NTPT THINPREG™ 135
DATA SHEET

INTRODUCTION

ThinPreg™ 135 is a breakthrough product combining high strength and high toughness in a thin ply format. The PES-toughened epoxy system shows compression after impact properties typical of 3rd generation aerospace matrices. Thin ply materials achieve higher usable properties from the fibre through spreading load more consistently though the laminate and delaying first ply failure. Negligible ply drop-off effects and greater degrees of freedom in design are now combined with a PES-toughened system for high resolution, highly optimised, super-strong composite structures.

This hot-melt epoxy prepreg is recommended to be cured at 150°C (302°F) for a Tg of > 150°C . This matrix has a good out-life of up to 12 weeks at 18-22°C (64-72°C). ThinPreg™ 135 offers excellent mechanical properties on a wide variety of fibres, and fibre weights.

PRODUCT FEATURES

- High-strength, high-toughness, high Tg prepreg system
- Autoclave and press curable
- Can be processed with vacuum-only processing
- Cure 4h at 150°C.
- Suitable tack for most hand layup and automated tape placement processes
- Ideal for prepreg with fibre weights from 30gsm to 150gsm

PURPOSE

ThinPreg™ 135 is commonly used in autoclave processes and press moulding. It can also be used for vacuum bagging processes.

ThinPreg™ 135 achieves very high mechanical properties (ILSS~100MPa, G1C~718J/m^2) and achieves remarkable Tg (149°C for a 135°C cure, or 170°C for a 150°C cure), maximum dry Tg 205°C. It is suitable for structural parts in demanding applications such as motorsport and aerospace.

NTPT prepreg products are often used with automated tape laying machines (ATL). Our products are formatted both for ATL and for manual layup

PRODUCT FORMAT

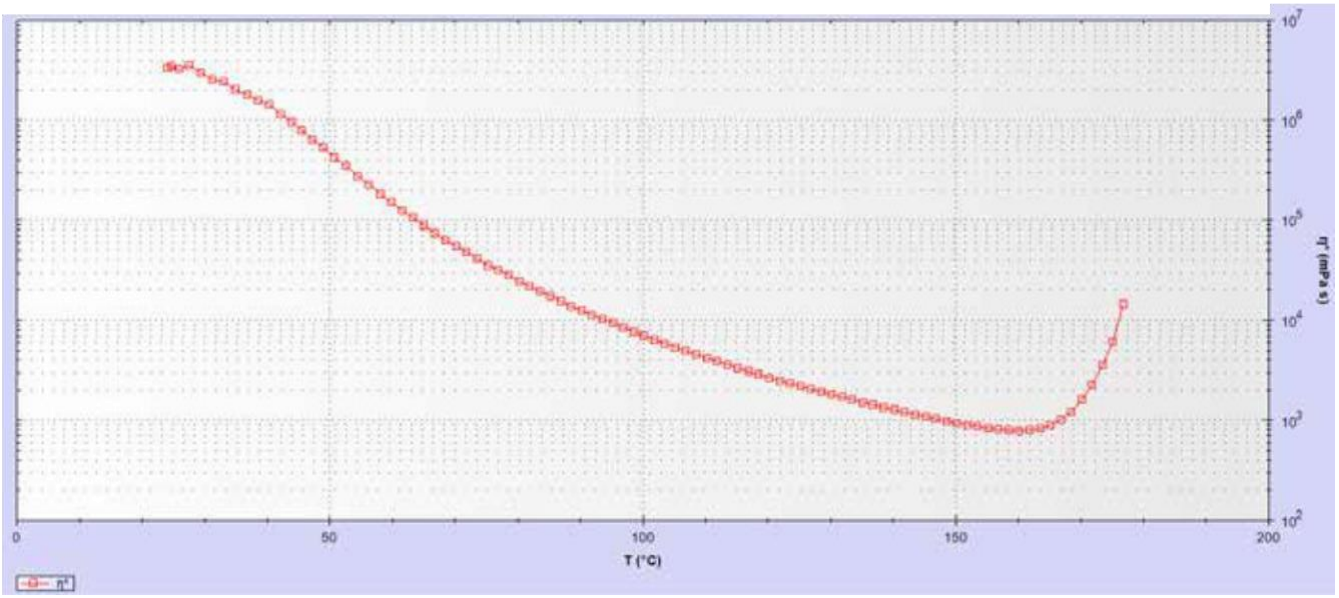
THINPREG™ 135 PRODUCT FORMAT		
	Hand Layup	ATL
Paper	Yes	Yes
Polythene Film	Yes	No
Width (mm)	300	300
Available FAW (gsm)	Custom	
	50	
	75	
	100	
	150	

Please contact Customer Support to discuss specific requirements and availability.

