



NTPT TPI35 DATA SHEET

INTRODUCTION

TP135 is a breakthrough product combining high strength and high toughness in a thin ply format. The PES-toughened epoxy system shows outstanding compression and fatigue properties, more particularly in thin ply format. Thin ply materials achieve higher usable properties from the fibre through spreading load more consistently through the laminate and delaying first ply failure.

This hot-melt epoxy prepreg is recommended to be cured at 135°C to 180°C for a large co-curing panel potential and a T_g until 165°C Onset (by E' DMA). This matrix has a very long out-life of up to 12 weeks at 18-22°C. TP135 offers excellent mechanical properties on a wide variety of fibres, and fibre weights.

TP135 is commonly used in autoclave processes and press moulding. It can also be used for vacuum bagging processes.

TP135 achieves very high mechanical properties (like ILSS~115MPa and Compression~1553 MPa on T800S fiber) and achieves remarkable T_g. It is suitable for structural parts in demanding applications such as motorsport and high-end industry.

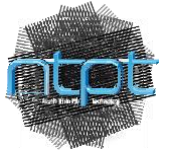
NTPT prepreg products are often used with automated tape laying machines (ATL). Our products are formatted both for ATL and for manual layup.

PRODUCT FEATURES

- Very high-strength, high-toughness, high T_g prepreg system (165°C Onset)
- Autoclave and press curable
- Can be processed with vacuum-only processing
- Cure 4h at 135°C or 2h at 180°C
- Good thermal stability
- Suitable tack for most hand layup and automated tape placement processes
- Ideal for prepreg with fibre weights from 30g

TP135 data sheet

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PRODUCT FORMAT

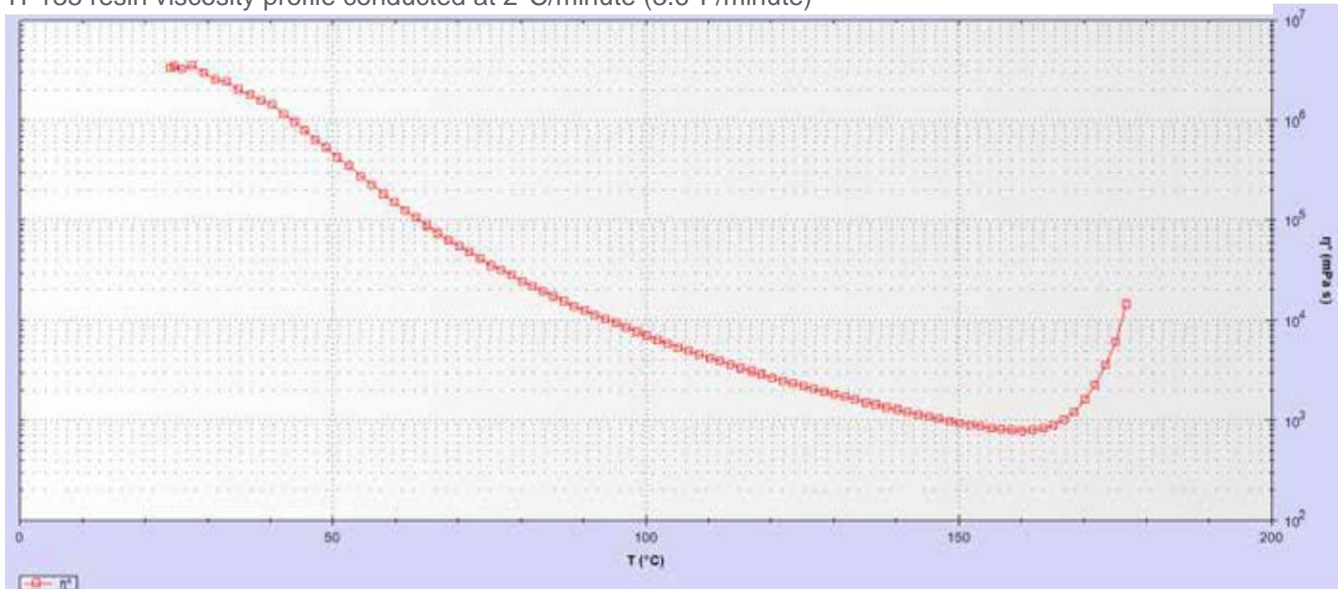
TP135 STANDARD PRODUCT FORMAT			
Use		Hand Layup	Preform from ATL
Backing paper		Silicon paper (50 or 100µm)	Silicon paper (75µm) or polyester foil (50µm)
Top release		None or polyethylene foil	Polyethylene foil or embossed
Width [mm]		300 mm	up to 1500mm
Available FAW [gsm]	Lowest	30 gsm	60gsm
	Range	from 30 to 150gsm, per 30 gsm step	from 2 to 8 layers (16 with thin ply)
Mass Resin Content	Range	from 30% to 55% - thin ply 38%	
Cardboard tube [mm]	Inner diameter	76mm (3 inches)	300mm
	Width	320mm	1600mm

Please contact Customer Support to discuss specific requirements and availability.

