

SE 70

Low Temperature Cure High Toughness Epoxy Prepreg System

- Low temperature 70°C curing
- Faster cycle times at elevated temperature
- Excellent balance of mechanical properties and toughness
- Long outlife - up to 4 weeks @ 18-22°C
- Range of compatible adhesive films and ancillary products
- Excellent surface finish
- Good Tg
- Suitable for vacuum bag, press or autoclave consolidation

Introduction

SP-High Modulus' SE 70 is a hot melt, low temperature cure, epoxy prepreg system. It has been developed for use in the construction of large components using low energy cure cycles. Excellent properties can be achieved with a processing temperature of just 70°C. At this cure temperature the system exhibits very good mechanical properties and excellent toughness.

Cure temperature for a 16 hours cure cycle is 70°C - this temperature allows less expensive tooling and ovens to be used, with lower thermal movement and distortion. Faster cures are available from higher cure temperatures. However, thicker sections (>10mm) will require the insertion of a suitable dwell into the cure cycle. Up to 20mm thick laminates may be moulded at 70°C with a peak exotherm only slightly above the cure temperature.

Processing Notes - General

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.

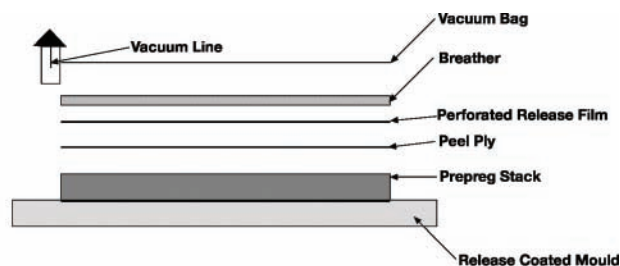
Laying-Up

The following procedure is recommended for preparing vacuum cured laminates.

1. The moulding surface must first be treated with a suitable release agent. A separate prepreg nylon peel ply is available for covering the mould tool prior to lay-up in order to leave a clean, textured surface for subsequent bonding. The required number of plies of SE 70 prepreg are placed on the tool and a thermocouple inserted into the lay-up near the centre ply of the thickest edge section. Typically several vacuum debulks are required during the lay-up to ensure the removal of entrapped air. The frequency and temperature of debulks can vary depending on the type and size of application. The user should carry out test panels to determine the optimum schedule. Further advice can be obtained from Technical Services.
2. Apply a peel ply to the surface of the lay-up. Note that for good secondary bonding of a peel-ply surface of an SE 70 prepreg laminate, a nylon peel ply, such as Tygavac stitch Ply A is strongly recommended. Cover the peel ply entirely with a perforated release film. Normally, no edge resin bleeder system is used. P9 grade release film is recommended. With the perforated release film, the amount of resin bled away is controlled by the number of dry plies of resin bleeder cloth placed over the perforated release film. For thin skins care must be taken not to overbleed the laminate (prepreg peel ply will ensure this does not occur).
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. Commence the heat-up cycle, typically between 0.3°C/min and 2°C/min to the final cure temperature. At 70°C the temperature should be held for 16 hours. Faster cures may be obtained at elevated temperatures, e.g. 100 mins @ 100°C, or 25 minutes @ 120°C. All temperatures should be measured by the previously installed thermocouple. When curing at 70°C, a minimum of 16 hours is recommended. Vacuum should be maintained as high as possible, with a minimum of 85% throughout the cure cycle.
5. Upon completion of cure, the heat is turned off and the part cooled until its temperature has fallen below 60°C. When fully cooled, the part may be debagged, trimmed and machined as necessary. A post-cure is not required.

Gloves should be worn both to avoid skin contact with the prepreg, and to avoid transfer of sweat onto the prepreg, which may cause voiding on cure.

A diagram of the laminate / vacuum bag stack is shown below.



Processing Notes - Thin Laminates

When using very thin laminates (eg with a total laminate fibre weight of less than 300g/sm), 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 preimpregnated peel ply should be used before the application of a P9 perforated release film and breather / bleeder fabric.

Processing Notes - Thick Laminates

When processing thick laminates, extra care should be taken to avoid entrapping air in the laminate by the use of regular vacuum debulks.

An intermediate dwell can be included during the cure to burn off any excess exothermic energy in a controlled manner. Contact Technical Services for further details.