TYPICAL CHARACTERISTICS

Rheology

ThinPreg™ 135 resin viscosity profile conducted at 2°C/minute (3.6°F/minute)



TYPICAL CHARACTERISTICS

Unidirectional laminate properties

Cured using 6 bars autoclave curing processing techniques and a minimum cure time of 240 minutes at 150°C (275°F).

		135/HS40/29g				135/HS40/67g				
Property	Symbol	HS40 carbon fiber 29gsm				HS40 carbon fiber 67gsm				Test Standard
		SI		Imperial		SI		Imperial		
Fiber Density	ρ_{fiber}	1.81	g/cm³	0.065	lb/in³	1.81	g/cm³	0.065	lb/in³	-
Fiber Modulus	E_{fiber}	455	Gpa	65.99	Msi	455	Gpa	65.99	Msi	-
Fiber Strength	X_{fiber}	4610	Mpa	669	ksi	4610	Mpa	669	ksi	-
Resin Content	%	38%				34%				ASTM D3171 Method II
Cured Ply Density	ρ_{ply}	1.62	g/cm3	0.100	lb/in3	1.62	g/cm3	0.100	lb/in3	ASTM D792
Glass Transition Temperature	T_{g1}	168°C		284°F		168°C		284°F		ISO 6721
Cured Ply Thickness	T_{ply}	0.029 mm		0.0011in		0.062mm		0.0024in		ASTM D3171 Method II
0° Tensile Cured Fiber Volume	V_f	57.0%				57.0%				ISO 527-4
0° Tensile Strength (Normalized to 60%)	X_T	2290	Mpa	332.1	ksi	2190	Mpa	317.6	ksi	ISO 527-4
90° Tensile Strength (Normalized to 60%)	X_T	*tba*	Mpa	*tba*	ksi	41	Mpa	6.0	ksi	ISO 527-4
90° Tensile Modulus (Normalized to 60%)	X_T	*tba*	Mpa	*tba*	ksi	*tba*	Mpa	*tba*	ksi	ISO 527-4
0° Compressive Strength Fiber Volume	v_{11}	57.0%				57.0%				ASTM D3171 Method II
0° Compressive Strength (Normalized to 60%)	X_C	1115	Mpa	161.66	ksi	1057.00	Mpa	153.31	ksi	SACMA SRM1-94
0° Compressive Modulus Fiber Volume	V_f	57.0%				57.0%				ASTM D3171 Method II
0° Compressive Modulus (Normalized to 60%)	E_{c11}	232	Gpa	32.92	Msi	237	Gpa	34.37	Msi	SACMA SRM1-94
+-45° IPS Fiber Volume	V_f	57.0%				57.0%				ASTM D3171 Method II
+-45° In Plane Shear Strength	$\tau_{12\,u}$	*tba*	Mpa	*tba*	ksi	81.00	Mpa	11.75	ksi	ISO 14129
+-45° In Plane Shear Modulus	G_{12}	*tba*	Gpa	*tba*	Msi	5.0	Gpa	0.73	Msi	ISO 14129
0° ILSS Fiber Volume	V_f	57.0%								ASTM D3171 Method II
0° ILSS	X_{ILSS}	96	Mpa	13.92	ksi	83	Mpa	12.0	ksi	ISO 14130
G1C mode I - initiation	G_{1C}^{VIS}	*tba*	Mpa	*tba*	ksi	tba	Mpa	tba	ksi	ASTM D5528 - 01 (2007)
G1C mode I - 100mm propagation	$G_{1C}^{5\%}$	*tba*	Mpa	*tba*	ksi	tba	Mpa	tba	ksi	ASTM D5528 - 01 (2007)
G1C mode I - ultimate	G_{1C}	*tba*	Mpa	*tba*	ksi	tba	Mpa	tba	ksi	ASTM D5528 - 01 (2007)

tba = to be advised, product currently being measured, data to follow

TYPICAL CHARACTERISTICS

Unidirectional laminate properties (cont.)

