Product Description

LTM®123 is a low temperature curing, toughened prepreg matrix system developed for structural applications requiring ultimate dimensional stability in a space environment. Its low moisture absorption and low electrical permittivity characteristics also make it suitable for radomes and radar absorbing structures. LTM123 is also suitable for high service temperature structural applications in the motorsport market.

LTM123 can be processed using autoclave and vacuum bag methods to give low voidage composites and can be moulded off a range of low cost tooling with few constraints on structure dimensions.

For space applications, LTM123 can develop a Tg of 140°C (284°F) after a minimum initial cure at 80°C (176°F) and a free-standing post-cure of 120°C (248°F).

For motorsport applications, LTM123 can develop a Tg of 250°C (482°F) after a minimum initial cure at 80°C (176°F) and a free-standing post-cure of 240°C (464°F).

Features

- Out life: 2 to 3 days at 21°C (70°F)
- Exhibits good tack and drape
- Excellent dimensional stability
- Minimum initial cure temperature: 80°C (176°F)
- More rapid cure cycles are possible at higher temperatures
- Maximum dry Tg of 250°C (482°F) following a 240°C (464°F) free-standing post-cure
- Hot/wet performance: 120°C (248°F)
- Very low moisture uptake
- Good dielectric properties

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CERTIFICATE No. 924425

PDS1129/01.10/5

Registered Office
Registered No. 2264869 England

Instructions for Use

Moisture Effects - Special Precautions

LTM123 prepreg polymerisation reaction can be adversely affected by moisture. Therefore, special precautions must be taken to ensure that the prepreg, and everything in contact with it during the cure cycle, is as free as possible from absorbed moisture. The same precautions need to be taken with an initially cured (partially cross-linked) component during the post-cure cycle.

Under certain conditions, moisture will react with the polymer functional groups to produce carbon dioxide gas and, at high temperature, any trapped gas will expand and cause the laminate to blister.

The prepreg should be removed from the freezer, thawed and allowed to reach room temperature before it is removed from the protective polythene bag. All tooling and any moulded inserts must be thoroughly dried before lay-up commences.

Release Agents

The type of release coating on the mould surface can have a significant effect on both surface appearance and internal voids of cured laminates.

For vacuum bag oven-based processing, ACG recommends using adhesive backed PTFE coated glass fabrics against the tool face. Such fabrics are microporous and allow air to escape during cure. However, these fabrics are only suitable for flat or gently curving surfaces and allowance must be made for the thickness of the release fabric.

Silazane release agents, such as Frekote™ 700NC, and PTFE spray can be readily applied to complex tool shapes, but they will not give the same surface quality.

Both Silazane and PTFE release agents should produce acceptable surface finish when LTM123 is cured under autoclave conditions.

