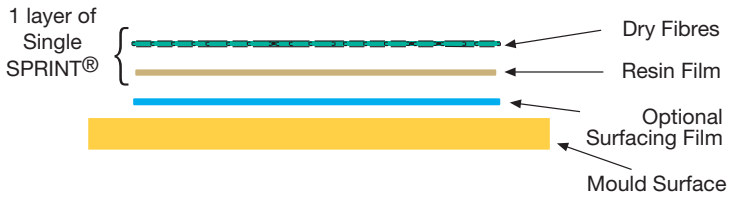
ST 94

Single SPRINT®

- **Drape and tackiness optimised for excellent handling**
- **Ideal for complex or vertical mouldings**
- **Excellent balance of mechanical performance and toughness**

Introduction

ST 94 Single SPRINT® is a moulding material that consists of a layer of dry reinforcement plied to a precast, precatalysed resin film.



Cross-section of 1 ply of Structural SPRINT®

ST 94 is a toughened hot-melt, epoxy resin that offers an extremely good balance of mechanical properties. It has been formulated to give an ideal tack level at workshop temperature. It is ideal for structural components where improved impact performance and resistance to resin microcracking is desired. ST 94 has a flexible cure envelope from 12 hours at 85°C to 45 minutes at 120°C. This makes it suitable for use in regular part production as well as for the development of trial components.

Typical End Use Applications

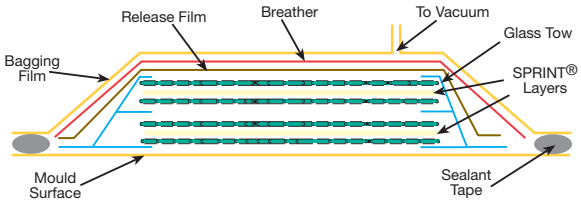
Single SPRINT® has been developed for use in large marine structures where heavyweight materials need to remain intact in the mould during the long build time of such products.

Instructions for Use

1. The moulding surface must first be treated with a release agent. If a Surface Film is required, this should be applied directly to the tool face prior to the layup of SPRINT®. Please refer to Processing Notes for application details.

The required number of plies of SPRINT® are then placed on to the tool face. A thermocouple may be inserted into the lay-up outside the net trim line. Dry glass tows should be inserted between plies of SPRINT® to provide an air evacuation path out of the laminate. The second end of the tow should be made available for contact with the breather

2. If required, a peel ply, pre-impregnated or dry, can be applied over the top of the laminate stack. Note that for good secondary bonding of a peel-plied surface of a laminate, a nylon peel ply such as Tygavac Stitch Ply A, is strongly recommended. The peel ply is covered entirely with a non-perforated release film such as Tygavac WL3600 or a low bleed release film, such as WL3600RP2. The release film is then covered with breather material, such as Tygavac Econoweave 44W, so that it extends over the release film in all directions and contacts the dry glass strands.



Typical processing diagram showing two SPRINT® layers

3. Once the lay up is complete, a vacuum bag is installed by standard techniques. At least two vacuum stems should be inserted through the bag, one connecting to the vacuum source and the other, at a point on the part furthest from the source, to a calibrated vacuum gauge. The major benefit of SPRINT® is that it enables all of the air to be removed from the laminate prior to fibre wet out and resin cure. It is recommended that a vacuum is applied at ambient temperature prior to cure, to fully evacuate the laminate stack. This should be held for between 5 minutes and 1 hour, depending upon the size and thickness of the component. Full vacuum is then maintained throughout the cure.

PLEASE NOTE: Further advice can be found in the SPRINT® Processing Notes or by contacting Technical Services.

4. Cure the laminate in accordance with the specification given later in this data sheet.

Curing schedule

Cure Envelope and Cured Properties

Single SPRINT® ST 94 has a relatively flexible cure envelope. The minimum cure is 12 hours 85°C and a rapid cure is 45 minutes at 120°C. Other cure temperatures and times are given in the Working Properties section.