Cured using 6 bars autoclave curing processing techniques and a minimum cure time of 240 minutes at 150°C (275°F).

135/T800/67g

Property	Symbol	IMC* carbon Fiber 67gsm			
		SI		Imperial	
Fiber Density	ρ_{fiber}	1.8	g/cm³	0.065	lb/in³
Fiber Modulus	E_{fiber}	294	Gpa	42.64	Msi
Fiber Strength	X_{fiber}	5880	Mpa	853	ksi
Resin Content	%	34%			
Cured Ply Density	ρ_{ply}	1.62	g/cm3	0.100	lb/in3
Glass Transition Temperature	T_{g1}	168°C		284°F	
Cured Ply Thickness	T_{ply}	0.063mm		0.0025in	
0° Tensile Cured Fiber Volume	V_f	58.3%			
0° Tensile Strength (Normalized to 60%)	X_T	3028	Mpa	439.14	ksi
90° Tensile Strength (Normalized to 60%)	X_T	*tba*	Mpa	*tba*	ksi
90° Tensile Modulus (Normalized to 60%)	X_T	*tba*	Mpa	*tba*	ksi
0° Compressive Strength Fiber Volume	v_{11}	58.3%			
0° Compressive Strength (Normalized to 60%)	X_C	1343	Mpa	194.79	ksi
0° Compressive Modulus Fiber Volume	V_f	58.3%			
0° Compressive Modulus (Normalized to 60%)	E_{c11}	130	Gpa	18.85	Msi
+-45° IPS Fiber Volume	V_f	58.3%			
+-45° In Plane Shear Strength	$\tau_{12\,u}$	153.97	Mpa	22.33	ksi
+-45° In Plane Shear Modulus	G_{12}	4.7	Gpa	0.68	Msi
0° ILSS Fiber Volume	V_f	58.3%			
0° ILSS	X_{ILSS}	99	Mpa	13.20	ksi
G1C mode I - initiation	$G_{1C_{VIS}}$	227	J/m²	32.92	Msi
G1C mode I - 100mm propagation	$G_{1C_{5\%}}$	616	J/m²	89.34	ksi
G1C mode I - ultimate	G_{1C}	718	J/m²	104.14	ksi

