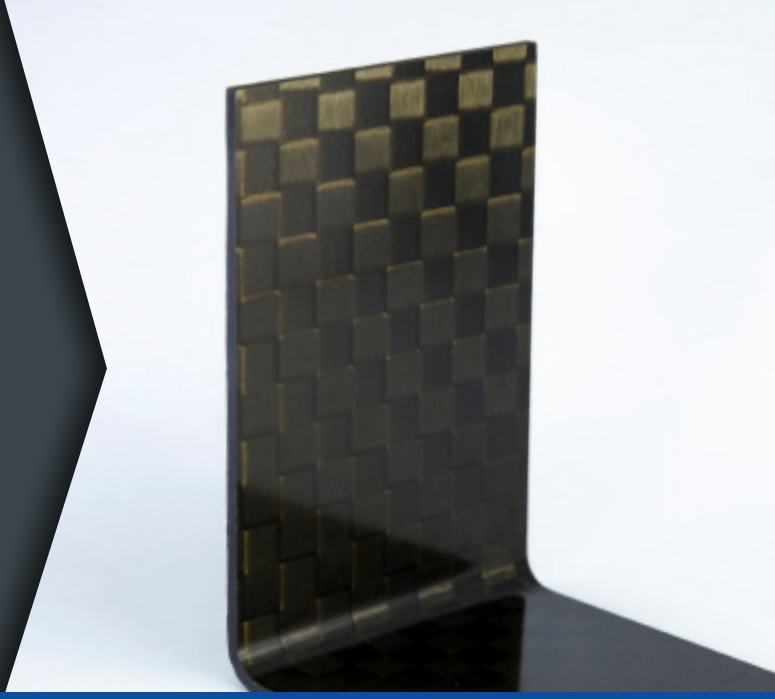
TORAY

Toray Composite Materials America, Inc.

2511 PREPREG SYSTEM

This semi-toughened epoxy prepreg system was specifically formulated for better oven cure processing than the #2510 general aviation (AGATE) prepreg system. #2511 provides excellent all-around structural properties with a high wet and dry TG while offering a flexible cure temperature (250°F to 350°F, 121°C to 177°C) with a very low void content. This prepreg system also can be used in industrial and recreational applications.



Industry Material Specification
Material procurable to CMA specification TCSPF-T-2511 or Aerospace Material Specification (AMS) 3962.

Industry Database
Select products listed in CMH-17 Vol 2. Contact us for more information.

High Heat Tolerance
High Tg is suitable for structures exposed to elevated service temperatures.

Easy Layup
Product allows complex part layup with minimal cuts or ridge lines. It maintains a comparable class A finish through post-cure, minimizing sanding and finishing times.

Readily Available
AMS products, marked with this icon, are kept in stock and ready to ship.

Flexible Cure Methods
Curing methods include autoclave or oven cure. Product can be cured with or without using a dwell.

www.toraycma.com
253-846-1777

AVAILABLE PRODUCT FORMATS

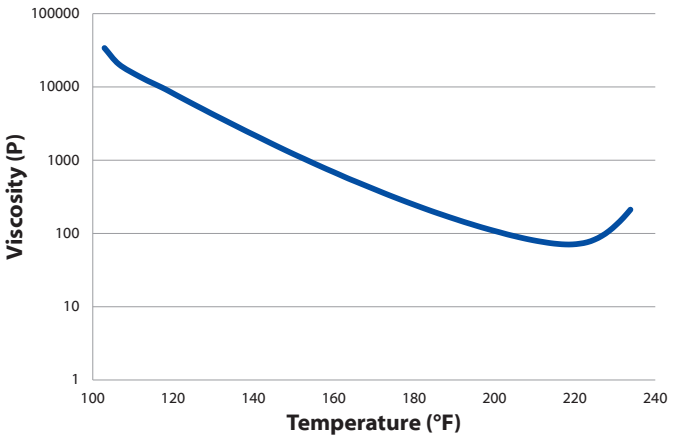
2511 resin is available with numerous types of unidirectional carbon fibers and woven and glass fabrics with Fiber Areal Weight (FAW) ranging from 70 g/m2 to 300 g/m2 and Resin Content, (RC%) by weight percent, ranging from 24% to 44%. The table below lists commonly available product formats. Unidirectional products can be slit to widths between 1/8" and 60", and fabric products to widths above 6". Common product formats include: 1/4", 1/2", 1", and 1.5" AFP spools (UD only); 6", 500mm, 9", and 12" ATL rolls; and 24" to full width rolls for hand layup.

