

## Product Description

MTM49 series of prepregs is based on 80-160°C (176-320°F) curing toughened epoxy matrix resins designed for the manufacture of components.

The series possesses excellent ambient and hot mechanical performance combined with good impact resistance after only moderate cure cycles.

The series comprises:-

- |         |  |
|---------|--|
| MTM49   | Component prepreg with a good balance of Tg and toughness properties.  |
| MTM49-1 | Component prepreg for use where toughness improvements are required over MTM49 whilst retaining a satisfactory 80°C (176°F) wet service temperature. |
| MTM49-3 | Component prepreg giving a high Tg and moderate toughness.   |
| MTM49-7 | Component prepreg for use in applications where a very high dry Tg is required after a suitable postcure.  |

## Features

- Range of end use temperatures, depending on application and postcure.
- Good tack and drape.
- Long outlife.
- Good impact resistance.
- Autoclave, vac bag or press curable.

## Instructions for use

### Thawing prepreg before use:

MTM49 series prepreg should be removed from the freezer and allowed to reach room temperature prior to opening the sealed bag. The presence of moisture within a curing laminate may degrade the quality and aesthetic appearance of the structure produced. Consequently it is prudent to ensure that prepreg of all types is fully thawed to the core of the roll before the seal on the storage bag is broken to avoid potential moisture contamination as a result of condensation. For a 25m (82ft) roll of MTM49 series prepreg, the typical thaw time from storage at  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) is of the order of 4 to 6 hours.

### Cutting prepreg:

The prepreg should be cut prior to removal of the release films. The balance of prepreg not required should be resealed and returned to the freezer although it is preferable to cut up complete rolls on the first removal from the freezer.

### Release Agents:

The type of release coating or fabric can have a significant effect on both surface appearance and internal void content of cured laminates.

For vacuum-only oven cured part manufacture, adhesive backed PTFE coated glass fabrics (RF851) applied to the tool face will provide the optimum conditions for air removal. Such fabrics are slightly microporous which allows air to escape during cure. However, these fabrics are not easy to use. On flat or gently curving surfaces allowance needs to be made for the thickness of the release fabric and in complex geometry tools it may not be practical to drape the fabric into corners and small radii. Nevertheless, where practical, strongly recommends the use of such fabrics for vacuum-only cure conditions to facilitate internal void contents well below 0.5%, and fault free surfaces with a wide range of reinforcements and fibre volume fractions.

For autoclave curing of MTM49 series prepreps, Silazane spray release agents (such as Frekote™ 700NC) are good release agents which are easy to apply to the most complex of tool shapes. The resultant surface is smooth however, and air may be trapped between the surface of the laminate and the surface of the tool if other precautions are not taken to provide paths for air to escape.

PTFE spray release agents have different surface tension characteristics to silazane and has found a slight improvement in surface appearance compared to silazane. The effect, however, is insignificant compared to the influence of other process parameters.

### Laying-up the prepreg including debulk instructions:

The release paper should be removed from the first ply, which should be positioned into the carefully released mould tool. Care must be taken to ensure the prepreg conforms exactly to the tool shape, especially around internal corners. If necessary, the tack of the system may be increased by gentle warming with hot air.

The lay up should be vacuum debulked at regular intervals using a P3 (pin pricked) Halar release film on the prepreg surface and 2 lightweight breather layers. The laminate should be vacuum bagged and a vacuum of 982 mbar (29in Hg) applied for 2 to 10 minutes depending on component complexity. As a general recommendation, the lay-up should be debulked after the first and every subsequent third ply.

### Preparation for Autoclave or Vacuum Bag Cure:

Once the required thickness has been built up, the laminate should be prepared for cure.