TYPICAL CHARACTERISTICS

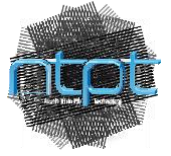
Rheology

TP135 resin viscosity profile conducted at 2°C/minute (3.6°F/minute)



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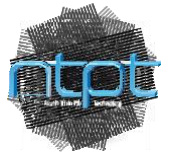


TYPICAL CHARACTERISTICS

Laminate properties

Property		Symbol	T800S / 60gsm		Test Standard
Fibers	Fiber Density	ρ_{fiber}	1.80	g/cm ³	-
	Fiber Modulus	E_{fiber}	294	Gpa	-
	Fiber Strength	X_{fiber}	5880	Mpa	-
Prepreg	Resin Content	%	34	%	ASTM D3171
Cured laminate	FVF	%	57	%	Method II
	Cured Ply Thickness	T_{ply}	0.058	mm	ASTM D3171
	Cured Ply Density	ρ_{ply}	1.63	g/cm ³	ASTM D792
Glass Transition Temperature	Tg by E' DMA	Tg Onset	168.9	°C	ISO 6721
	Tg by tand DMA	Tg Peak	205.9	°C	
Tensile QIs (Normalized to 60%)	Strength	σ_{MQI}	1190	Mpa	ISO 527-4
	Modulus	E_{QI}	62.8	GPa	
	Strain	ϵ_{MQI}	1.81	%	
90° Tensile	Strength	σ_{M2}	67.5	Mpa	ISO 527-5 / B / 2
	Modulus	E_2	10.4	Gpa	
0° Compressive (Normalized to 60%)	Strength	σ_{CM}	1553	Mpa	ISO 14126 (ASTM D695)
	Modulus	E_C	189.5	Gpa	
In Plane Shear [$\pm 45^\circ$] _s	Strength at 5% y12	$\tau_{12 \text{ m}}$	94.3	Mpa	ISO 14129
	Strength at break	$\tau_{12 \text{ M}}$	174.6	Mpa	
	Modulus	G_{12}	6.21	Gpa	
0° ILSS	Short Beam Strength	F_{sbs}	117	Mpa	ISO 14130
0° Flexural	Strength	σ_F	1720	Mpa	ISO 14125
	Modulus	E_F	158.8	Gpa	
	Strain	ϵ_F	1.11	%	
Double Cantilever Beam	Mode I	G_{ic}	592	J/m ²	EN6033

Cured using 5 bars autoclave curing for 240 minutes at 165°C.



INSTRUCTIONS FOR USE

Curing cycles

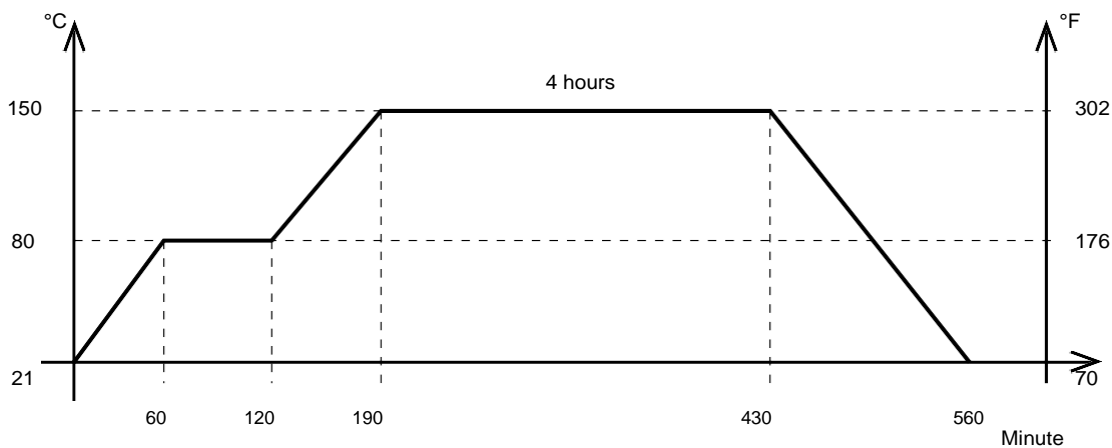
For a good balance of composite properties, the laminate should be cured at 150°C (302 F) for a minimum of 4 hours. However, there are three possible curing cycles for TP135:

Curing Cycle 1: This is the cycle to use to achieve the datasheet values

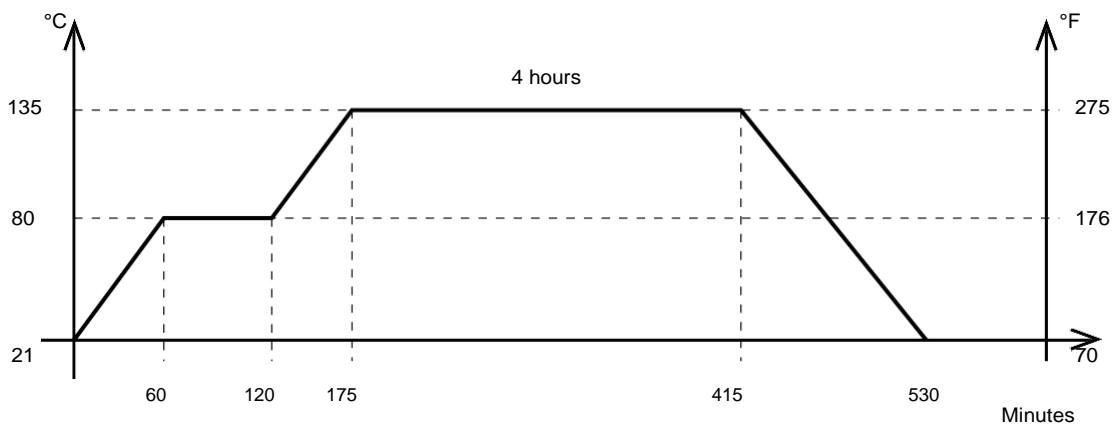
Curing Cycle 2: This is a lower temperature cure schedule

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

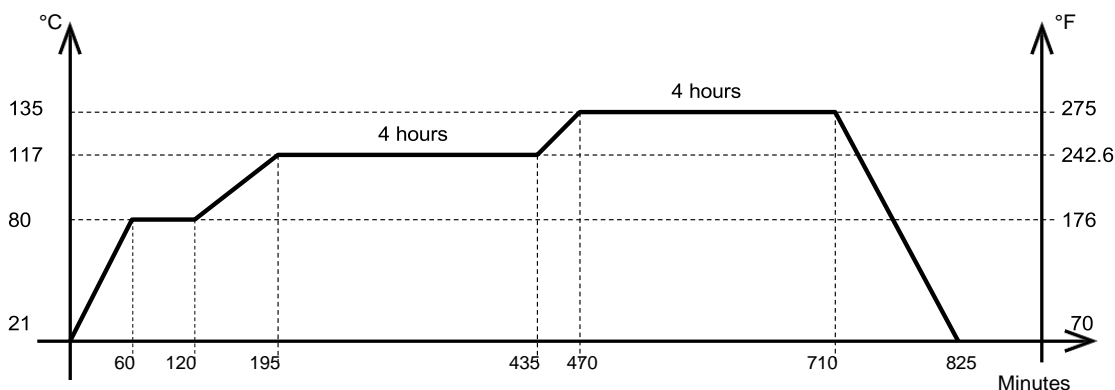


Note: NTPT recommends a 4 hours at 150°C cure cycle to fully cross link the TP135 matrix resin and develop the best properties for the composite, especially if the product is foreseen to be used in a thin laminate application. A lower temperature cure cycle is possible but please note that the resin 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

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Curing Cycle 3: Thicker laminate curing

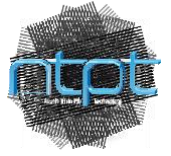


Attention: TP135 is a highly energetic system with a very high level of cure enthalpy within the system, typically >600J/g. In cases when TP135 is envisaged to be used in conventional or thick laminate format i.e. in every circumstance other than thin laminate performance, and specifically on laminates >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). TP135 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 300gm²), 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.

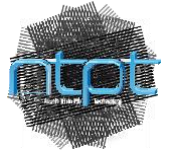


INSTRUCTIONS FOR USE

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-plyed surface of a TP135 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 TP135 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

TP135 contains epoxy resins which can cause allergic reaction. When uncured, TP135 should be handled with appropriate gloves. When cured, a composite laminate made of TP135 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.

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