T-SPRINT® 160

Low Temperature Curing SPRINT®

- **Low initial cure temperature of 65°C**
- **160°C Thermal performance**
- **Low void high quality laminate**
- **Excellent drapability and conformability**
- **Easy to lay-up**
- **Reduced labour working times**
- **Suitable for small to large mould builds**

Introduction

T-SPRINT® 160 is a low temperature curing SPRINT® material specifically designed for moulds operating up to 160°C.

The material has a dry appearance with a tack film on one side of the product to hold the material in place on vertical surfaces. The dry nature of the SPRINT® material results in a highly drapable product and channels for air breathing, which results in a low void content, high quality laminate when cured.

With the low initial cure temperature of 65°C T-SPRINT® 160 can be used with a wide variety of pattern materials to give a mould with high dimensional accuracy. Further post cure is required to obtain 160°C thermal performance.

Product Availabilty

T-SPRINT® 160 is available with the following reinforcements:-

Product Code	Resin System	Fabric 1	Resin Content (%)	Fabric 2	Width (mm)	Total weight of fabric in single SPRINT® layer (g)
SA11-3238	T-SPRINT® 160	RE290T	34%	RE290T	1240	580
SA11-3428	T-SPRINT® 160	WRE400T	34%	WRE400T	1250	780
SA11-2985	T-SPRINT® 160	WRE600T	34%	WRE600T	1240	1200
SA11-2920	T-SPRINT® 160	WRE581T	34%	WRE581T	1240	1160
SA13-2869	T-SPRINT® 160	RC200T	42%	RC200T	1270	400
SA13-2867	T-SPRINT® 160	RC660T	42%	RC660T	1270	1200

Table 1

Instructions for Use / Processing Recommendations

Test Panels

It is recommend to produce test panels, using the same materials and processing route, employed in the manufacture of the production mould. This is to ensure that there are no processing issues and the mould is of high quality.

Pattern / Plug Preparations

All the materials used in the construction of the plug should be capable of withstanding 75°C and not deform. Any coatings used on the pattern should be fully cured and solvent free. Ensure that the pattern is sealed and released coated with a suitable product. Make sure that the manufactures instructions are followed so a clean release is achieved.

Surface Coats or Gel Coats

It is not recommended to use a gelcoat with the T-SPRINT® 160 products.

Lay-Up Recommendations

It is recommended that best laminating practices be followed when laying up a mould. All joints should be butted on the first three layers and subsequent layers be either butted or have 0-10mm over laps. When laminating over and around corner details be sure that the layers do not bridge over the detail to cause resin rich areas. It is best to tailor the layers in areas of complex curvature, to avoid bridging.

De-bulking

On large planar areas it is not necessary to de-bulk the T-SPRINT® 160 during the layup. The T-SPRINT® 160 system will allow the air to be removed through the dry fibre passages. Introducing a low pressure de-bulk into the lay up of thick laminate sections will aid the laminating process by consolidating the loft of the material making it easier to apply the backing layers. This should completed with perforated release film, breather and vacuum bag. A 15 minute de-bulk between 60-90% vacuum pressure is adequate.

Cure Schedules Recommended Initial Cure

Step	Temperature	Process
1	20°C	Ambient de-bulk (time dependant on size)
2	Start at 20°C	Start cure at ambient
3	Ramp to 65°C	Ramp at a rate of 0.2-0.3°C per minute to 65°C
4	Dwell at 65°C	Dwell at 65°C + 5°C-0°C for 16 hours
5	Cool to 20°C	Cool slowly back to ambient, do not de-mould hot

Table 2 – Initial Cure

The T-SPRINT® 160 resin system has a minimum cure temperature of 65°C and caution should be taken when curing, that there are no cold spots in the oven that are below 65°C. It is advisable that if there is variation in the oven temperature that the dwell temperature is raised to compensate and ensure that the minimum cure temperature is reached.