For autoclave cures, the following consumables pack should be used:-

1. Apply 1 layer of non-perforated release film over the entire back face of the laminate and extending approximately 25mm (1in) beyond the edge of the lay-up. Cut and tailor the film to avoid potential bridging problems.
2. Fit glass tows at 0.5m (20in) intervals around the periphery of the lay-up such that they fit under the release film and over the edge of the lay-up by approximately 25mm (1in) and also outwards beyond the edge of the release film by 25mm (1in).
3. Apply 1 layer of heavyweight 340 gsm (10oz/yd<sup>2</sup>) breather fabric over the entire lay-up and extending to the valve positions. The fabric should be cut in and tailored carefully to avoid bridging. Extra plies should be fitted at valve positions.
4. Apply the vacuum membrane, allowing sufficient slack to avoid bridging when vacuum is applied.

The same consumables pack can be used for vacuum-only oven curing.

## General Cure Cycles

The MTM49 series of prepregs can be initially cured between 80°C and 160°C (176°F and 320°F), and they are extremely tolerant to this level of cure cycle variation. As a general guide, the following minimum cure cycles may be employed for the MTM49 series of prepregs.

Cure Temperature		Time
80°C	(176°F)	16 hours
90°C	(194°F)	8 hours
100°C	(212°F)	4 hours
120°C	(248°F)	1 hour
140°C	(284°F)	25 mins
150°C	(302°F)	15 mins
160°C	(320°F)	7 mins

Individual systems vary in their cure characteristics to some extent, so specific checks with the selected resin are required to ensure satisfactory performance.

After initial cure, a postcure may be required to meet the end-use requirements for the material. Postcures from 100-200°C (212-392°F) may be used to suit specific applications. Please consult technical support staff if you require assistance in determining the correct cure cycle for your application.

### Vacuum Bag Cure:

The bagged laminate should be heated to the initial cure temperature at 1-3°C (2-5.4°F) per minute under a vacuum of 982 mbar (29in Hg).

After the appropriate time at the chosen cure temperature, the laminate should be cooled to room temperature at 3°C (4°F) per minute maximum and the vacuum released.

### **Autoclave Cure:**

With 982 mbar (29in Hg) vacuum applied to the bag, the autoclave pressure should be increased to 0.62 MPa (90 psi) or the maximum allowable for the honeycomb type if producing sandwich structures.

The temperature should be increased to 120°C (248°F) or, to the initial cure temperature, at 1-3°C (2-5.4°F) per minute and held at temperature for the appropriate length of time given in the preceding table.

The laminate should be allowed to cool under pressure to 60°C (140°F) at 3°C (5.4°F) per minute. The pressure may then be released.

### **Matched Die Moulding:**

MTM49 series prepregs may also be processed by compression moulding. Mould tools should restrain flow sufficiently under moulding conditions to avoid fabric or fibre distortion.

The material should be placed in the mould and a minimum pressure of 40psi applied.

The assembly should be heated to the initial cure temperature at a suitable rate and held at temperature for the indicated dwell time.

### **Exotherm**

In certain circumstances, such as the production of thick section laminates (over 10mm) (0.4in), rapid heat-up rates or highly insulating mould tools, MTM49 series prepregs can undergo exothermic heating leading to rapid temperature rise and component degradation or loss in extreme cases.

It is strongly recommended that in such cases, trials representing all relevant process parameters should be carried out by the user to confirm a safe processing specification.

Technical support staff should be consulted for advice on exotherm behaviour.

## Technical Data

### Cured Resin and General Prepreg Properties:

Property	Units	MTM49	MTM49-1	MTM49-3	MTM49-7
Prepreg volatiles		<1%	<1%	<1%	<1%
Cured resin density	g/cm <sup>3</sup>	1.23	TBA	TBA	1.22
Tg# after 80°C (176°F) cure	°C	102	104	100	107
Peak Tan δ after 80°C (176°F) cure	°C	117	124	124	130
Tg# after 135°C (275°F) cure - 2 hours	°C	145	140	150	TBA
Peak Tan δ after 135°C (275°F) cure - 2 hours	°C	188	182	215	TBA
Max Dry Tg#	°C	170	160	180	200
Max Dry Peak Tan δ	°C	195	188	216	220
Max Wet Tg#**	°C	97	84	115	120
Max Wet Peak Tan δ **	°C	113	104	135	TBA
Prepreg Outlife at 21°C (70°F) *		30 days	30 days	60 days	60 days
Prepreg Minimum Cure Temperature	°C (°F)/hrs	75(167)/24	75(167)/24	70(158)/24	70°C(158)/24
Prepreg Tack / Handleability*		Good	Good	Excellent	Good