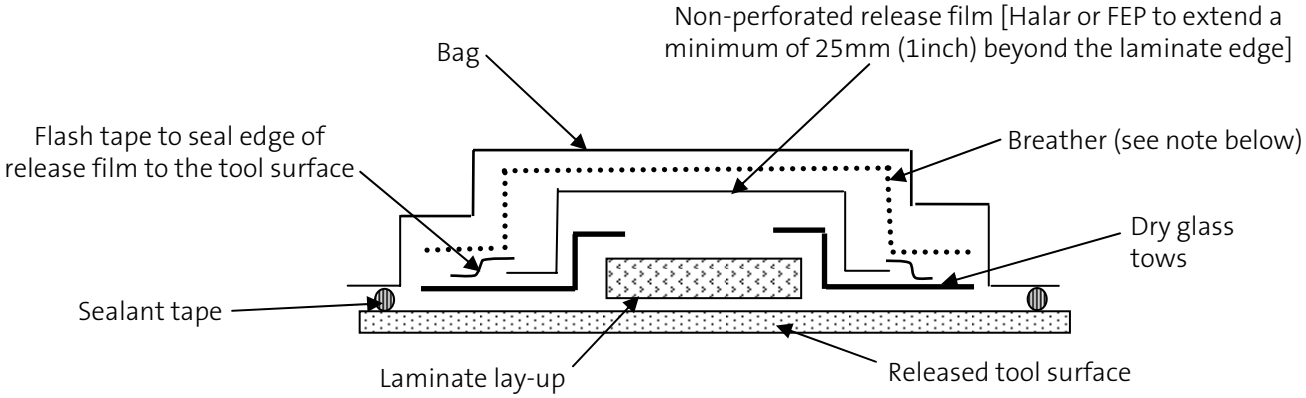
Laminating

Prepreg should be cut to shape and laid up in accordance with design instructions. It is common practice to kit cut and re-freeze material to maximise out life.

Debulking During Lay-Up

During the lay-up process, the laminate stack should be debulked at regular intervals to ensure the prepreg conforms exactly to the tool shape, especially around internal corners thereby preventing bridging and ensuring good consolidation over the whole surface area. The lay-up should be covered with a perforated release film (P3) plus a suitable breather and a low cost membrane. It should then be placed under vacuum for approximately 5 to 10 minutes. It is recommended that the lay-up is debulked every 3 to 4 plies.

Recommended Bagging Arrangement



Glass Tows Detail
Placing dry glass tows at 0.5m (20in) intervals around the edge of the laminate will provide air paths under the release film and into the breather (depicted above).

Release Film Detail
The release film may be taped down to the tool surface with flash tape as required.

Breather Detail
Apply one layer of heavyweight breather fabric over the entire lay-up. Extra plies may be fitted at valve positions as required. Special care should be taken to ensure that breather is well fitted into corners to prevent bridging in the curing laminate.

During cure the highest available vacuum must be used - typically 980mbar (29in Hg). The vacuum should be checked with a gauge at the opposite side of the laminate to the position of the vacuum port.

A vacuum drop test should be performed prior to cure of the part. The test must show no more than 68mbar (2in Hg) vacuum loss within 10 minutes once vacuum is removed.

Exotherm

LTM123 is a reactive formulation which can undergo severe exothermic heat build up during the initial curing process if incorrect curing procedures are followed.

Great care must be taken to ensure that safe heating rates; dwell temperatures and lay-up/bagging procedures are adhered to, especially when moulding solid laminates in excess of 5mm (0.2inch) thickness. The risk of exotherm increases with lay-up thickness and increasing temperature. It is strongly recommended that the user carries out representative trials of all the relevant circumstances to allow a safe cure cycle to be specified. It is also important to recognise that the model or tool material and its thermal mass, combined with the insulating effect of breather/bagging materials can affect the risk of exotherm in particular cases.

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If in doubt, contact the Advanced Composites Group's technical support staff for advice on modified cure cycles for thick laminates, especially those greater than 5mm (0.2inch).

Typical Cure Cycles

Autoclave Cure:
Apply 982 mbar (29in Hg) vacuum at room temperature and maintain this throughout the cure cycle.

The heat-up rate may be varied to suit the size and thickness of the tool and the component lay-up. Typically, heat up rates between 2 and 5°C (3.6 and 9°F) per minute will probably be suitable for most components. Cure temperature may be varied to suit the particular application or production schedule.

Pressurisation should commence when the leading thermocouple has reached 70°C (158°F). This will normally be around 30 minutes from the start of the cure. Do not, under any circumstances, delay pressurisation beyond 1 hour from the start of cure.

Note:
Following initial cure, it is preferable to cool under vacuum only. Autoclave pressure may be released at the onset of the cooling stage. The vacuum may be vented and debagging commenced when part temperature has fallen by >20°C (36°F) below the cure temperature, but this may be detrimental to the dimensional accuracy of the part. Sandwich panels may require cooling to a lower temperature to avoid skin to core bond failure.

