

# HexPly® F655™

## Resin Systems for Advanced Composites

### Product Data

## Description

HexPly® F655™ is a bismaleimide resin that cures via an addition™ reaction in a toughened two-phase thermoset matrix with no condensation by-products. HexPly® F655™ is a controlled flow polyimide resin system designed for alternative processing capabilities such as co-curing over honeycomb core, compression molding, as well as standard autoclave processing.

## Features

### Uncured

- Controlled Flow
- Process Working Life Greater Than 20 Days

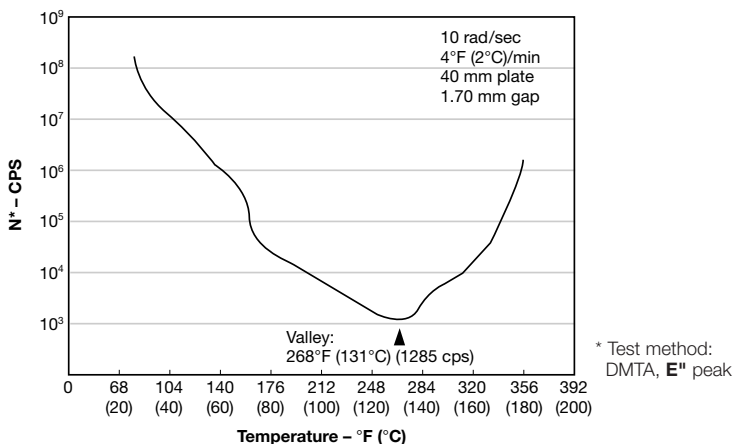
### Cured

- High Laminate Mechanical Strengths and Strains
- High Strength Retention at 450°F (232°C) Dry and 350°F (177°C) Wet
- Improved Compression After Impact Properties
- Void-Free Thick Laminate Processability
- Void-Free Thick Laminate Co-Cure Processing Over Honeycomb Core
- Long-term Service Life to 400°F (204°C)
- Excellent Electrical Properties

## Neat Resin Properties

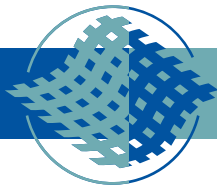
Specific gravity	1.25
T <sub>g</sub> dry*	550°F (288°C)
T <sub>g</sub> wet*	> 400°F (204°C)
Equilibrium moisture absorption	4.1%
Coefficient of thermal expansion	
Temperature range	75–482°F = 2.66 x 10 <sup>-5</sup> in/in/°F 24–250°C = 4.78 x 10 <sup>-5</sup> mm/mm/°C
Temperature range	347–482°F = 3.55 x 10 <sup>-5</sup> in/in/°F 175–250°C = 6.32 x 10 <sup>-5</sup> mm/mm/°C
Fracture toughness, K <sub>1C</sub>	1.25 ksi√in (1.37 MPa√m)