# Tg defined by DMA as 15% loss of elastic modulus from a defined onset position

\* Fresh material with no accumulated out time

\*\* Wet conditioning for 14 days immersion in water at 70°C (158°F)

## Typical Mechanical Properties

Comparison of Unidirectional Carbon Laminates:

Performance data for MTM49 series / T800 unidirectional prepreg laminates. Data normalised to 60%Vf.

Property	Units	Test Condition	MTM49*	MTM49-1*	MTM49-3*	MTM49-7
Interlaminar Shear Strength 0°	MPa	RT Dry	116	95	115	123#
		120°C (248°F) Dry	65	55	84	76#
		120°C (248°F) Wet**	35	31	34	34†
In-plane Shear Strength ± 45°	MPa	RT Dry	111	113	98	TBA
		120°C (248°F) Dry	100	86	96	TBA
		120°C (248°F) Wet**	47	34	63	TBA
In-plane Shear Modulus ± 45°	GPa	RT Dry	4.9	5.4	5.5	TBA
		120°C (248°F) Dry	3.2	3.1	4.9	TBA
Ultimate Tensile Strength 0°	MPa	RT Dry	2405	1974	2300	2379#
		120°C (248°F) Dry	2116	2073	2247	TBA
Flexural Strength 0°	MPa	RT Dry	2033	2069	2207	2198#
		120°C (248°F) Dry	-	-	-	1574#
Flexural Modulus 0°	GPa	RT Dry	130	127	162	147#
		120°C (248°F) Dry	-	-	-	144#
Ultimate Compression Strength 0°	MPa	RT Dry	1362	1529	1450	TBA
		120°C (248°F) Dry	911	1216	1044	TBA
		80°C (176°F) Wet**	675	627	772	TBA
Compression Modulus 0°	GPa	RT Dry	TBA	177	142	TBA
		120°C (248°F) Dry	TBA	155	162	TBA
Compression Strength after 6.6J/mm Impact (QI)	MPa	RT Dry	160.0	205.2	160	152^

\* Cure condition 2 hours at 135°C (275°F) plus 2 hours at 150°C (302°F) postcure

† Cure condition 2 hours at 135°C (275°F) plus 2 hours at 200°C (392°F) postcure

^ Cure condition 16 hours at 80°C (176°F) plus 2 hours at 175°C (347°F) postcure

# Cure condition 2 hours at 135°C (275°F)

\*\* Wet conditioning for 14 days immersion in water at 70°C (158°F)

Performance data for MTM49/woven T800 2x2 Twill fabric in 0/90° configuration. Laminates cured for 1 hour at 120°C (248°F)

Property	Units	Test Condition			
		RT Dry	80°C (176°F) Dry	130°C (266°F) Dry	130°C (266°F) Wet*
Interlaminar Shear Strength (retention %)	MPa	70 (100%)	65 (93%)	40 (57%)	30 (43%)
Ultimate Tensile Strength	MPa	850	TBA	TBA	TBA
Tensile Modulus	GPa	80	TBA	TBA	TBA
Flexural Strength (retention %)	MPa	1200 (100%)	1050 (88%)	900 (75%)	740 (62%)
Flexural Modulus (retention %)	GPa	65 (100%)	65 (100%)	54 (99%)	64 (99%)
Ultimate Compression Strength	MPa	760	TBA	TBA	TBA