PART NUMBER	FIBER FORMAT	FIBER TYPE/STYLE	FAW (GSM)	RC % WEIGHT	ROLL WIDTH (IN)
P711AG-15	Unidirectional	T700GC-12K-31E	150	35	39
F6273C-11M (AMS 3962)	Plain Weave	T700SC-12K-50C	190	42	38
P211AS-200	Unidirectional	T800SC-24K-10E	200	35	60
FM6673G-11M	Plain Weave	T830HB-6K-41B	196	42	60
P6111-200	Unidirectional	M46JB-12K-50C	200	38	39
F4289-11M	Plain Weave	M46JB-6K-50C	202	42	39
FGF108-11M	Plain Weave	Style 108 E-Glass	48	42	38

NEAT RESIN PHYSICAL PROPERTIES

PROPERTY	METHOD	UNITS	VALUE
Density	ASTM D792	g/cc	1.267
Tg (Dry)	ASTM D7028	°F (°C)	324 (162)
Tg (Wet)	ASTM D7028	°F (°C)	244 (118)
K_{IC}	ASTM D5045	$ksi*in^{0.5}$	0.75
Minimum Viscosity	ASTM D4440	Poise	70.8
		°F (°C)	218 (103)

RESIN VISCOSITY CURVE



STORAGE LIFE

Out Life	28 days @ 75 °F (24 °C)
Freezer Life	24 months @ <10 °F (-12 °C)

Notes:
CTA: -65°F (-54°C), Ambient
RTA: 72°F (22°C), Ambient
ETW: 180°F (82°C), conditioned at 160°F/85% RH until equilibrium
Tension and compression values are normalized to the indicated CPT values

For more information or purchasing inquiries:
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LAMINA/LAMINATE MECHANICAL PROPERTIES: F6273C-11M (T700S-12K PW)

PROPERTY	SYMBOL	METHOD	UNITS	CTA	RTA	ETW
0° Tensile Strength	F_{1t}	ASTM D3039	Ksi (MPa)	145 (1000)	158 (1089)	158 (1089)
90° Tensile Strength	F_{2t}	ASTM D3039	Ksi (MPa)	141 (972)	144 (993)	131 (903)
0° Tensile Modulus	E_{1t}	ASTM D3039	Msi (GPa)	8.49 (58.5)	8.58 (59.2)	9.12 (62.9)
90° Tensile Modulus	E_{2t}	ASTM D3039	Msi (GPa)	8.25 (56.9)	8.23 (56.7)	8.59 (59.2)
0° Compressive Strength	F_{1c}	ASTM D6641	Ksi (MPa)	106 (731)	97.7 (674)	74.6 (514)
90° Compressive Strength	F_{2c}	ASTM D6641	Ksi (MPa)	104 (717)	92.6 (638)	65.5 (452)
0° Compressive Modulus	E_{1c}	ASTM D6641	Msi (GPa)	7.15 (49.3)	7.73 (53.3)	8.4 (57.9)
90° Compressive Modulus	E_{2c}	ASTM D6641	Msi (GPa)	7.22 (49.8)	7.04 (48.5)	8.18 (56.4)
In-Plane Shear Strength @ 5%	F_{12}	ASTM D5379	Ksi (MPa)	17.2 (119)	12.5 (86.2)	6.92 (47.7)
In-Plane Shear Modulus	G_{12}	ASTM D5379	Msi (GPa)	0.695 (4.79)	0.582 (4.01)	0.429 (2.96)
Short Beam Shear Strength	SBS	ASTM D2344	Ksi (MPa)	10.1 (69.6)	9.83 (67.8)	4.63 (31.9)
Poisson's Ratio	v_{12}	ASTM D3039	-	0.057	0.054	0.024
Open Hole Compression Strength (QI: 25/50/25)	OHC	ASTM D6484	Ksi (MPa)	49.1 (339)	39.5 (272)	30.4 (210)
Compression After Impact @ 1500 in-lb/in (QI: 25/50/25)	CAI	ASTM D7137	Ksi (MPa)	28.3 (195)	25.9 (179)	19.9 (137)
Laminate Density	ρ	ASTM D792	g/cc		1.51	
Fiber Volume Fraction	V_f	ASTM D3171	%		48.2	
Cured Ply Thickness	CPT	-	Inches (mm)		0.0086 (0.218)	

LAMINA/LAMINATE MECHANICAL PROPERTIES: P711AG-15 (T700G-12K UD)

