



SOLVAY

asking more from chemistry®



Lightweighting & Fire Protection

For Composite Rail Applications

**COMPOSITE
MATERIALS**

Solvay leads the way in the provision of structural and interior prepregs to the rail industry, supplying epoxy and phenolic resin systems formulated to comply with stringent fire requirements. Our portfolio includes a comprehensive range of processing consumables and tooling solutions, all of which are fully compatible with our prepregs.



Reduced weight lowers initial inertia, allowing higher speeds to be achieved quickly and efficiently. This also has the potential to reduce track load, decrease wear and lower trackside maintenance costs.

Our design, engineering and application support departments offer a unique service to assist customers in converting existing structures from current material configurations into weight-saving, cost effective prepreg formats.

A typical composite panel weighs

- 50% less than aluminum
- 80% less than steel



A Forward Thinking Approach

With our in depth understanding of the rail rolling stock market, Solvay is ideally placed to offer the correct materials from our range to meet any of the myriad of international fire regulations.

- Tooling materials for the manufacture of the tooling hardware necessary to form our prepregs
- Vacuum bagging consumables
- Adhesive films

Composite Materials

- Suitable for low cost vacuum bag processing, and press and autoclave molding
- Ideal for simple and complex shapes
- Ease of use with a broad processing window
- Provide an excellent surface finish
- Ideal for monolithic and sandwich structures
- Offer good mechanical performance
- Supplied across a wide range of fabrics and fibers

Composite Materials Product Selector Guide

Our MTM® prepreg technology allows for the manufacture of lightweight advanced composite panels for carriage interiors, and interior and exterior structural applications.

Prepreg	Resin Type	Applications		
		Carriage Interiors	Exterior Panels	Structural Parts
MTM® 82S-C	Phenolic	Yes	Yes	Limited
MTM® 29SFR	Epoxy	Yes	Yes	Yes
MTM® 348FR	Epoxy	Yes	Yes	Yes

Applications

Carriage Interiors:

- Wall panels and partitions
- Window frames
- Connecting archways
- Floors, ceilings and decking
- Bulkheads and standbacks
- Luggage racks and compartments
- Seating and furnishings
- Hatches and doors
- Drivers' cab instrument panels

Exterior panels and structural parts:

- Front end fairings
- Energy absorbers
- Doors and inspection covers
- Bogie debris inspection plates
- Stone guards
- Sundry interior and exterior structural parts
- Composite rooves and carriages
- Bogie leaf springs
- Bogie frames and fittings
- Tunnel reinforcement props and panels
- Fishplates

Fire Performance

MTM® 82S-C phenolic resin prepregs comply with:

- BS476 Parts 6 and 7
- BS 6853 Cat 1a
- NF P 92-501 Rating M1
- NF F 16-101 Rating F1
- DIN5510 Rating S4, SR2, ST2
- EN45545-2:2013, Categories HL1, HL2, HL3

MTM® 29SFR epoxy resin prepregs comply with:

- BS 6853 Cat 1b (exteriors)
- BS 6853 Cat 2 (interiors)
- DIN5510 Rating S4, SR2, ST2

MTM® 348FR epoxy resin system meets the requirements of:

- EN45545-2:2013, Category HL2
- ASTM E662-09
- ASTM E162-08
- ASTM E1354-08
- BSS 7239

Process Materials

We offer composite processing materials and consumables optimized for this market and which are completely compatible with our structural prepreg range.

Prepreg Processing

A select range of consumables for high temperature curing (over 212°F/100°C) includes:

- VACFILM™ 450V 338°F (170°C) vacuum bagging film
- High air flow breathers
- High temperature sealant tapes
- Quick release/high temperature peel ply
- Release films
- Flash tapes

Resin Infusion Processing

Unique consumables including INFUPLY, VMS3 and CW3 are designed to cater market requirements:

- Reduce labor costs
- Minimize the scrap rate
- Improve part repeatability

Value-Added Consumables & Engineering Solutions

We reduce the cost of resin infusion processing, by offering:

- Welded/tailored vacuum bags
- Combination assemblies of consumables to reduce lay-down time
- Reduce labor costs
- Reusable vacuum bags and kitted consumables

Process Materials Product Selector Guide

Prepreg product	Bagging Film	Release Film	Sealant Tape	Peel Ply	Breather	Flash Tape
250°F (120°C) Epoxy OOA	VACFILM™ 450V	A6000	LTS90B	A100	AB100	FT1
	HS8171	A5000	UCS180	B100	AB10	FT2
	STRETCH-VAC™ 3000	A2000				FT5
250°F (120°C) Epoxy in-autoclave	VACFILM™ 450V	A6000	LTS90B	A100	AB100	FT1
	HS8171	A5000	UCS180	B100	AB10	FT2
	STRETCH-VAC™ 3000	A2000	SM5142			FT5
350°F (180°C) Epoxy OOA	HS8171	A6000	SM5142	A100	AB100	FT1
	STRETCH-VAC™ 3000	A5000	SM5127	B100	AB10	FT2
			SM5130			FT5
350°F (180°C) Epoxy in-autoclave	HS8171	A6000	SM5142	A100	AB40N	FT1
	STRETCH-VAC™ 3000	A5000	SM5127	B100	AB10	FT2
			SM5130			FT5
Phenolic	VACFILM™ 450V	A6000	SM5142	60001	AB100	FT1
		A5000	SM5127	G500	AB10	FT2
		A2000	RS200		AB40N	FT5
Epoxy Infusion	VACFILM™ 200G	A2200	LTS90B	A100PSI	AB100	FT1
	VACFILM™ 300R	A2000	UCS180		AB10	FT2
	VACFILM™ 400Y	E2760			VMS3	FT5
	VACFILM™ 450V	A6200			Vi1	GFMT (bonding tape)
	VACFILM™ 800G				Vi2	
				Infuply (resin carrier)		
Polyester Infusion	VACFILM™ 200G	A2200	LTS90B	A100PSI	AB100	FT1
	VACFILM™ 300R	A2000	UCS180		AB10	FT2
	VACFILM™ 400Y	E2760			VMS3	FT5
	VACFILM™ 450V				Vi1	GFMT (bonding tape)
	VACFILM™ 800G				Vi2	
				Infuply (resin carrier)		

Tooling

Our tooling prepregs offer outstanding surface finish and longevity for the manufacture of complex mold tools. Our design service can support tool design optimization to ensure a fit-for-purpose solution. In addition we offer soft tooling technology including reusable vacuum bags, integral heater blankets, intensifiers and caul sheets.

Tooling Product Selector Guide

	Product Form	Out Life (days)	Service Temp. °F (°C)	Cure Flexibility/Recommended Cure °F (°C)	Cure Method
CYFORM® 1-5-1	Epoxy Prepreg	3 to 4	356 (180)	40 hours at 95 (35) or 8 hours at 140 (60) Post-cure 15 minutes at 392 (200) plus 8 hours at 374 (190)	Autoclave
CYFORM® 22	Epoxy Prepreg	3 to 4	350 (177)	168 hours at 68 (20) or 5 hours at 131 (55) Post-cure 5 hours at 390 (200)	Autoclave
CYFORM® 777	Epoxy Prepreg	12 to 15	350 (177)	48 hours at 122 (50) or 3 hours at 194 (90) Post-cure 5 hours at 390 (200)	Autoclave
DForm® Fabric	Epoxy Prepreg	3	356 (180)	8 hours at 140 (60) Post-cure 15 minutes at 392 (200) plus 8 hours at 374 (190)	Autoclave
LTM® 12	Epoxy Prepreg	3	356 (180)	70 hours at 86 (30) or 5 hours at 158 (70) Post-cure 15 minutes at 392 (200) plus 8 hours at 374 (190)	Autoclave
LTM® 16	Epoxy Prepreg	6	356 (180)	70 hours at 104 (40) or 4 hours at 176 (80) Post-cure 15 minutes at 392 (200) plus 8 hours at 374 (190)	Autoclave
LTM® 212	Epoxy Prepreg	2	356 (180)	40 hours at 95 (35) or 8 hours at 140 (60) Post-cure 15 minutes at 392 (200) plus 8 hours at 374 (190)	Autoclave
LTM® 217	Epoxy Prepreg	8	356 (180)	20 hours at 131 (55) or 5 hours at 176 (80) Post-cure 15 minutes at 392 (200) plus 8 hours at 374 (190)	Autoclave
LTM® 317-1B	Epoxy Prepreg	30	302 (150)	16 hours at 150 (65) or 5 hours at 176 (80) Post-cure 2 hours at 302 (150)	Vacuum/ Autoclave





