SE 140 PREPREG

140°C TG EPOXY PREPREG SYSTEM

- Optimised prepreg for compression moulding and autoclave cure
- Flow-controlled resin for improved surface finish
- Toughened for improved mechanical properties
- 20min Cure at 130-135°C (266-275°F)

INTRODUCTION

SE140 is designed for manufacture of complex composite components which are typically manufacture in the automotive, motorsport and sporting goods sectors. The cured resin has a good balance of laminate strength, toughness and environmental performance making it a very versatile product.SE140 is a flow controlled prepreg, which has been optimised for fast cure under high consolidation pressures but can also be cured under vacuum pressure if required. The prepreg resin provides suitable tack to adhere to metal and composite tools but is still easy to reposition at ambient temperatures.

INSTRUCTIONS FOR USE

SE140 is low tack prepreg and yet still offers high drape characteristics for precision laminating. It is possible to reposition when applied together but once pushed into place it will become difficult to separate. It will also self-adhere to a mould surface at 21°C (70°F), additional heat can used to increase tack, but the product will be difficult to use in workshop temperatures above 23°C.

SE 140 SFP resin is a clear resin and is not filled, which help to maintain good resin clarity. However, it is not UV stable and will gradually become more yellow on exposure to UV light, so a protective clear coat is recommended when making visual parts.

When manufacturing cosmetic carbon components, it is recommended that high consolidation pressure curing methods are used. This will ensure no surface pinholes and give a repeatable surface finish for lacquering.

AUTOCLAVE, PRESSURE BLADDER & VACUUM BAG PROCESSING

The mould should be treated with a high temperature release agent or film prior to lay-up. Place the layers of material into the mould in the same manner as a traditional prepreg. Overlaps are needed to ensure a continuous fibre distribution, the overlap distance should be in region of 10-20mm.

Vacuum debulks may be needed to aid the placement of the layers, typically a 15-30 min debulking at 21°C is used. A perforated release film and a breather mesh should be used in this operation to gain even vacuum over the part. Vacuum debulks will also reduce the amount of surface pin holes and voiding in the cured laminate when using a vacuum only cure.

For vacuum only -1bar cures a perforated release film should be used and for autoclave where the pressure is greater than +1bar a non-perforated release film is typically required.

PRESS PROCESSING

The press perform or charge should be made from multiple plies stacked on top of each other. Depending on part complexity preforms can be made from either; rough shaping the material by hand, vacuum, or diaphragm forming methods. Woven and fabric preforms will not flow during pressing and therefore need to be neat shape or larger.

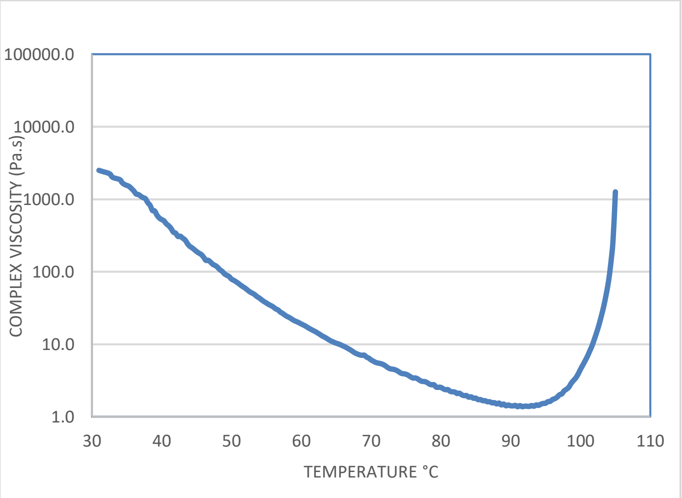
The tooling used should have a closed or sealed cavity edge as the viscosity of the resin reduces during cure and needs to be contained within the cavity. If the tooling is open on the edge a reduced consolidation pressure will be achieved and this will result in surface pin holes or dry surface fibres. An improved surface finish can be obtained by partially closing the tool and applying a vacuum before the upper tool contacts the prepreg. This a vacuum step will remove trapped air before the mould contacts the prepreg. The controlled flow of SE 140 makes it more tolerant to pressing without vacuum or mould edge flow control, but generally a more repeatable surface finish is obtained with these features. Pressing without vacuum is likely to result in a part with some minor porosity.

