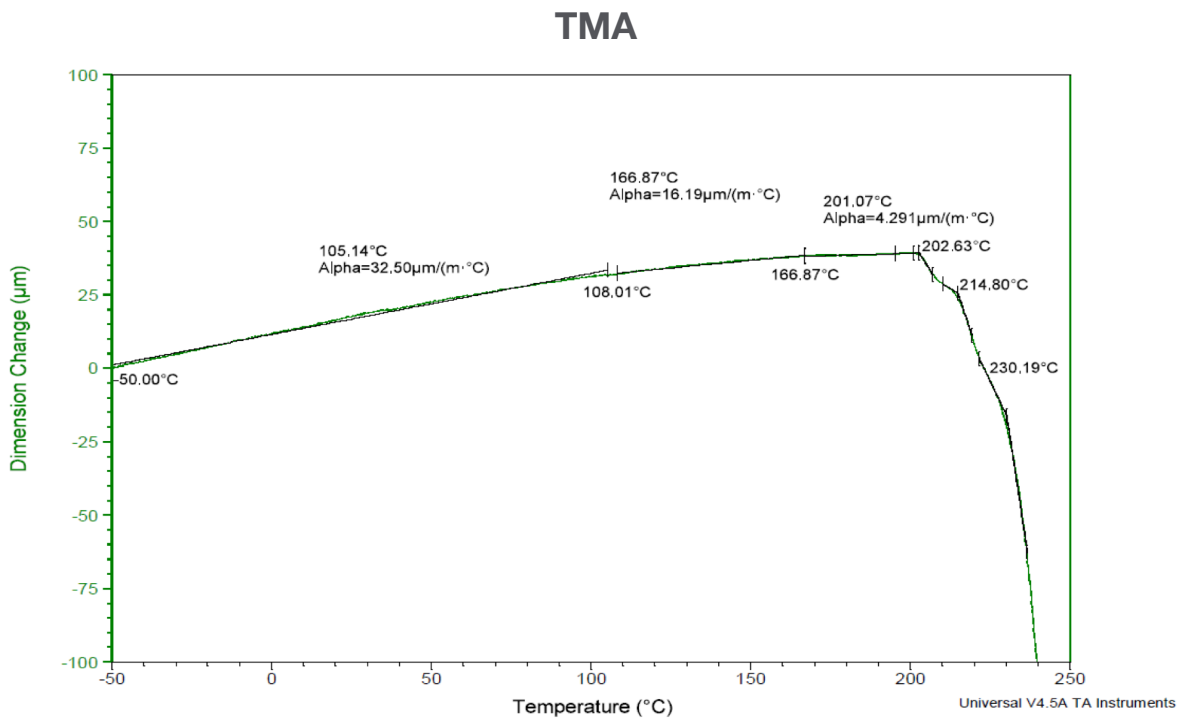
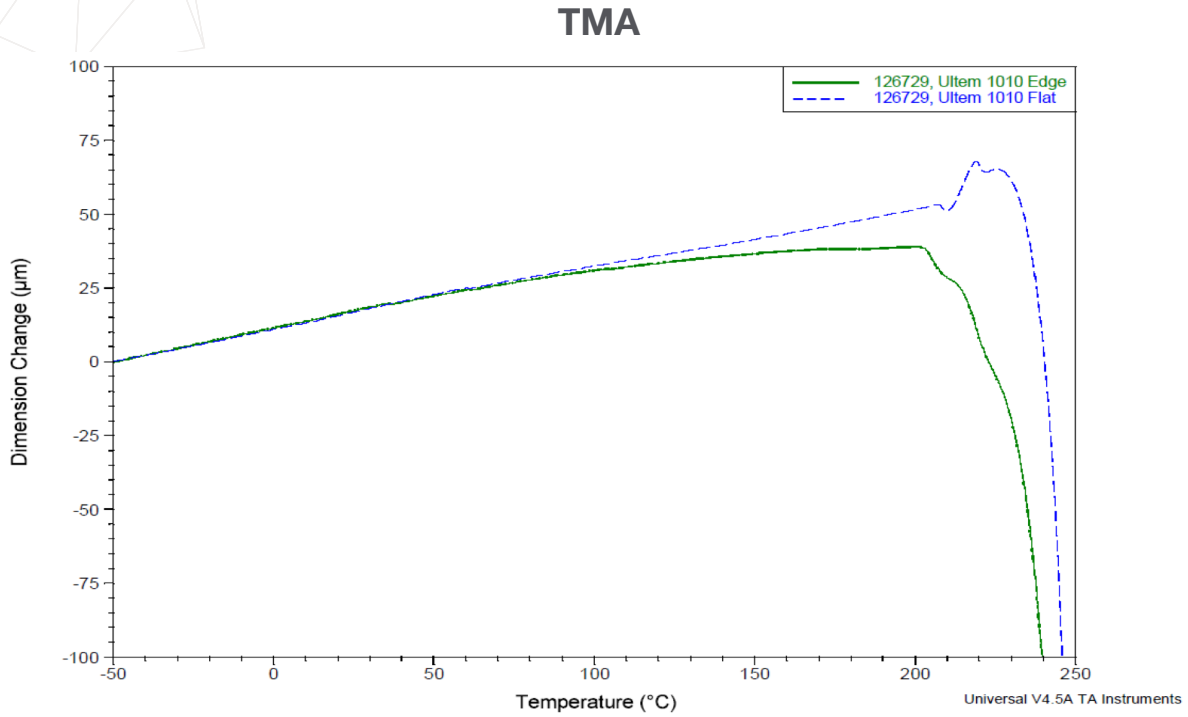


Figure 4. – Overlay of the dimension change data for the Flat (XY) and On Edge (XZ) ULTEM™ 1010 resin samples.



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