Single SPRINT® ST 94 works by first applying a vacuum to the laminate stack to remove all air. It is recommended that an ambient vacuum is applied prior to cure, to fully evacuate the laminate stack. The temperature is then increased so that the matrix resin reduces in viscosity and wets the evacuated reinforcement within the laminate. A dwell can be used at the "infusion" temperature to ensure good laminate quality. The temperature is then further increased to cause the matrix resin to cross-link and is then held at the cure temperature until the cross linking process is complete. Once this is achieved heating is removed so that the temperature is reduced under natural cooling. The vacuum must be maintained throughout the cure and until the part has cooled to 40°C.

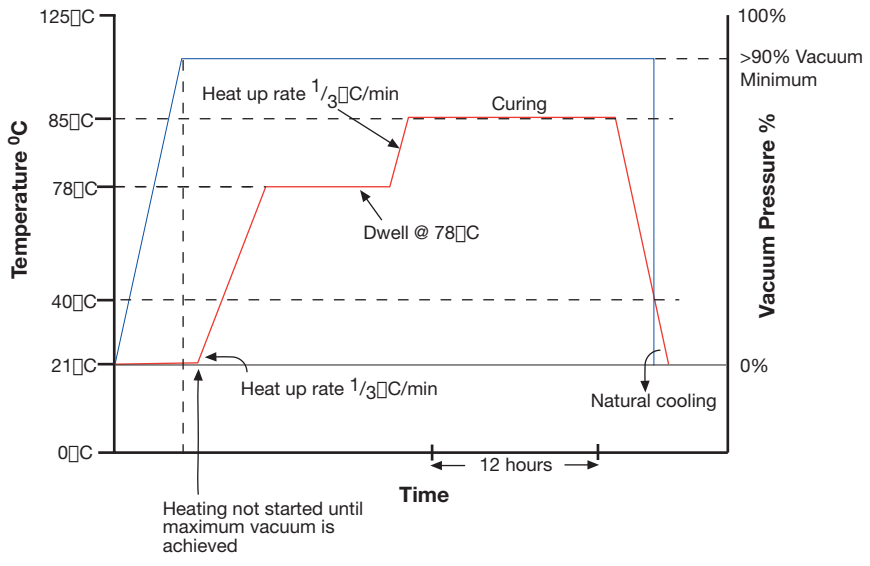
Typical Cure Profiles

The successful use of these cure schedules will depend on part size and laminate construction. Heat up rate and dwell periods need to be tailored to take consideration of oven capacity, thermal mass of tool, laminate construction etc. Data in the table below is based on laminate temperatures, air temperatures may need to be higher. It is recommended that SP-High Modulus is contacted for further advice before utilising any of the suggested cure cycles.

	Ultra Slow Cure Schedule	Standard Cure Schedule	Fast Cure Schedule
	0.3°C/minute ramp to 78°C	1°C/minute ramp to 78°C	2°C/minute ramp to 75°C
	2 hour dwell @ 78°C	78°C for 1 hour	1/2°C/minute Ramp to 90°C
	0.3°C/minute ramp to 85°C	1°C/minute ramp to 85°C	2°C/minute ramp to 120°C
	10 hour dwell @ 85°C	10 hour dwell @ 85°C	45 minutes @ 120°C
Total Time	**15 hours**	**12 hours**	**1 hour 55 minutes**

NB. It is strongly recommended that laminate temperatures are monitored throughout the cure.