Quality of the laminate with different cure schedules

As plugs / masters often have a high thermal mass and heat up slowly the resin system has been formulated to achieve a high quality laminate from a slow ramp rate to the initial dwell temperature. Reducing the ramp of this system below 0.3°C per minute does reduce the amount of resin flow in the laminate. Ramp rates above 0.3°C / minute will affect the quality of the laminate and it will be noticeable in areas were fibre bridging has occurred and the resin is less likely to flow and fill voids.

Post Cure after the mould has been de-moulded

A free standing postcure will be required to achieve the ultimate HDT of the mould. The mould should be postcured according the the postcure schedule shown below.

Step	Temperature	Step	Process
1	20°C	Start	Start cure at ambient
2	75°C	Ramp	Ramp at a rate of 0.3°C
3	75°C	Dwell for 30 minutes	
4	90°C	Ramp	Ramp at a rate of 0.3°C
5	90°C	Dwell for 60 minutes	
6	120°C	Ramp	Ramp at a rate of 0.3°C
7	120°C	Dwell for 30 minutes	
8	140°C	Ramp	Ramp at a rate of 0.3°C
9	140°C	Dwell for 360 minutes	Dwell for 6 hrs to fully cure the resin matrix
10	20°C	Cool	Cool slowly back to ambient

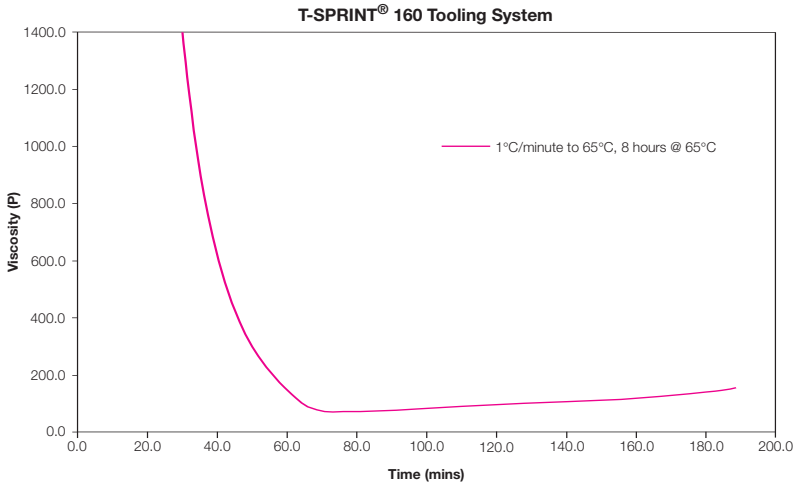
Table 2 – Initial Cure

Technical Data

Working Properties

Viscosity Profile

The following graph show the typical viscosities obtained during a cure of 1°C/min ramp to 65°C and dwelled at 65°C. Other testing has shown that lower temperatures dwells between 40°C and 50°C, for periods up to 2 hours will not significantly increase the viscosity of the matrix resin, when the T-SPRINT® 160 product reaches the initial cure temperature of 65°C. This is useful when using an intermediate dwell at 40°C-50°C to ensure the oven has achieved a uniform temperature.



Graph 1 - Viscosity Profile of Cure

Property	Result	Method	Notes
Minimum Cure Temperature (°C)	65°	DSC	
Minimum Initial Cure Time (hrs) @ 65°C	16	DSC	
Minimum Viscosity (1°C/min ramp) (P)	81	Rheometer	30-130°C @ 2°C/min
Temp @ Minimum Viscosity (°C)	65	Rheometer	30-130°C @ 2°C/min
Tg2 after cure at initial cure at 65°C	70-75°c	DSC	
Minimum vacuum processing pressure	90% or 26.5" Hg		
Post Cure Time @ 80°C (hours)	29	IR	*
Post Cure Time @ 100°C (hours)	20	IR	*
Post Cure Time @ 120°C (hours)	12	IR	*
Tg2 after post cure at 140°C	161°c	DSC	