### Dynamic Viscosity Analysis

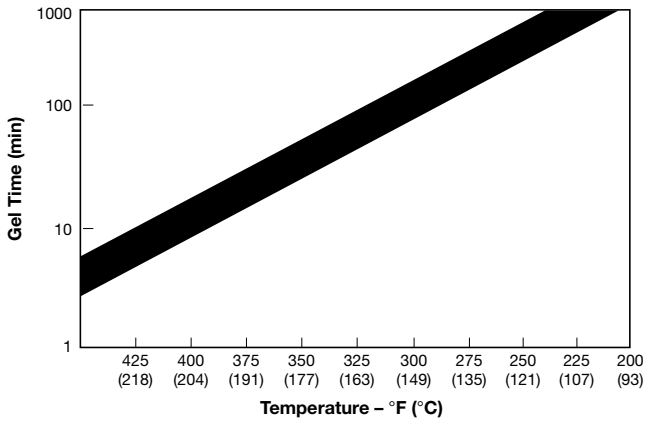


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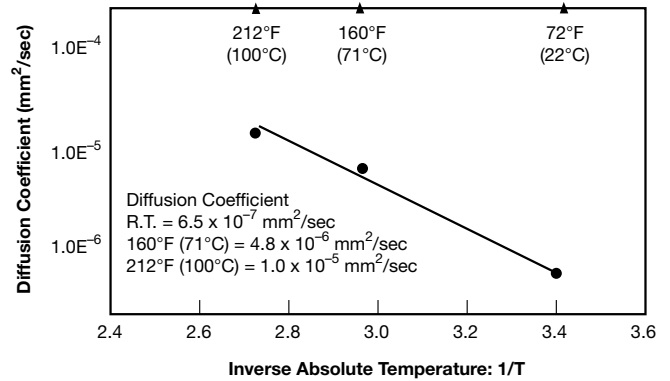




**Gel Time vs Temperature**



**Neat Resin Hydrothermal Behavior**



## Cure Procedure

### Thin Laminates: ≤ 0.50" (1.27 cm)

- Apply vacuum of 22 inches Hg (74 kPa) minimum.
- Heat to 270 ± 5°F at 2–4°F/minute (132°C at 1.2–2.4°C/minute). Apply 85 ± 5 psig (586 kPa).
- Dwell at 270 ± 5°F (132°C ± 3°C) for 30 ± 5 minutes. Release vacuum.
- Heat to 375°F at 2–4°F/minute (191°C at 1.2–2.4°C/minute); cure 4 hours.
- Cool to 150°F at 5°F/minute (66°C at 3°C/minute) before releasing pressure.

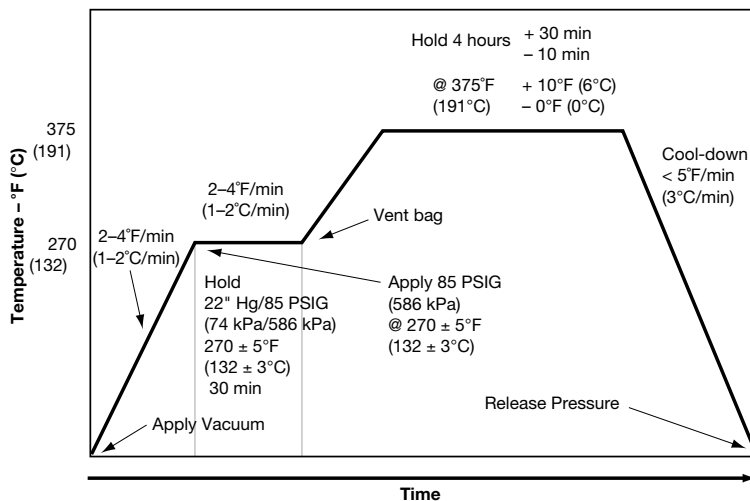
### Thick Laminates: > 0.50" (1.27 cm)

Laminates may be cured with modified cure cycle.

## Postcure Procedure

- Postcure 16 hours at 450°F (232°C) (free-standing oven).
- Raise temperature from ambient to 375°F at a rate of 5–10°F/minute (191°C at a rate of 3–6°C/minute) and at a rate of 1–2°F/minute (0.6–1.2°C/minute) above 375°F (191°C).

Note: Alternate postcure cycle: 6 hrs at 470°F (243°C) using same rates as standard.



## Availability

Form	Hexcel Designation	Fiber	Fiber Areal Wt. g/m <sup>2</sup>	Weave	Count Warp x Fill	Widths Available in (cm)
Carbon Tape	T2T145-12"-F655	T300-12K	145	n/a		2"-24" (5.08-60.96 cm)
	T9A145-12"-F655	IM7-12K	145	n/a		2"-24" (5.08-60.96 cm)
Carbon Fabrics	W3T282-42-F655 Plain Weave	T300-3K	194	Plain	12.5 x 12.5	42" (106.68 cm)
	F3T584-42-F655 8 H.S.	T300-3K	370	8 H.S.	24 x 24	42" (106.68 cm)

Note: Carbon tapes may be produced with various carbon fiber types and tow sizes. In designating tape, the second digit represents tow size and the third digit represents fiber source. Consult your nearest Hexcel Sales Representative for additional information.

