SE 140

140° Tg Epoxy Prepreg System

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.

The SE140 UV variant uses UV blockers to reduced resin yellowing from the sun and environmental conditions.

The SE140 BL variant has a low level of black pigment to darken the colour of resin yet still allow the fabric weave to be visible.

This document covers the properties for all variants.

- Optimised prepreg for compression moulding and autoclave cure
- Flow-controlled resin for improved surface finish
- Tinted black resin version avaible
- Enhanced UV stable version avaible
- 20 minute cure at 130-135°C (266-275°F)
- Can also be cured with vacuum bag. Six hours at 80°C (176°F)
- Toughened for improved mechanical properties

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 resin is a clear resin and has no fillers, which helps to maintain good resin clarity for cosmetic applications. The resin will exhibit good UV and environmental weathering protection. However, like all epoxy resin prepregs over time the resin will gradually become more yellow on exposure to UV light, so a protective clear coat lacquer is recommended to help protect the final component surface.
When manufacturing high quality cosmetic carbon components, it is recommended that a high consolidation pressure is used during cure 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

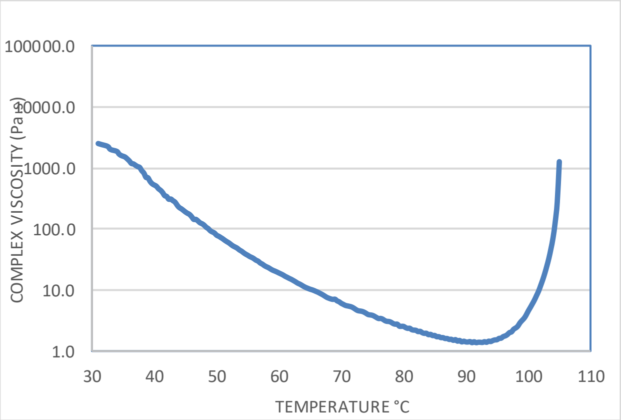
The press perform or charge should be made from multiple plies stacked on top of each other. Depending on part complexity preforms can be made from either; rough shaping the material by hand, vacuum, or diaphragm forming methods. Woven and fabric preforms will not flow during pressing and therefore need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

PRODUCT INFORMATION

AVAILABILITY

SE 140 is available in unidirectional carbon formats ranging in weight from 110 to 600g/m^2, also woven or multiaxial reinforcements in carbon or glass from 100-660g/m^2.

PREPREG PROPERTIES



RHEOLOGY DATA

PROPERTY	UNITS	VALUE
Minimum Viscosity	Pa.s (P)	1.4 (14)
Temperature at minimum viscosity	°C (°F)	92 (198)

TRANSPORT AND STORAGE

STORAGE TEMPERATURE	UNITS	VALUE
-18°C (0°F)	months	12
+18-20°C (64-68°F)	weeks	4

To maximise the de-frosted shelf life of the material it is beneficial to maintain a cool working environment. When not in use SE140 products should be maintained at -18°C (0°F).

TYPICAL CURE TIME AND TEMPERATURES

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

AUTOCLAVE AND VACUUM PROCESSING CURE

Typical cure schedules for SE140, SE140 BL and SE140 UV

PROPERTY	80°C CURE (158°C)	120°C CURE (176°C)	130°C CURE (248°C)	TEST METHOD
Processing method	Vacuum Bag/Autoclave	Vacuum Bag/Autoclave	Vacuum Bag/Autoclave	
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	
Tg (DMA)	85-90°C (185-194°F)	125-130°C (257-266°F)	135-140°C (275-284°F)	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 CURE (257°F)	130°C CURE (266°F)	135°C CURE (275°F)
Flow Time	2:54	2:03	1:21
Cure Conversion(90%) Mins:Seconds	18:30	9:15	6:30
Cure Conversion(95%) Mins:Seconds	-	17:45	9:15
Cure Conversion(97.5%) Mins:Seconds	--		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

SE140/RC245T/42% (Values for SE140 BL & SE140 UV are the same)

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PROPERTY	SYMBOL	UNITS	RC245T/42%	TEST METHOD
Resin System	–	-	SE140	-
Fabric Style	–	-	0/90 Woven 2x2 Twill	-
Fabric Areal Weight	FAW	-	245	ASTM D3171
Typical Fibre Length	L_{fibre}	m	Continuous	-
Typical Fibre Density	ρ_{fibre}	Kg/m³	1800	-
Typical Resin Density	ρ_{resin}	Kg/m³	1200	-
Fibre Modulus	E_{fibre}	GPa	227-257	
Resin Content	RC	%	42	ASTM D3171 Method II
Nominal Prepreg Areal Weight	PAW	g/m²	422	ASTM D3171 Method II
Nominal Cured Ply Thickness	t_{CPT}	mm	0.28	ASTM D792
Nominal Fibre Volume	ν_t	%	42	ASTM D3171 Method II
Nominal Cured Density	$\rho_{Lamiante}$	Kg/m³	1488	ASTM D3171 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, High Pressure Cure, 12Bar pressure, cure 10 minutes at 130-135°C (266°F to 275°F).

SE140 BL & SE140 UV variants will achieve the same properties.