PROPERTY	SYMBOL	METHOD	UNITS	CTA	RTA	ETW
0° Tensile Strength	F_{1t}	ASTM D3039	Ksi (MPa)	272 (1847)	321 (2212)	272 (1874)
0° Tensile Modulus	E_{1t}	ASTM D3039	Msi (GPa)	17.8 (123)	17.6 (121)	17.8 (123)
0° Compressive Strength	F_{1c}	SACMA SRM 1	Ksi (MPa)	235 (1619)	231 (1592)	166 (1144)
In-Plane Shear Strength @ Ultimate	F_{12}	ASTM D3518	Ksi (MPa)	-	25.0 (172)	-
Short Beam Shear Strength	SBS	ASTM D2344	Ksi (MPa)	-	15.4 (106)	-
Open Hole Compression Strength (QI: 25/50/25)	OHC	ASTM D6484	Ksi (MPa)	-	42.8 (295)	34.2 (236)
Compression After Impact (QI: 25/50/25)	CAI	ASTM D7137	Ksi (MPa)	-	26.2 (181)	-
Fiber Volume Fraction	V_f	ASTM D3171	%	-	54.7	-
Cured Ply Thickness	CPT	-	Inches (mm)	-	0.0058 (0.148)	-

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LAMINA/LAMINATE MECHANICAL PROPERTIES: P211AS-200 (T800S-24K UD)

PROPERTY	SYMBOL	METHOD	UNITS	RTA	ETW
0° Tensile Strength	F_{1t}	ASTM D3039	Ksi (MPa)	405 (2792)	-
90° Tensile Strength	F_{2t}	ASTM D3039	Ksi (MPa)	7.4 (51)	2.7 (18.6)
0° Tensile Modulus	E_{1t}	ASTM D3039	Msi (GPa)	21.1 (145)	-
90° Tensile Modulus	E_{2t}	ASTM D3039	Msi (GPa)	1.3 (9)	-
0° Compressive Strength	F_{1c}	ASTM D6641	Ksi (MPa)	180 (1241)	-
90° Compressive Strength	F_{2c}	ASTM D6641	Ksi (MPa)	32 (221)	17.6 (121)
0° Compressive Modulus	E_{1c}	ASTM D6641	Msi (GPa)	18 (124)	-
90° Compressive Modulus	E_{2c}	ASTM D6641	Msi (GPa)	1.3 (9)	1.2 (8.3)
In-Plane Shear Strength @ 5%	F_{12}	ASTM D5379	Ksi (MPa)	13.1 (90.3)	7.6 (52.4)
In-Plane Shear Modulus	G_{12}	ASTM D5379	Msi (GPa)	0.55 (3.79)	0.49 (3.38)
Short Beam Shear Strength	SBS	ASTM D2344	Ksi (MPa)	13.3 (91.7)	-
Open Hole Compression Strength (QI: 25/50/25)	OHC	ASTM D6484	Ksi (MPa)	43 (296)	33.7 (232)
Laminate Density	ρ	ASTM D792	g/cc		
Fiber Volume Fraction	V_f	ASTM D3171	%		
Cured Ply Thickness	CPT	-	Inches (mm)		

LAMINA/LAMINATE MECHANICAL PROPERTIES: FM6673G-11M (T830H-6K PW)

PROPERTY	SYMBOL	METHOD	UNITS	RTA	ETW
90° Tensile Strength	F_{2t}	ASTM D3039	Ksi (MPa)	123 (848)	
90° Tensile Modulus	E_{2t}	ASTM D3039	Msi (GPa)	9.89 (68.2)	
90° Compressive Strength	F_{2c}	ASTM D6641	Ksi (MPa)	96.1 (6.63)	
90° Compressive Modulus	E_{2c}	ASTM D6641	Msi (GPa)	8.82 (60.8)	
In-Plane Shear Strength @ 5%	F_{12}	ASTM D5379	Ksi (MPa)	16.3 (112)	8.14 (56.1)
In-Plane Shear Modulus	G_{12}	ASTM D5379	Msi (GPa)	0.51 (3.52)	0.42 (2.9)
Short Beam Shear Strength	SBS	ASTM D2344	Ksi (MPa)	8.91 (61.4)	
Open Hole Compression Strength (QI: 25/50/25)	OHC	ASTM D6484	Ksi (MPa)	39.9 (275)	34.8 (240)
Laminate Density	ρ	ASTM D792	g/cc		
Fiber Volume Fraction	V_f	ASTM D3171	%		
Cured Ply Thickness	CPT	-	Inches (mm)		

LAMINA/LAMINATE MECHANICAL PROPERTIES: P6111-200 (M46J UD)