Processing Notes - Curing

Curing on a Release Coated Mould

Several thermocouples should be positioned at various parts of the lay-up; a minimum of 12 is recommended but this may vary depending on the size of the moulded structure.

On a well-sealed mould tool it should be possible to achieve 660-710 mm (26"-28") Hg vacuum. If the achievable vacuum is below 510mm (20") Hg do not proceed with cure until the bag leaks have been plugged. The vacuum should be held at ambient temperature for one hour prior to heating. The vacuum should be maintained throughout the cure. Acceptable ramp rates vary from 0.3 - 2.0°C per minute, with 0.3-0.5°C/min being typical on large structures.

When curing large structures a dwell period can be included to allow temperature equilibration of the tool and laminate. See Processing Notes for further information.

For a good balance of composite properties, it is recommended that the laminate is cured at 70°C for a minimum of 16 hours. A laminate may be cured in two stages - if, for example, making a cored component. However in a two stage cure, a minimum of 8 hours at 70°C or 4 hours at 80°C is recommended before debagging a skin, and it must be ensured that this skin is cured for the equivalent of at least 16 hours at 70°C or 8 hours at 80°C before going into service.

Curing at 70°C

When curing at 70°C it is important to ensure the temperature is monitored off the trailing thermocouple as 70°C should be treated **as the minimum cure temperature** for SE 70. At temperatures below 70°C, extremely long cure times are required to generate adequate performance.

Curing at Higher Temperatures

SE 70 may be cured at higher temperatures for a shorter time. At a cure temperature of 100°C (212°F) cure can be achieved in 100 minutes, or at 120°C (250°F) cure can be achieved in 25 minutes.

It is not recommended to cure SE 70 under vacuum pressures of less than -0.85 bar. If a ramp rate of less than 0.3°C/min is used, users should satisfy themselves that this allows adequate flow.

Temp °C	Time
70	16 hours
75	12 hours
80	8 hours
85	6 hours
90	3 hours 45 minutes
100	100 minutes
110	50 minutes
120	25 minutes

Availability

SE 70 preregs are available in a variety of fabric forms, normally supplied on a single polythene film. Please contact Technical Services to discuss specific requirements and availability.

Properties

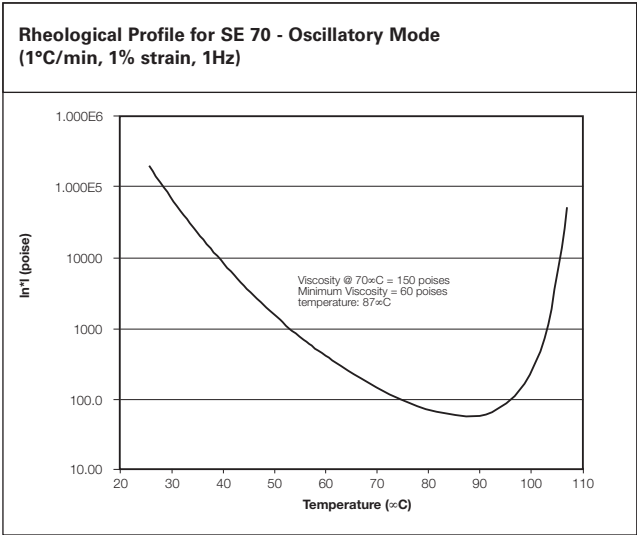
The following are typical mechanical properties of the SE 70 system impregnated into unidirectional carbon fibre, and cured at the standard cure cycle of 16 hours at 70°C.

Cure	0° HEC 200 16 hours @ 70°C
Process	Vacuum Bag
Fibre Weight	200
Prepreg Areal Weight	317
Prepreg Resin Content	37%
Tensile Strength (MPa)	2480
Tensile Modulus (GPa)	131.0
Tensile Laminate Fibre Volume (%)	57.7
Cured Ply Thickness (mm)	0.2
Normalised Tensile Strength 60%	2579
Normalised Tensile Modulus 60%	136.2
Compressive Strength (MPa)	1303
Compressive Laminate Fibre Volume (%)	59.9
Normalised Compressive Strength (MPa)	1305
ILSS	68.6
Microcracking Strain (%)	0.74

Cure schedule 16 hours at 70°C with ramp rate 0.3°C per minute.