Vacuum/Oven Cure:
The consumables arrangement should be identical to that used for an autoclave cure.

Apply 982 mbar (29in Hg) vacuum at room temparture (RT) and maintain throughout the cure cycle.

The heat-up rate may be varied to suit the size and thickness of the tool and the component lay-up. Typically, heat-up rates between 2 and 5°C (3.6 and 9°F) per minute will probably be suitable for most components. Cure temperature may be varied to suit the particular application or production schedule.

Instructions for demoulding the part are identical to those supplied for autoclave curing.

Initial Cure Conditions:

LTM123 Cure and Post-Cure (Space Applications)	
Tg after 16 hours @ 80°C (176°F) (minimum initial cure)	90°C (194°F)
Tg after 4 hours @ 100°C (212°F) post-cure	120°C (248°F)
Tg after 3 hours @ 120°C (248°F) post-cure	140°C (284°F)
Tg after 4 hours @ 150°C (302°F) post-cure	170°C (338°F)
Tg after 8 hours @ 200°C (392°F) post-cure	210°C (410°F)

Tg determined as DMA tangent intercept.

LTM123 Cure and Post-Cure (Motorsport Applications)	
Tg after 2 hours @ 135°C (275°F)	140°C (194°F)
Tg after 2 hours @ 240°C (464°F) post-cure	250°C (482°F)

Tg determined as DMA tangent intercept.

Post-Cure

Components must be post-cured to develop the maximum Tg and mechanical properties. It is recommended that parts are subjected to a minimum post-cure of 120°C (248°F) before further processing operations are carried out. The final post-cure temperature may be varied up to a maximum of 240°C (464°F), depending on the final service temperature.

ACG recommends performing the post-cure immediately after the initial cure has been completed. This will avoid the risk of moisture absorption by the partially cured polymer, which can cause blistering.

- Parts may be loaded into a pre-heated oven set at the initial cure temperature. Alternatively, parts can be heated at 3°C (5°F)/minute to the initial cure temperature.
- Continue heating at a rate of 0.3°C (0.54°F)/minute to post-cure temperature.
- Maintain at post-cure temperature for duration indicated in above tables.
- Cool at a rate of 3°C (5°F)/minute to 70°C (158°F).

Note:
Large components should be adequately supported to avoid distortion.

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Technical Data

Uncured Resin Viscosity:

Temperature	Viscosity (Poise)
30°C (86°F)	91780
60°C (140°F)	154.0
80°C (176°F)	14.0
Prepreg Volatiles:	< 1% w/w

Cured Resin Properties:

Density	1.193 g/cm^3
Electrical properties: Dielectric constant at 10-14 GHz Loss Tangent at 10-14 GHz	 2.77 0.0050

Laminate Properties (Space Applications):

LTM123/M55J (Low Temperature Cure followed by post-cure of 3 hours @ 120°C (248°F)		
Property	**Units**	**Value**
Coefficient of Thermal Expansion: 20 to 80°C (68 to 176°F) on 0° carbon M55J	10^{-6}mm/mm/°C	-1.00 ± 0.02
Coefficient of Moisture Expansion: 0 to 60%RH, 60°C (140°F), 1.5mm $[0, \pm 60°]_s$ / M55J	µm/m/°C	97
Moisture Saturation level: 0 to 60%RH, 60°C (140°F), 1.5mm $[0, \pm 60°]_s$ / M55J	%	0.22
Moisture Saturation level (cast resin): 50%RH, 23°C (75°F)	%	0.75
Moisture Strain: 0 to 60%RH, 60°C (140°F), Quasi Isotropic / M55J	µm/m	21.3
Linear shrinkage after 200°C (392°F) post-cure, 0/90° - 60%Vf	%	0.02

LTM123/M55J Low Temperature Cure followed by 3 hours @ 120°C (248°F) post-cure			
	Orientation	Units	RT Dry
ILSS	0/90°	MPa (ksi)	36 (5.22)
Compression Strength	0/90°	MPa (ksi)	380 (55.1)
Tensile Strength	0/90°	MPa (ksi)	>760 (>110.2)
In Plane Shear Strength	± 45°	MPa (ksi)	56 (8.1)
Laminate Voidage	0/90°	%	0.0
Tg (TMA)	0/90°	°C (°F)	140 (284)

Compressive and Tensile properties normalised to 60%Vf.