PROPERTY	SYMBOL	UNITS		SE140/RC245T		TEST METHOD
0° Tensile Strength*	σ_{T11}	MPa	(ksi)	645	(93.6)	ISO527-4
0° Tensile Modulus*	E_{t11}	GPa	(Msi)	65.3	(9.50)	ISO527-4
Poissons Ratio	v_{12}	-	-	0.05	(0.10)	ISO527-4
90° Tensile Strength*	σ_{T22}	MPa	(ksi)	657	(95.2)	ISO527-4
90° Tensile Modulus*	E_{T22}	GPa	(Msi)	64.6	(9.40)	ISO527-4
Poissons Ratio	v_{21}	-	-	0.05	(0.10)	ISO527-4
0° Compression Strength	σ_{C11}	MPa	(ksi)	723	(105)	SACMA SRM1-94
0° Compression Modulus	E_{c11}	GPa	(Msi)	61.0	(8.80)	SACMA SRM1-94
90° Compression Strength	σ_{C22}	MPa	(ksi)	720	(104)	SACMA SRM1-94
90° Compression Modulus	E_{C22}	GPa	(Msi)	60.5	(8.80)	SACMA SRM1-94
0° Flexural Strength	σF	MPa	(ksi)	935	(136)	ISO 14125
0° Flexural Modulus	EF11	GPa	(Msi)	54.7	(7.90)	ISO 14125
90° Flexural Strength	σF	MPa	(ksi)	900	(131)	ISO 14125
90° Flexural Modulus	EF11	GPa	(Msi)	55.3	(8.00)	ISO 14125
0° ILSS	τ_{ILSS}	MPa	(ksi)	74.3	(10.8)	ISO 14130
Glass Transition Tg1 DMA	Tg_1	°C	(°F)	141	(287)	ISO14125

* Normalised to 60% V_f

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

SE140 BL & SE140 UV variants will achieve the same properties.

PROPERTY	SYMBOL	UNITS		SE140/RC245T		TEST METHOD
0° Tensile Strength*	σ_{T11}	MPa	(ksi)	620	(89.9)	ISO527-4
0° Tensile Modulus*	E_{t11}	GPa	(Msi)	63.8	(9.30)	ISO527-4
Poissons Ratio	v_{12}	-	-	0.05	(0.05)	ISO527-4
90° Tensile Strength*	σ_{T22}	MPa	(ksi)	626	(90.7)	ISO527-4
90° Tensile Modulus*	E_{T22}	GPa	(Msi)	62.8	(9.10)	ISO527-4
Poissons Ratio	v_{21}	-	-	0.05	(0.10)	ISO527-4
0° Compression Strength*	σ_{C11}	MPa	(ksi)	703	(102)	SACMA SRM1-94
0° Compression Modulus*	E_{c11}	GPa	(Msi)	60.3	(8.70)	SACMA SRM1-94
90° Compression Strength*	σ_{C22}	MPa	(ksi)	680	(98.7)	SACMA SRM1-94
90° Compression Modulus*	E_{C22}	GPa	(Msi)	60.5	(8.80)	SACMA SRM1-94
0° Flexural Strength	σF	MPa	(ksi)	828	(120)	ISO 14125
0° Flexural Modulus	EF11	GPa	(Msi)	50.7	(7.40)	ISO 14125
90° Flexural Strength	σF	MPa	(ksi)	823	(119)	ISO 14125
90° Flexural Modulus	EF11	GPa	(Msi)	51.3	(7.40)	ISO 14125
0° ILSS	τ_{ILSS}	MPa	(ksi)	75.7	(11.0)	ISO 14130
Glass Transition Tg_1 DMA	Tg_1	°C	(°F)	134	(273)	ISO14125

* Normalised to 60% V_f

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

PROPERTY	SYMBOL	UNITS		SE140/RC245T		TEST METHOD
0° Tensile Strength	σ_{T11}	MPa	(ksi)	167	(24.2)	ISO527-4
0° Tensile Modulus	E_{t11}	GPa	(Msi)	12.7	(1.80)	ISO527-4
0° Compression Strength	σ_{C11}	MPa	(ksi)	166	(24.0)	SACMA SRM1-94
0° Compression Modulus	E_{c11}	GPa	(Msi)	12.0	(1.70)	SACMA SRM1-94
0° Flexural Strength	σF	MPa	(ksi)	166	(24.1)	ISO 14125
0° Flexural Modulus	EF11	GPa	(Msi)	12.7	(1.84)	ISO 14125
0° ILSS	τ_{ILSS}	MPa	(ksi)	18.9	(2.80)	ISO 14130
Glass Transition Tg_1 DMA	Tg_1	°C	(°F)	132	(269)	ISO14125

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

HEALTH AND SAFETY

The following points must be considered:

1. Skin contact must be avoided by wearing protective gloves. Gurit recommends the use of disposable nitrile gloves for most applications. The use of barrier creams is not recommended, but to preserve skin condition a moisturising cream should be used after washing.
2. If the skin becomes contaminated, then the area must be immediately cleansed. The use of resin-removing cleansers is recommended. To finish, wash with soap and warm water. The use of solvents on the skin to remove resins etc must be avoided.

   Washing should be part of routine practice:
   - before eating or drinking
   - before smoking & vaping
   - before using the lavatory
   - after finishing work
3. The inhalation of sanding dust should be avoided and if it settles on the skin then it should be washed off. After more extensive sanding operations a shower/bath and hair wash is advised.

Gurit produces a separate full Safety Data Sheet for all hazardous products. Please ensure that you have the correct SDS to hand for the materials you are using before commencing work.

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