Typical moulding pressures are between 10-20 bar (145 – 290 PSI) although higher pressures are also acceptable.

PREPREG PROPERTIES

PROPERTY	VALUE	
Minimum Viscosity	1.4 Pa.s	14 P
Temperature at Minimum Viscosity	92°C	198°F

STORAGE TEMP		UNIT	VALUE
-18°C	0°F	months	12
+21°C	+70°F	weeks	4



All prepreg materials should be stored in a freezer when not in use to maximise 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.

HEALTH AND SAFETY

Please refer to product SDS for up to date information specific to this product.

MINIMUM CURE TIME & TEMPERATURE

SE 140 Prepreg offers flexible curing options and can be cured via autoclaved, pressure bladder and press cure methods. Vacuum curing is also possible.

AUTOCLAVE & VACUUM PROCESSING CURE

Autoclave curing is possible using a 2°C /min (4°F/min) ramp to 130°C (266°F), including a dwell at 80°C for 20min will provide some additional resin flow time and improve the surface finish and porosity. With the controlled flow of the prepreg 3 to 7 bar autoclave pressure can be applied at the start of the cure process, or before the laminate reaches 80°C (176°F) to give parts with excellent surface finish on gloss and matt tooling.

With vacuum only curing some surface porosity can occur. Surface porosity can be reduced by reducing the ramp rate to 0.5 °C /min (0.5°F/min) and adding a dwell of at least 45min at 80°C. For painted parts surface porosity can be removed by using Gurit SF75-90 Surface film as the first ply in the laminate stack.

PROPERTY	80°C CURE	120°C CURE	130°C CURE	TEST STANDARD
Processing Method	Autoclave / Vacuum	Autoclave / Vacuum	Autoclave / Vacuum	
Typical Ramp Rate	0.3 – 2°C/minute	1– 2°C/minute	1 – 2°C/minute	-
Cure Time	6 hrs	45 minutes	20 minutes	-
Cure Pressure	-1 Bar	-1 Bar / +6 Bar	-1 Bar / +6 Bar	-
Dry Tg (DMA)	85-90°C	125-130°C	135-140°C	ASTM D7028

PRESS PROCESSING

Typically, in Prepreg Compression Moulding (PCM) processing parts are demoulded once 85% cure conversion has been achieved but to maximise the glass transition (Tg) of the resin a longer cure is recommended, especially for flat large parts without significant shape rigidity.

The table below is a guide of flow and cure vs. temperature when using a hot in-hot out press process.

PROPERTY	125°C (302°F)	130°C (302°F)	135°C (302°F)
Flow Time / (min:ss)	2:54	2:03	1:21
Cure Conversion 90% / (min:ss)	18:30	9:15	6:30
Cure Conversion 95% / (min:ss)	-	17:45	9:15
Cure Conversion 97.5% / (min:ss)	-	-	13:15

The tool should be shut before the recommended flow time to avoid pre-gelling or an exotherm in the prepreg. Parts < 6mm thick have been processed without exothermic heat release problems using metal compression tooling to conduct heat away from both the A and B surfaces. Tests may be needed to check for exothermic heat release in thicker laminates. Excessive exotherm may discolour the resin.

Recommended press process, 1) Apply the charge to a 130-135C (266°F to 275°F) tool; 2) Partial close to apply a vacuum; 3) Begin final close 1min and 30seconds after the charge first contacts the hot tool; 4) Aim to have completed the tool close by 1min and 40 seconds; 5) Open the press and demould 15 minutes after the charge first contacts the hot tool.

Shorter cures can be achieved with a lower level of cure conversion, timings are given in the table above.