LTM123 AS4 (145gsm) 16 hours/80°C (176°F) followed by 2 hours @ 175°C (347°F) post-cure				
	Orientation	Units	RT Dry	120°C (248°F) Wet *
Compression Strength	0°	MPa (ksi)	1130 (164)	790 (144.5)
Flexural Strength	0°	MPa (ksi)	2013 (292)	-
Flexural Modulus	0°	GPa (msi)	129 (18.7)	-
Interlaminar Shear Strength	0°	MPa (ksi)	100 (1.45)	-
In plane Shear Strength	±45°	MPa (ksi)	119 (17.2)	-

* Wet conditioned for 14 days immersion at 70°C (158°F). Compressive and Tensile properties normalised to 60%Vf.

LTM123 / CF0300 (199gsm 3K HS 2x2T carbon fabric) 16 hours / 80°C (176°F) followed by 3 hours @ 200°C (392°F) post-cure				
	Orientation	Units	RT Dry	177°C (351F) Dry
Flexural Strength	0/90°	MPa (ksi)	995 (144.3)	899 (130.4)
Flexural Modulus	0/90°	GPa (msi)	56 (8.1)	57 (8.3)
Compression Strength	0/90°	MPa (ksi)	-	533 (77.3)
Interlaminar Shear Strength	0/90°	MPa (ksi)	75 (10.9)	47 (6.8)
6.7J/mm CAI (mod. SACMA)		MPa (ksi)	143 (20.7)	-

Compressive and Tensile properties normalised to 55%Vf

LTM123/GF0102 8H satin - 300gsm E-glass fabric (epoxy Silane finish) 16 hours at 80°C (176°F) followed by 2 hours @ 200°C (392°F) post-cure					
	Orientation	Units	RT Dry	120°C (248°F) Wet*	160°C (320°F) Wet*
Flexural Strength	0/90°	MPa (ksi)	1001 (145.1)	557 (80.8)	550 (80)
Flexural Modulus	0/90°	GPa (msi)	33 (4.8)	27 (3.9)	26 (3.8)
Interlaminar Shear Strength	0/90°	MPa (ksi)	80 (11.6)	40 (5.8)	34 (4.9)

* Wet conditioned 14 days immersion at 70°C (158°F). Flexural data normalised to 55%Vf.

Laminate Properties (Motorsport Applications):

LTM123/CF1218 (200g, 2x2T, T800 carbon fabric) 2 hours @ 135°C (275°F) followed by 2 hours @ 240°C (464°F) post-cure				
	Orientation	Units	RT Dry	200°C Dry
Compressive Strength	0/90°	MPa (ksi)	864 (125.3)	602 (87.3)
Interlaminar Shear Strength	0/90°	MPa (ksi)	63 (9.1)	37 (5.4)

Compressive data normalised to 55%Vf.

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Availability

LTM123 prepreg is available in a wide range of reinforcing fabrics and unidirectional tapes including glass, carbon, aramid and hybrids.

Out Life and Storage Data

Storage at -18°C (0°F)	6 months
Out life at 21°C (70°F)	2 to 3 days

Health and Safety

LTM123 contains cyanate ester resin which can cause allergic reaction on prolonged or repeated skin contact. Gloves and protective clothing must be worn.

Wash skin thoroughly with soap and water or resin-removing cream after handling. Do not use solvents for cleaning the skin.

Use mechanical exhaust ventilation when heat curing the resin system.

For further information consult the ACG (Material) Safety Data Sheet.

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