## Physical Properties

	Property	Carbon Tape	Carbon Fabric
Prepreg	Material description	T2T145	T9A145 (IM7)
	% Volatile content	< 2	< 2
	% Resin content (dry)	33-37	33-37
Laminate	Cured thickness per ply: in (cm)	0.0053-0.0061 (0.013-0.015 cm)	0.0053-0.0061 (0.013-0.015 cm)
	% Fiber volume	55-59	54-59
	Density (g/cm <sup>3</sup> )	1.53-1.56	1.53-1.56

## Dielectric Properties

Material	Frequency (GHz)	Temperature °F (°C)	Dielectric Constant Accuracy ± 2%	Loss Tangent Accuracy ± 1/2 Significant Figure
F655 Resin Casting*	3	75 (24)	3.08	0.004
		300 (149)	3.14	0.005
		450 (232)	3.19	0.006
	9	75 (24)	3.04	0.005
		300 (149)	3.09	0.006
		450 (232)	3.15	0.007
	16	75 (24)	2.98	0.006
		300 (149)	3.04	0.007
		450 (232)	3.11	0.008
Astro Quartz II/F655 Dry	49	75 (24)	3.44	0.003
Astro Quartz II/F655 Wet	49	75 (24)	3.60	0.012
E-Glass/F655 Dry	49	75 (24)	4.44	0.0065
E-Glass/F655 Wet	49	75 (24)	4.65	0.0145