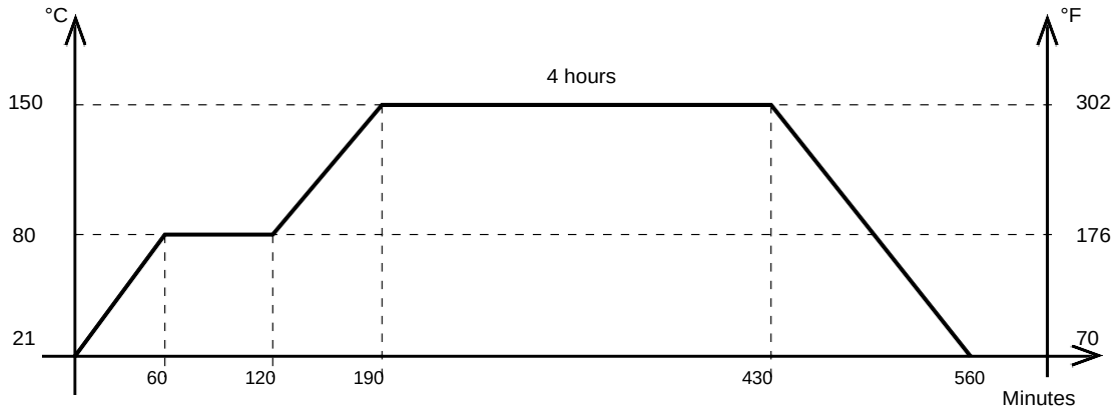
INSTRUCTIONS FOR USE

Curing cycles

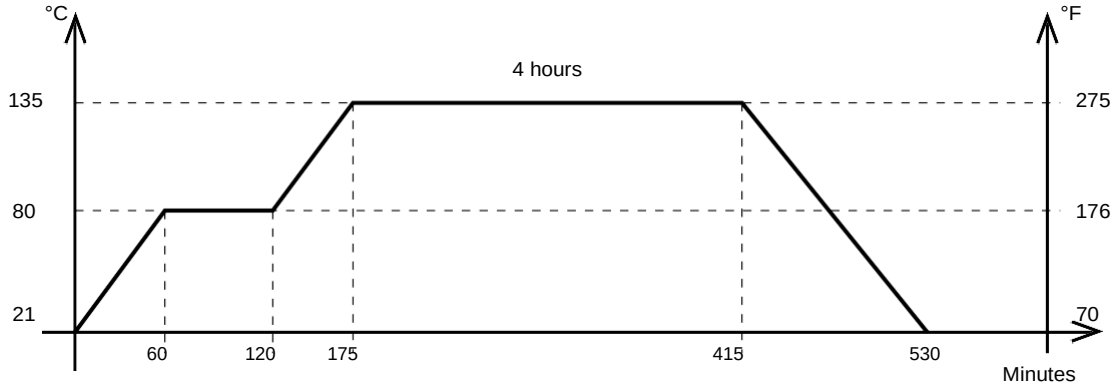
For a good balance of composite properties, the laminate should be cured at 150°C (302 F) for a minimum of 4 hours. However, there are three possible curing cycles for ThinPreg™ 135:

Curing Cycle 1: This is the cycle to use to achieve the datasheet values
Curing Cycle 2: This is a lower temperature cure schedule
Curing Cycle 3: This is the cure schedule for thicker laminates, those >2mm thick

Curing Cycle 1: Standard curing

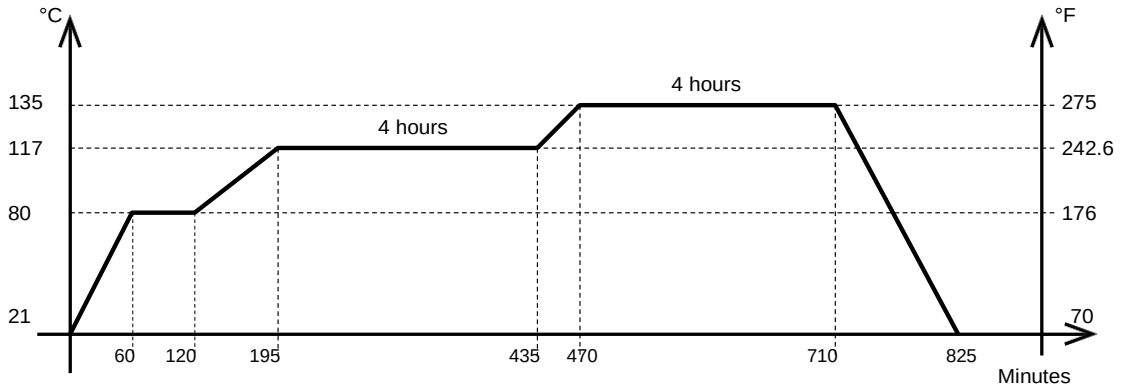


Curing Cycle 2: Lower temperature curing



Note: NTPT recommends a 4 hours at 150°C cure cycle to fully cross link the TP135 matrix resin and develop the best properties for the composite, especially if the product is foreseen to be used in a thin laminate application. A lower temperature cure cycle is possible but please note that the resin matrix may not fully cross link and may not develop its full properties using this lower temperature cure. NTPT always advises that users should perform tests and satisfy themselves on the suitability of the product and the intended cure cycle through the manufacture of and mechanical testing of tests panels before commencing the production item. Please contact NTPT Technical Services department for further advice on this point.

Curing Cycle 3: Thicker laminate curing



Attention: TP135 is a highly energetic system with a very high level of cure enthalpy within the system, typically >600J/g. In cases when TP135 is envisaged to be used in conventional or thick laminate format i.e. in every circumstance other than thin laminate performance, and specifically on laminates >2mm in thickness, extra care needs to be taken with the curing. We recommend a slow ramp rate, as well as well one or two intermediate elevated temperature dwells in the cure schedule so that cross linking energy can be managed. We recommend that precautions are taken so that in the event that an uncontrolled exothermic reaction is created, the curing laminate energy can be quickly dissipated from the component i.e. should the monitored temperature of the laminate under curing start to spike and the spike is accelerating in terms of increase in temp per second, towards 200°C, there should be some user intervention and laminate temperature should be actively managed lower. Management strategies include removing the heat source used for curing e.g. turn off the press or oven, passing cooled air over the part, or in extreme situations submerging the part in a large reservoir of cold water (can be done with the part remaining in the vacuum bag). ThinPreg™ 135 users can seek specific advice on this point by contacting NTPT's Customer Support Team. NTPT advises that in all cases trials and sample parts should be made to confirm the suitability of process parameters to confirm the intended cure cycle will produce the parts as planned. NTPT specifically limits its liabilities to zero from damages caused through the use of NTPT products in the manufacturing processes of our customers.