PREPREG PROPERTIES

PROPERTY	SYMBOL	UNIT	RC245T/42%	STANDARD
Resin System	-	-	SE 140	-
Prepreg Format	-	-	Impregnated	-
Fibre / Fabric Style	-	-	0/90 Woven 2x2 Twill	-
Fabric Areal Weight	FAW	g/m^2	245	ASTM D 3171 Method II
Typical Fibre Length	L_{fibre}	mm	Continuous	-
Typical Fibre Density	ρ_{fibre}	Kg/m^3	1800	-
Typical Resin Density	ρ_{resin}	Kg/m^3	1200	-
Fibre Modulus	E_{fibre}	GPa	227 – 257	-
Resin Content	RC	%	42	ASTM D 3171 Method II
Nominal Prepreg Areal weight	PAW	g/m^2	422	ASTM D 3171 Method II
Nominal Cured Ply Thickness	t_{CPT}	mm	0.28	ASTM D792
Nominal Fibre Volume Fraction	V_t	%	48	ASTM D 3171 Method II
Nominal Cured Density	$\rho_{Lamiante}$	Kg/m^3	1488	ASTM D 3171 Method II

CURED LAMINATE PROPERTIES

Average properties were taken in the roll (0°) and across roll (90°) directions with cured laminate thickness of 2.0 – 2.5mm

SE140 / RC245T Compression moulded at 12Bar pressure, cure 10 minutes at 130-135°C (266°F to 275°F).

PROPERTY	SYMBOL	N	FVF	RESULTS (METRIC)			RESULTS (US)		
			%	MEAN	UNIT	STANDARD	MEAN	UNIT	STANDARD
0° Tensile Strength*	σ_{T11}	7	52.3%	**645.3**	MPa	ISO 527-4	**93.6**	ksi	ASTM D3039
0° Tensile Modulus*	E_{t11}	8	52.3%	**65.3**	GPa	ISO 527-4	**9.5**	msi	ASTM D3039
Poission's Ratio	ν_{12}	8	52.3%	**0.06**	-		**0.06**	-	
90° Tensile Strength*	σ_{T22}	8	52.9%	**656.5**	MPa	ISO 527-4	**95.2**	ksi	ASTM D3039
90° Tensile Modulus*	E_{T22}	8	52.9%	**64.6**	GPa	ISO 527-4	**9.4**	msi	ASTM D3039
Poission's Ratio	ν_{21}	8	52.9%	**0.05**		ISO 527-4	**0.1**	-	ASTM D3039
0° Comp. Strength*	σ_{C11}	12	52.1%	**723.1**	MPa	SACMA SRM1	**104.9**	ksi	ASTM D695
0° Comp. Modulus*	E_{c11}	10	51.7%	**61.0**	GPa	SACMA SRM1	**8.8**	msi	ASTM D695
90° Comp. Strength*	σ_{C22}	12	53.6%	**720.0**	MPa	SACMA SRM1	**104.4**	ksi	ASTM D695
90° Comp. Modulus*	E_{C22}	10	52.5%	**60.5**	GPa	SACMA SRM1	**8.8**	msi	ASTM D695
0° Flexural Strength	σ_F	10	52.6%	**934.8**	MPa	ISO 14125	**135.6**	ksi	ASTM D790
0° Flexural Modulus	E_{F11}	10	52.6%	**54.7**	GPa	ISO 14125	**7.9**	msi	ASTM D790
90° Flexural Strength	σ_F	10	52.8%	**900.2**	MPa	ISO 14125	**130.6**	ksi	ASTM D790
90° Flexural Modulus	E_{F11}	10	52.8%	**55.3**	GPa	ISO 14125	**8.0**	msi	ASTM D790
0° ILSS (MPa)	τ_{ILSS}	10	52.7%	**74.3**	MPa	ISO 14130	**10.8**	ksi	ASTM D2344
Glass Transition Tg_1 DMA	Tg_1	1	52.8	**141**	°C	ISO 6721	**287**	°F	ASTM 7028

SE140 / RC245T Woven Carbon, Vacuum Cure using cure of 2°C/min to 130°C (266°F), 130°C (266°F) dwell for 20min.