\* Testing method: ASTM D2520

## Laminate Mechanical Properties

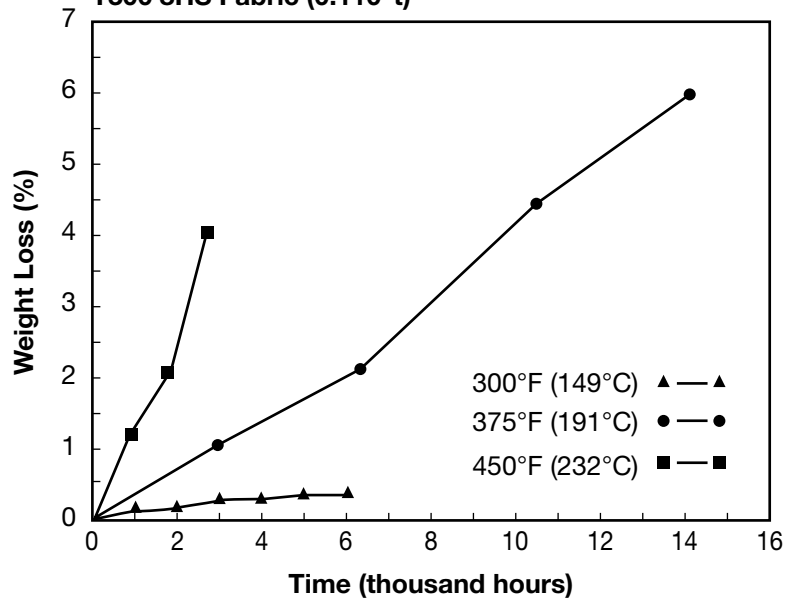
Properties	Carbon Tapes							
	T300 (6K)				IM7 (12K)			
	RT	350°F (177°C)	450°F (232°C)	350°F(W) (177°C)	RT	350°F (177°C)	450°F (232°C)	350°F(W) (177°C)
<b>Autoclave Cured</b>								
<b>Tension (0°)<sub>8</sub></b>								
Strength: ksi (MPa)	220.0 (1517)				396.0 (2730)		292.0 (2013)	300.0 (2068)
Modulus: msi (GPa)	20.70 (142.7)				23.3 (160.6)		23.7 (163.4)	23.9 (164.8)
Strain: %	1.04				1.61			
<b>Tension (90°)<sub>16</sub></b>								
Strength: ksi (MPa)					9.53 (66)		6.15 (42)	2.33 (16)
Modulus: msi (GPa)					1.33 (9.2)		1.14 (7.9)	0.871(6.0)
Strain: $\mu$ in/in					7668		6215	2875
<b>Compression (0°)<sub>8</sub></b>								
Strength: ksi (MPa)	242.4 (1671)	228.5 (1575)		164.3 (113.3)	314.3 (2167)		171.3 (1181)	140.4 (968)
<b>Flexure (0°)<sub>16</sub></b>								
Strength: ksi (MPa)	308.5 (2127)	240.0 (1655)	195.9 (1351)	161.0 (1110)				
Modulus: msi (GPa)	20.0 (137.9)	20.1 (138.6)	20.7 (142.7)	18.5 (127.6)				
<b>Flexure (90°)<sub>16</sub></b>								
Strength: ksi (MPa)	20.1 (138)	15.5 (107)	11.6 (80)	7.0 (48)				
Modulus: msi (GPa)	1.43 (9.9)	1.31 (9.0)	1.11 (7.7)	0.77 (5.3)				
<b>Short Beam Shear (0°)<sub>16</sub></b>								
Strength: ksi (MPa)	20.6 (142)	12.7 (88)	9.7 (67)	8.0 (55)	18.8 (130)		7.57 (52)	7.57 (52)
<b>Tension (<math>\pm 45^\circ</math>)<sub>2s</sub></b>								
Strength: ksi (MPa)	31.4 (216)	29.3 (202)		21.0 (148)				
Modulus: msi (GPa)	2.39 (16.5)	2.28 (15.7)		0.94 (6.5)				
<b>Shear (<math>\pm 45^\circ</math>)<sub>2s</sub></b>								
Strength: ksi (MPa)	15.7 (108)	14.6 (101)		10.5 (72)	18.2 (125)		11.5 (79)	10.8 (74)
Modulus: msi (GPa)	0.71 (4.9)	0.63 (4.3)			0.75 (5.2)		0.56 (3.9)	0.40 (2.8)
<b>Edge Delamination [[<math>\pm 25^\circ</math>]<sub>2</sub> / 90°]<sub>s</sub></b>								
First crack stress: ksi (MPa)	50.0 (345)				35.1 (242)			
<b>Post Impact Compression (45°, 0°, -45°, 90°)<sub>4s</sub></b>								
Impact Energy 270 in-lb, class 1*								
Strength: ksi (MPa)	31.6 (218)				35.2 (243)			
Modulus: msi (GPa)	6.18 (42.6)				7.5 (51.7)			
Strain: $\mu$ in/in	5091				4665			
Damage area: in <sup>2</sup> (cm <sup>2</sup> )	1.84 (11.9)				1.87 (12.1)			
<b>Post Impact Compression (45°, 0°, -45°, 90°)<sub>4s</sub></b>								
Impact energy 1500 in-lb, class 2*								
Strength: ksi (MPa)	23.8 (164)				30.7			
Modulus: msi (GPa)	5.65 (38.9)				7.5			
Strain: $\mu$ in/in	4268				3672			
Damage area: in <sup>2</sup> (cm <sup>2</sup> )	2.26 (14.6)				3.50 (22.6)			
<b>Mode I Strain Energy Release Rate</b>								
G <sub>IC</sub> in-lb/in <sup>2</sup> (kJ/m <sup>2</sup> ) – Dry (0°) <sub>20</sub>					1.91 (0.34)			
<b>Mode II Strain Energy Release Rate</b>								
G <sub>IIC</sub> in-lb/in <sup>2</sup> (kJ/m <sup>2</sup> ) – Dry (0°) <sub>20</sub>					3.85 (0.68)			
<b>Open Hole Compression (+45°, 0°, -45°, 90°)<sub>2s</sub></b>								
Strength: ksi (MPa)					48.8 (336)		41.4 (285)	35.3 (243)