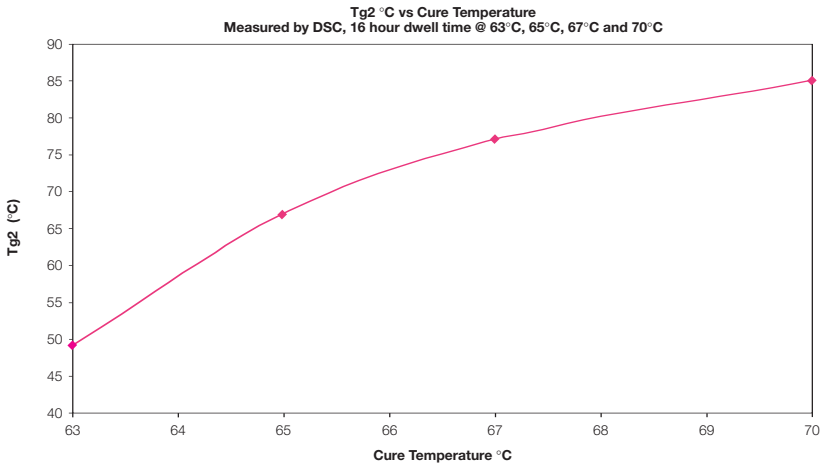
Table 4 – Material Processing characteristics

* This measurement is the minimum recommended cure time for the resin matrix to achieve maximum properties at this temperature. Note that if the system is cured at a lower temperature further reaction will occur if the resin matrix is subjected to higher temperatures.

Cure	Material Construction	Tg1 (DMTA)
Ramp. 0.3°C/minute, dwell 16 hours @ 65°C	T-SPRINT®160 1 layer of WRE581T	65°C
Ramp. 0.3°C/minute, dwell 16 hours @ 65°C	T-SPRINT®160 4 layers of WRE581T	75°C

Table 5 - Effect on Tg with thin layers of T-SPRINT®160

The following graph shows that if the dwell temperature drops below 65°C the Tg of the cured part may be lower than expected. If there are any concerns of cold spots within the oven, during the initial cure, it is recommend that the dwell temperature be raised to ensure the part has a suitable Tg when de-moulded.



Graph 2 – Effects of Cure Temperature vs. Tg

Post Cure	Tg1 by DMTA	ILSS (ASTM D2344)	Climbing Drum Peel (BS5350 Part C13)	Flexural Strength (ASTM D790M)
	(°C)	N/mm²	(N/70mm)	Rm mm²
16 hours at 65°C	67.7	53.06	262.9	691.5
16 hours at 80°C	104.43	51.32	267.1	659.85
16 hours at 100°C	115.86	49.35	232.9	626.71
16 hours at 120°C	137.63	47.03	208.6	618.86
6 hours at 140°C	152.66	43.89	185.7	570.25

Testing completed on SA11-2920, SPX4787/WRE581T/34%/WRE581T/1260

Table 6

Health and Safety

Although 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 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 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 and Safety Phrases

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

Transport and Storage

When not in use T-SPRINT® products should be maintained at -18°C. Shelf life for T-SPRINT® 160 is two years at -18°C and two weeks at 18-22°C. To avoid condensation on the rolls allow to reach room temperature before unwrapping.

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 4 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 SP 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

The resin and hardeners should be kept in securely closed containers during transport and storage. Any accidental spillage should be soaked up with sand, sawdust, cotton waste or any other absorbent material. The area should then be washed clean (see appropriate Safety Data Sheet).

Adequate long term storage conditions will result in a shelf life of two years for both the resin and hardeners. Storage should be in a warm dry place out of direct sunlight and protected from frost. The temperature should be between 10°C and 25°C. Containers should be firmly closed. Hardeners, in particular, will suffer serious degradation if left exposed to air.

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 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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