PROPERTY	SYMBOL	METHOD	UNITS	RTA
0° Tensile Strength	F_{1t}	ASTM D3039	Ksi (MPa)	244 (1682)
90° Tensile Strength	F_{2t}	ASTM D3039	Ksi (MPa)	7.4 (51)
0° Tensile Modulus	E_{1t}	ASTM D3039	Msi (GPa)	32.6 (225)
90° Tensile Modulus	E_{2t}	ASTM D3039	Msi (GPa)	1.3 (9)
0° Compressive Strength	F_{1c}	ASTM D6641	Ksi (MPa)	120 (827)
90° Compressive Strength	F_{2c}	ASTM D6641	Ksi (MPa)	32 (221)
0° Compressive Modulus	E_{1c}	ASTM D6641	Msi (GPa)	26.2 (181)
90° Compressive Modulus	E_{2c}	ASTM D6641	Msi (GPa)	1.3 (9)
In-Plane Shear Strength @ 5%	F_{12}	ASTM D5379	Ksi (MPa)	10 (68.9)
In-Plane Shear Modulus	G_{12}	ASTM D5379	Msi (GPa)	0.55 (3.79)
Short Beam Shear Strength	SBS	ASTM D2344	Ksi (MPa)	9.4 (64.8)
Open Hole Compression Strength (QI: 25/50/25)	OHC	ASTM D6484	Ksi (MPa)	31.1 (214)
Laminate Density	ρ	ASTM D792	g/cc	1.52
Fiber Volume Fraction	V_f	ASTM D3171	%	51
Cured Ply Thickness	CPT	-	Inches (mm)	0.0084 (0.213)

LAMINA/LAMINATE MECHANICAL PROPERTIES: F4829-11M (M46J-6K PW)

PROPERTY	SYMBOL	METHOD	UNITS	RTA
90° Tensile Strength	F_{2t}	ASTM D3039	Ksi (MPa)	83 (572)
90° Tensile Modulus	E_{2t}	ASTM D3039	Msi (GPa)	13.8 (95.1)
90° Compressive Strength	F_{2c}	ASTM D6641	Ksi (MPa)	70.2 (484)
90° Compressive Modulus	E_{2c}	ASTM D6641	Msi (GPa)	12 (82.7)
In-Plane Shear Strength @ 5%	F_{12}	ASTM D5379	Ksi (MPa)	9.3 (64.1)
In-Plane Shear Modulus	G_{12}	ASTM D5379	Msi (GPa)	0.57 (3.93)
Short Beam Shear Strength	SBS	ASTM D2344	Ksi (MPa)	6.7 (46.2)
Open Hole Compression Strength* (25/50/25)	OHC	ASTM D6484	Ksi (MPa)	31.4 (216)
Fiber Volume Fraction	V_f	ASTM D3171	%	48.4
Cured Ply Thickness	CPT	-	Inches (mm)	0.0094 (0.239)

LAMINA/LAMINATE MECHANICAL PROPERTIES: FGF108-11M

PROPERTY	SYMBOL	METHOD	UNITS	CTA	RTA	ETW
Cured Ply Thickness	CPT	-	Inches (mm)		0.0016 (0.0406)	

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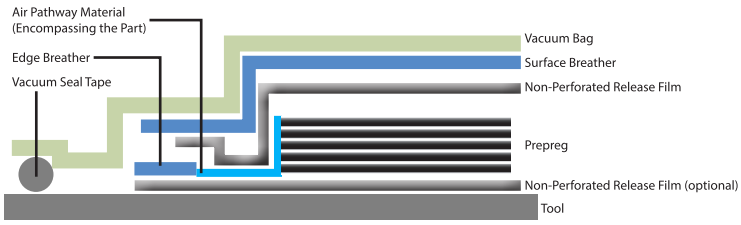
BAGGING PROCEDURE



Notes:

1. During layup, debulk after the first ply and then every 4 plies or as needed
2. It is recommended that panels have a pre-cure vacuum hold depending on size: for small panels 1 hour, for medium sized panels (>1ft^2) for 3 hours, and for complex layups (ply drops, >2ft^2) for 16+ hours.
3. The vacuum should be checked for leaks before beginning the cure cycle. The leak rate shall be less than 2.0 inches of Hg (7 kPa) over 5 minutes.

Please refer to the SDS for handling and disposal.

RECOMMENDED OVEN CURE CYCLE

1. Apply full vacuum* to the part. A pre-cure hold under vacuum is recommended based on panel size to minimize voids when curing OOA.
2. Ramp to 190 ± 10°F at 3 ± 1°F/min (88 ± 5°C at 0.6-2.8°C/min) and hold for 90-120 minutes.
3. Ramp to 270 ± 10°F at 3 ± 1°F/min (132 ± 5°C at 0.6-2.8°C/min) and hold for 120-150 minutes.
4. Cool oven to 140°F at a max rate of 5°F/min (54°C at 2.8°C/min) before releasing vacuum.

** Required vacuum level varies depending on elevation. 28" Hg (95 kPa) is the recommended minimum at sea level under average conditions.*