\* BSS 7260, Rev. C

Properties	Carbon Fabric – T300, Plain Weave				
	-75°F (-59°C)	RT (AMC)	450°F (232°C) (AMC)	450°F (232°C) (D)	350°F (177°C) (W)
Fill tensile strength, ksi (MPa)	83.3 (574)	96.5 (665)	84.0 (579)	92.6 (638)	83.1 (573)
Fill tensile modulus, msi (GPa)	9.4 (64.8)	8.9 (61.4)	8.7 (60.0)	–	8.8 (60.7)
Fill compression strength, ksi (MPa)	161.2 (1111)	129.9 (896)	64.6 (445)	–	60.9 (420)
Fill compression modulus, msi (GPa)	8.51 (58.7)	8.4 (57.9)	–	8.32 (57.4)	8.5 (58.6)
Fill SBS, ksi (MPa)	14.2 (97.88)	13.7 (94.41)	5.5 (37.90)	7.5 (51.68)	6.30 (43.41)

W = wet  
D = dry

**Isothermal Aging – Weight Loss (in air)**  
**T300 8HS Fabric (0.110"t)**





## **With Respect to All Data Herein Contained**

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Reported property values are typical averages to which no statistical assurance should be associated. While Hexcel believes that the data contained herein are factual, the data are not to be taken as a warranty or representation for which Hexcel assumes legal responsibility. They are offered solely for your consideration, investigation, and verification.

## **Storage**

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HexPly® F655™ prepreg should be sealed in a polyethylene bag and refrigerated, preferably below 32°F (0°C). Following removal from refrigerated storage, allow the prepreg to reach room temperature before opening the polyethylene bag to avoid moisture condensation. Shelf life: 12 months at 0°F (-18°C), 6 months at 40°F (4°C).

## **Shipping**

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Prepreg fabric and tape are generally shipped in sealed polyethylene bags in insulated containers packed with dry ice.

## **Disposal of Scrap**

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Disposal of this material should be in a secure landfill in accordance with state and federal regulations.

## **Handling and Safety Precautions**

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Hexcel recommends that customers observe established precautions for handling polyimide resins and fine fibrous materials. Operators working with this product should wear clean, impervious gloves to reduce the possibility of skin contact and to prevent contamination of the material.

Airborne graphite as a result of sawing, grinding, etc., can present electrical shorting hazards; refer to NASA Technical Memorandum 78652. Material Safety Data Sheets (MSDS) have been prepared for all Hexcel products and are available to company safety officers on request from your nearest Hexcel Sales Office.

## **Important**

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Hexcel Corporation believes, in good faith, that the technical data and other information provided herein is materially accurate as of the date this document is prepared. Hexcel reserves the right to modify such information at any time. The performance values in this data sheet are considered representative but do not and should not constitute specification minima. The only obligations of Hexcel, including warranties, if any, will be set forth in a contract signed by Hexcel or in Hexcel's then current standard Terms and Conditions of Sale as set forth on the back of Hexcel's Order Acknowledgement.

## **For more Information**

Hexcel is a leading worldwide supplier of composite materials to aerospace and other demanding industries. Our comprehensive product range includes:

- Carbon Fibre
- RTM Materials
- Honeycomb Cores
- Continuous Fiber Reinforced Thermoplastics
- Carbon, Glass, Aramid and Hybrid Prepregs
- Structural Film Adhesives
- Honeycomb Sandwich Panels
- Special Process Honeycombs
- Reinforced Fabrics

For EU quotes, orders and product information call toll-free 1-800-688-7734. For other worldwide sales office telephone numbers and a full address list please click here: <http://www.hexcel.com/contact/salesoffices>.