PROPERTY	SYMBOL	N	FVF	RESULTS (METRIC)			RESULTS (US)		
			%	MEAN	UNIT	STANDARD	MEAN	UNIT	STANDARD
0° Tensile Strength*	σ_{T11}	8	48.8%	**619.8**	MPa	ISO 527-4	**89.9**	ksi	ASTM D3039
0° Tensile Modulus*	E_{t11}	8	48.8%	**63.8**	GPa	ISO 527-4	**9.3**	msi	ASTM D3039
Poission's Ratio	v_{12}	8	48.8%	**0.05**	-		**0.05**	-	
90° Tensile Strength*	σ_{T22}	7	48.5%	**625.6**	MPa	ISO 527-4	**90.7**	ksi	ASTM D3039
90° Tensile Modulus*	E_{T22}	7	48.5%	**62.8**	GPa	ISO 527-4	**9.1**	msi	ASTM D3039
Poission's Ratio	v_{21}	8	48.5%	**0.05**		ISO 527-4	**0.1**	-	ASTM D3039
0° Comp. Strength*	σ_{C11}	10	47.0%	**702.6**	MPa	SACMA SRM1	**101.9**	ksi	ASTM D695
0° Comp. Modulus*	E_{c11}	10	49.1%	**60.3**	GPa	SACMA SRM1	**8.7**	msi	ASTM D695
90° Comp. Strength*	σ_{C22}	10	46.7%	**680.4**	MPa	SACMA SRM1	**98.7**	ksi	ASTM D695
90° Comp. Modulus*	E_{C22}	10	48.9%	**60.5**	GPa	SACMA SRM1	**8.8**	msi	ASTM D695
0° Flexural Strength	σ_F	10	49.1%	**828.4**	MPa	ISO 14125	**120.2**	ksi	ASTM D790
0° Flexural Modulus	E_{F11}	10	49.1%	**50.7**	GPa	ISO 14125	**7.4**	msi	ASTM D790
90° Flexural Strength	σ_F	10	48.4%	**822.6**	MPa	ISO 14125	**119.3**	ksi	ASTM D790
90° Flexural Modulus	E_{F11}	10	48.4%	**51.3**	GPa	ISO 14125	**7.4**	msi	ASTM D790
0° ILSS (MPa)	τ_{ILSS}	10	48.3%	**75.7**	MPa	ISO 14130	**11.0**	ksi	ASTM D2344
Glass Transition Tg_1 DMA	Tg_1	1	48.3%	**134**	°C	ISO 6721	**273**	°F	ASTM 7028

** Normalised to 55% Vf. Laminate fibre volume fraction calculated using fibre areal weight and assumed fibre density of 1800Kg/m³and normalised as per ASTM D 3171 Method II. Data is only normalised where appropriate. Future testing is not guaranteed to give exactly the same values. Engineers should account for variability when choosing their design allowable properties*

SE140 / RF300T Woven Flax fabric, Press moulded at 12Bar pressure, 135°C for 15 Minutes

PROPERTY	SYMBOL	N	FVF	RESULTS (METRIC)			RESULTS (US)		
			%	MEAN	UNIT	STANDARD	MEAN	UNIT	STANDARD
0° Tensile Strength	σ_{T11}	6	45.7%	**166.6**	MPa	ISO 527-4	**24.2**	ksi	ASTM D3039
0° Tensile Modulus	E_{t11}	6	45.7%	**12.7**	GPa	ISO 527-4	**1.8**	msi	ASTM D3039
0° Comp. Strength	σ_{C11}	6	43.7%	**165.9**	MPa	SACMA SRM1	**24.0**	ksi	ASTM D695
0° Comp. Modulus	E_{c11}	6	43.1%	**12.00**	GPa	SACMA SRM1	**1.7**	msi	ASTM D695
0° Flexural Strength	σ_F	6	42.5%	**166.0**	MPa	ISO 14125	**24.1**	ksi	ASTM D790
0° Flexural Modulus	E_{F11}	6	42.5%	**12.7**	GPa	ISO 14125	**1.84**	msi	ASTM D790
0° ILSS (MPa)	τ_{ILSS}	6	43.3%	**18.9**	MPa	ISO 14130	**2.8**	ksi	ASTM D2344
Glass Transition Tg_1 DMA	Tg_1	1	N/A	**132**	°C	ISO 6721	**269**	°F	ASTM 7028

Test data has not been normalised by fibre volume fraction. Future testing is not guaranteed to give exactly the same values. Engineers should account for variability when choosing their design allowable properties

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