All the tests performed in accordance with the relevant ASTM standards.

Properties (cont'd)

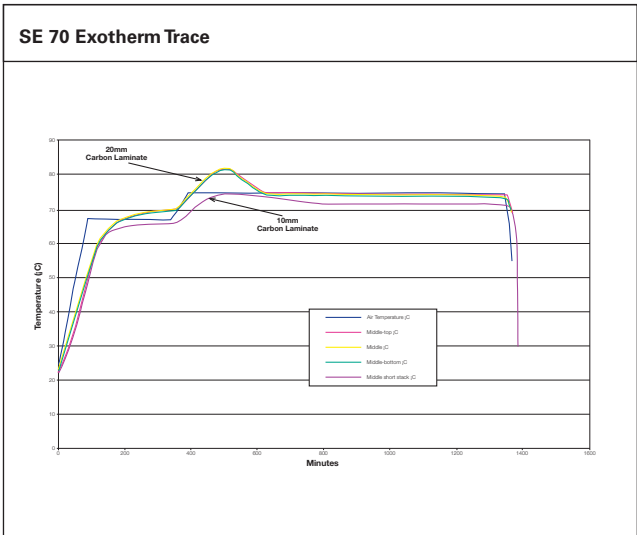
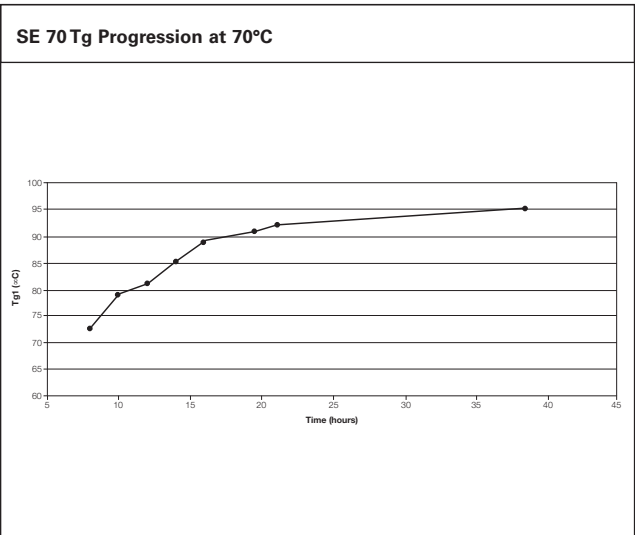


65 degree Tg Progression	
Time	Tg1
10	50
12	59
14	65
16	73

80 degree Tg Progression	
Time	Tg1
5	86
6	93
8	101
10	101
12	102
14	103

70 degree Tg Progression	
Time	Tg1
8	73
10	79
12	81
14	85
16	89
19.5	91
21	92
38.5	95

Cure Temp vs Tg		
Temperature	Time	Tg1
70	16	89
80	8	101
95	4	110
110	0.5	126



Health and Safety

Although SE 70 prepregs have greatly improved health and safety characteristics when compared to wet lay-up epoxy systems, the following points must still be considered:-

1. Avoid skin contact - wear disposable rubber gloves and use skin barrier creams.
2. Avoid eye contact. If this occurs, flush with water for 15 minutes and seek medical advice.
3. Ensure good ventilation of vacuum pump exhaust during laminate cure.
4. Avoid inhalation and eye contact with sanding dust. After any sanding operation of reasonable size a shower or bath should be taken and should include hair washing.
5. Wear overalls or other protective clothing. Thoroughly clean or discard soiled garments.
6. Use only resin removing creams/soap and water on exposed skin. Do not use solvents.

Washing should be part of routine practice:

- **before eating or drinking**
- **before smoking**
- **before using the lavatory**
- **after finishing work**

SP-High Modulus produces a separate full Materials Safety Data Sheet for this product covering usage, transport, storage and emergencies. Please ensure that you have the correct MSDS's to hand for the materials you are using before commencing work.

Applicable Risk & Safety Phrases

R 36/38, 43, 51/53
S 24, 26, 28, 37/39, 57, 60



Transport & Storage

When not in use SE 70 products should be maintained at -18°C. Shelf life for SE 70 is two years at -18°C and 4 weeks at 18-22°C. To avoid condensation on their surfaces, allow rolls to reach room temperature before unwrapping.

Notice

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