Case Study: Penso Lightweight Composite Rail Door

The Challenge

To manufacture a composite door leaf assembly that builds on existing performance by improving reliability, maintenance and delivery of substantial mass savings.

The Materials

Solvay provided MTM® 82C, a state of the art, market leading phenolic based prepreg system, as well as support from our engineers and material scientists. Our prepreg technology allows thinner structures, FST, weight savings and high mechanical performance to meet all necessary requirements.

The Penso Approach

1. Penso developed a 3D CAD model in Catia V5 based on GOM scan data obtained from carriages in the depot. This involved the integration of existing tube line paper drawings with a complete teardown of a door leaf assembly.
2. Then manufactured composite solution test coupons, which successfully passed fire, smoke and toxicity testing to meet stringent BS6853 Category 1A requirements.
3. Finally performed detailed CAE analysis of the current aluminum door to establish baseline targets for the composite door design.

The Results

Penso's engineers reached a ground breaking solution that utilizes Solvay's phenolic composite material in its construction. This maintains and improves on the performance from existing materials used in the manufacture of the doors, as well as a mass savings greater than 10kg (well above the agreed target of 5kg). Lighter rolling stock also means there will be less wear on the track, which is important when managing on-going maintenance and expected increases with the number of journeys being made.



Penso rail door design



Potential application for composite

Case Study: Kuala Lumpur Monorail

DK Composites used Solvay’s MTM® 29SFR epoxy prepreg to manufacture the skin of sandwich constructions for the cab masks and apron doors of the new, lower weight, trains for the Kuala Lumpur monorail system.

MTM® 29SFR:

- Meets the fire requirements of DIN 5510 for rolling stock
- Can be molded to complex shapes
- Offers good surface finish
- Has the added advantage of being able to bond directly to both foam core and aluminum honeycomb by vacuum bag processing alone and without the need for any additional adhesive film, thus significantly reducing manufacturing costs and part weight

Significant weight savings were achieved with the new apron doors and the cab masks in comparison with the older trains. See table below:

	Construction		Weight Reduction	
	Old	New	Kg/Train	%
Apron door	Aluminum composite panel with tubular steel frame	Epoxy/glass prepreg with aluminum honeycomb	745	49
Cab mask	Hand-laminated polyester/glass/PVC foam	Epoxy/glass prepreg with PET foam	268	30



Kuala Lumpur Monorail





Solvay

Composite Materials
4500 McGinnis Ferry Rd
Alpharetta, GA 30005-3914 USA
custinfo@solvay.com

Solvay

Composite Materials
Composites House, Sinclair Close, Heanor Gate
Industrial Estate, Heanor, Derbyshire, DE75 7SP, UK
custinfo@solvay.com

www.solvay.com

DISCLAIMER: The data and information provided in this document have been obtained from carefully controlled samples and are considered to be representative of the product described. Solvay does not express or imply any guarantee or warranty of any kind including, but not limited to, the accuracy, the completeness or the relevance of the data and information set out herein. Because the properties of this product can be significantly affected by the fabrication and testing techniques employed, and since Solvay does not control the conditions under which its products are tested and used, Solvay cannot guarantee the properties provided will be obtained with other processes and equipment. No guarantee or warranty is provided if the product is adapted for a specific use or purpose. Solvay declines any liability with respect to the use made by any third party of the data and information contained herein. Solvay has the right to change any data or information when deemed appropriate. All trademarks are the property of their respective owners. ©2018, Solvay. All rights reserved.