Ultra Slow Cure Cycle Single SPRINT® ST 94

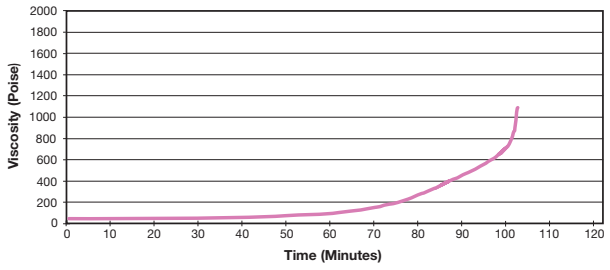


Properties

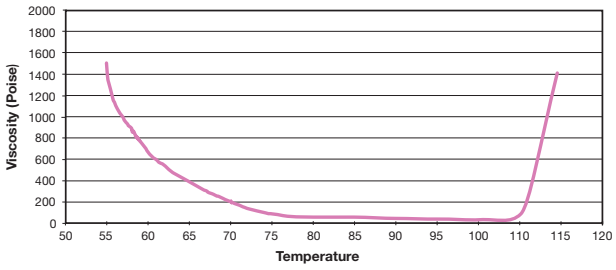
Working Properties	
Minimum Cure Temperature (°C)	85
Minimum Cure Time (@ minimum cure temperature) (hours)	12
Minimum Viscosity (isothermal @ minimum cure temperature) (P)	52.5
Minimum Viscosity (1°C/minute ramp) (P)	22.5
Temperature @ minimum viscosity (1°C/minute ramp) (°C)	100°C
Minimum Cure Time @ 90°C (hours:minutes)	6:00
Minimum Cure Time @ 100°C (hours:minutes)	3:00
Minimum Cure Time @ 110°C (hours:minutes)	1:30
Minimum Cure Time @ 120°C (hours:minutes)	0:45

Cure	10 hours @ 85°C	1 hour @ 120°C	10 hours @ 85°C + 1 hour @ 120°C
Tg1	103.4	116.1	117.2
Peak Tan δ	121.5	137.3	135.3

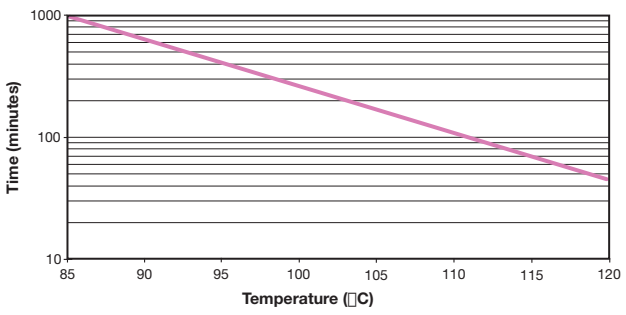
Isothermal Viscosity Profile of ST 94 @ 85°C



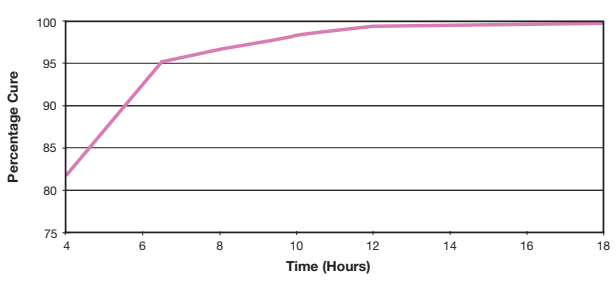
Viscosity Profile of ST 94 vs Temperature @ 1°C/min



Cure Time vs Temperature for a 2mm ST 94 Casting



Percentage Cure vs Time for ST 94 @ 85°C



Properties (cont'd)

Mechanical Properties		
	Material	
	ST 94/QEA1201/1270/35.3%/S/S	ST 94/YE1597/1250/33%/S/S
Cure	12 hours / 85°C / 1 bar	12 hours / 85°C / 1 bar
Process	vacuum bag	vacuum bag
Fibre weight (g/sm)	1280.0	1597.0
SPRINT® areal weight (g/sm)	1902.0	2383.0
SPRINT® resin content (g/sm)	35.3	33.0
Average Cured Ply thickness (mm)	1.16	1.25
Tensile strength @ 0° fibre direction (MPa)	276.9	638.0
Tensile strength @ 90° fibre direction (MPa)	288.5	80.6
Tensile modulus @ 0° fibre direction (GPa)	17.9	31.2
Tensile modulus @ 90° fibre direction (GPa)	18.9	12.9
Tensile Laminate Fibre vol. (%)	47.5	49.1
Normalised Tensile strength @ 60% fvf @ 0° fibre direction (MPa)	350.0	778.9
Normalised Tensile modulus @ 60% fvf @ 0° fibre direction (MPa)	22.7	98.5
Compressive strength @ 0° fibre direction (MPa)	322.5	716.9
Compressive Modulus @ 0° fibre direction (MPa)	21.5	32.2
Compressive Laminate fibre volume (%)	45.6	48.8
Normalised compressive strength @ 60%	424.7	882.2
fvf @ 0° fibre direction (MPa)		
Normalised compressive Modulus @ 60% fvf @ 0° fibre direction (MPa)	26.5	16.7
Flexural Strength @ 0° fibre direction (MPa)	516.1	1104.6
Flexural Modulus @ 0° fibre direction (MPa)	13.1	30.6
ILSS @ 0° fibre direction (MPa)	33.3	55.1
ILSS @ 90° fibre direction (MPa)	35.4	10.4

Note:

For data on other variants, please contact Technical Services

A full set of design allowables has been generated for these materials. Please contact Gurit for further details.