Material preparation

When preparing the lay-up the prepreg should be removed from the freezer and allowed to thaw in a sealed bag. This may take 6 to 24 hours depending on roll size. This prevents atmospheric moisture from condensing on the prepreg which may cause voiding on cure. The mould surface should be release coated and must have been tested for vacuum integrity prior to lay-up.

Thin laminates: When using very thin laminates (e.g. with a total laminate fibre weight of less than 300gm^2), care needs to be taken to avoid extracting excessive amounts of resin during the cure process. To avoid this, a microporous release film can be used, and for particularly critical components, a prepreg peel ply should be used.

INSTRUCTIONS FOR USE

Laying-up

The following procedure is recommended for preparing vacuum cured laminates.

1. Place the lay-up on a tool or caul sheet which has been treated with a release agent or film. Insert a thermocouple into the lay-up near the centre ply of the thickest edge section, outside the net trim line. A separate prepreg nylon peel ply is available for covering a mould tool prior to lay-up in order to leave a clean, textured surface for subsequent bonding.

2. Apply a peel ply to the surface of the lay-up. Note that for good secondary bonding of a peel-plied surface of a ThinPreg™ 135 prepreg laminate, a nylon peel ply is strongly recommended. This is particularly important where the cure temperatures are in excess of 90°C (194°F). Cover the peel ply entirely with a perforated release film. Normally, no edge resin bleeder system is used.

3. Install a vacuum bag by standard techniques. Insert at least two vacuum stems through the bag connecting one to the vacuum source and the other, at a point on the part furthest from the source, to a calibrated vacuum gauge. Position part in the oven or autoclave and draw vacuum to check for bag or system leaks.

4. Follow the recommended cure cycle as above.

5. Upon completion of cure, turn off heat and cool until part temperature has fallen below 60°C (140°F). When fully cooled, the part may be debagged, trimmed and machined as necessary. A post-cure is not required.

GENERAL INFORMATION

Storage

When stored sealed & out of direct sunlight.

Storage Temperature		Value	Unit
-18°C	0°F	24	Months
+18-22°C	+64-72°F	12	Weeks

All prepreg materials should be stored in a freezer when not in use to maximize their useable life, since the low temperature reduces the reaction of resin and catalyst to virtually zero. However, even at -18°C (0°F), the temperature of most freezers, some reaction will still occur. In most cases after some years, the material will become unworkable.

When not in use ThinPreg™ 135 products should be maintained at -18°C (0°F). To avoid contamination on their surfaces, allow rolls to reach room temperature before unwrapping.

Health and safety

ThinPreg™ 135 contains epoxy resins which can cause allergic reaction. When uncured, ThinPreg™ 135 should be handled with appropriate gloves. When cured, a composite laminate made of ThinPreg™ 135 should be cut, drilled or machined in a room equipped with an exhaust ventilation and filtration system, by operators wearing protective cloth and masks. Refer to Material Safety Data Sheet for further information.

Notice and disclaimer

The Company strongly recommends that Customers make test panels and conduct appropriate testing of any goods or materials supplied by the Company to ensure that they are suitable for the Customer's planned application. Such testing should include testing under conditions as close as possible to those to which the final component may be subjected. The Company specifically excludes any warranty of fitness for purpose of the goods other than as set out in writing by the Company.

All advice, instruction or recommendation is given in good faith but the Company only warrants that advice in writing is given with reasonable skill and care. No further duty or responsibility is accepted by the Company. All advice is given subject to the Terms and Conditions of sale (the Conditions) which are available on request from the Company. The Company reserves the right to change specifications and prices without notice and Customers should satisfy themselves that information relied on by the Customer is that which is currently published by the Company on its website. Any queries may be addressed to the Technical Services Department.

NTPT continuously reviews and updates its literature. Please ensure that you have the current version, by contacting your NTPT sales contact and quoting the revision number.

Contact

North Thin Ply Technology
Chemin du Closel 3
1020 Renens
Switzerland
Tel: +41 (0) 21 811 08 88 / sales@thinplytechnology.com / www.thinplytechnology.com