\* Wet condition is tested after a 24 hour water boil

Performance data for MTM49/34-700 unidirectional carbon in 0° configuration. Laminates cured for 1 hour at 120°C (248°F)

Property	Units	Test Condition			
		RT Dry	80°C (176°F) Dry	130°C (266°F) Dry	130°C (266°F) Wet*
Interlaminar Shear (retention %)	MPa	95 (100%)	75 (79%)	50 (53%)	45 (47%)
Flexural Strength (retention %)	MPa	2100 (100%)	1800 (86%)	1400 (67%)	1200 (57%)
Flexural Modulus (retention %)	GPa	130 (100%)	120 (92%)	100 (77%)	95 (73%)
Ultimate Compression Strength	MPa	1300	TBA	TBA	TBA
Compression Modulus	GPa	110	TBA	TBA	TBA

\* Wet condition is tested after a 24 hour water boil



Performance for MTM49-3/T800 unidirectional prepreg laminates 0°, after exposure to various Hot/Wet conditions. Data normalised to 60%Vf.  
All laminates cured at 135°C (275°F) and postcured for 2 hours at 200°C (392°F).

Property	Units	Test Conditions						
		RT dry	24 hr water boil			14 day immersion in water @ 70°C		
			80°C	100°C	120°C	80°C	100°C	120°C
Interlaminar Shear Strength (% retention)	MPa	112 (100%)	71 (63%)	61 (54%)	52 (46%)	60 (54%)	52 (46%)	42 (38%)
Compression Strength (% retention)	MPa	1437 (100%)	TBA	TBA	TBA	965 (67%)	828 (58%)	537 (37%)
Flexural Strength (% retention)	MPa	1985 (100%)	1427 (72%)	1309 (66%)	902 (45%)	TBA	TBA	TBA
Flexural Modulus (% retention)	GPa	147 (100%)	145 (98%)	149 (101%)	133 (90%)	TBA	TBA	TBA

Performance for MTM49-3/CF2518, 0/90° woven carbon laminates after exposure to various hot/wet conditions. Data normalised to 55%Vf.  
All laminates cured at 135°C (275°F) and postcured for 2 hours at 200°C (392°F)

Property	Units	Test Conditions						
		RT dry	24 hr water boil			14 day immersion in water @ 70°C		
			80°C	100°C	120°C	80°C	100°C	120°C
Interlaminar Shear Strength (% retention)	MPa	61 (100%)	52 (85%)	44 (72%)	34 (56%)	47 (77%)	36 (59%)	29 (48%)
Flexural Strength (% retention)	MPa	1184 (100%)	915 (77%)	740 (63%)	550 (47%)	TBA	TBA	TBA
Flexural Modulus (% retention)	GPa	70 (100%)	75 (107%)	64 (92%)	62 (89%)	TBA	TBA	TBA

## Availability

MTM49 series is available with a wide range of reinforcing fabrics and unidirectional tapes including glass, carbon, aramid and hybrids.

## Storage

The tack-life of the MTM49 series prepregs, in sealed wrapping in a dry environment at  $21\pm 3^{\circ}\text{C}$  ( $70\pm 6^{\circ}\text{F}$ ), is 30 days.

The storage life of the MTM49 series of prepregs, in sealed wrapping in a deep freeze at  $-18^{\circ}\text{C}$ , is 1 year.

## Health and Safety

MTM49 series prepregs contain an epoxy resin, which can cause allergic reaction on prolonged or repeated skin contact. Gloves and protective clothing must be worn.

Wash the skin thoroughly with soap and water or resin removing cream after handling. Do not use solvents to clean the skin.

Use mechanical exhaust ventilation when heat curing the resin system.

For further information consult the following Health and Safety Documents:-

MTM49	MSDS No 120
MTM49-1	MSDS No 184
MTM49-3	MSDS No 291
MTM49-7	MSDS No 293