Component Properties

ST 94 single SPRINT® is available in carbon, glass, aramid and hybrid formats, ranging in weight from 200g to 1600g. Please see price list for the latest product information.

Compatible Surface Films

SPRINT® can be used in combination with a variety of Gurit surfacing materials, suitable for many different applications. Please see price list for the latest product information.

Compatible Adhesive Films

SP-High Modulus have a range of SA 80 adhesive films which can be used with all SPRINT® materials. These are supplied with a supporting medium in 250g and 400g film weights.

Health and Safety

Although Single SPRINT® materials have improved health and safety characteristics when compared to wet lay-up epoxy systems and conventional prepregs, the following points must still be considered:-

1. Avoid skin contact - wear disposable nitrile gloves.

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

In the pre-cured state Single SPRINT® materials contain 'dry' fibres which can be released when the material is being cut or processed. Care should be taken while handling the material to prevent contact with the skin and to control the egress of fibres into the workplace. Products that contain carbon fibres should be treated with particular care as carbon fibre is electrically conductive. Electrical equipment should be protected from carbon dust and fibres.

SP-High Modulus produces a separate full Material Safety Data Sheet for all hazardous products. Please ensure that you have the correct MSDS to hand for the materials you are using before commencing work. A more detailed guide for the safe use of SP-High Modulus resin systems is also available from SP-High Modulus, and can be found on our website at www.gurit.com

Applicable Risk & Safety Phrases

R 36/38, 40, 43, 51/53
S 26, 28, 36/37/39, 57, 60

Storage Conditions & Outlife

Storage time and temperature will have an effect on resin reactivity and fibre impregnation. The product can be stored for two years at -18˚C or for 8 weeks at ambient temperature (18-22˚C) without affecting resin reactivity. However, at ambient temperature the material will begin to self-impregnate much sooner than this, depending on size and tension of the roll, resin content and fabric style. We recommend therefore, that rolls of SPRINT® are stored frozen at -18˚C and only brought to room temperature when pieces of material are required for use. Having cut the necessary pieces, we recommend that they are stored flat until use. Minimising the out time of the SPRINT® at room temperature will reduce the resin migration and preserve the handling properties. When not being used SPRINT® should be stored in the freezer at all times.

The self-impregnation of the SPRINT® can compromise its ability to generate high quality laminates as the air breathing properties decrease after a certain length of time at ambient temperature. Self-impregnation will increase the tack and reduce the drape of the material. While self-impregnation will vary from product to product, most SPRINT® materials stored at ambient temperatures will self-impregnate within approximately two weeks. It is recommended that ambient temperature storage is below 22°C as higher storage temperatures will induce premature self impregnation. Contact Technical Services for further advice.

Rolls of SPRINT® should be removed from freezer storage in sufficient time to allow them to warm up to ambient temperature before they are used. For most rolls an overnight defrost will suffice, however large rolls may take longer. Rolls of SPRINT® should always be supported horizontally by their cardboard tube, as laying the rolls on the floor or bench may result in lines of partially wet-out material at the areas of high pressure under the roll. Material should not be allowed to remain for long periods at ambient temperature before application, as this will compromise the handling properties.

Transport & Storage

When not in use Single SPRINT® products should be maintained at -18°C. Shelf life for SPRINT® ST 94 is 2 years at -18°C and 8-10 weeks at 18-22°C. Ambient "SPRINT® life" (that is the time for which the fabric will remain dry and breathable, not fully wet out at room temperature) will vary with reinforcement weight and thickness but is typically between 1 and 3 weeks. To avoid condensation on the rolls allow to reach room temperature before unwrapping.

Notice

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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. 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.

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