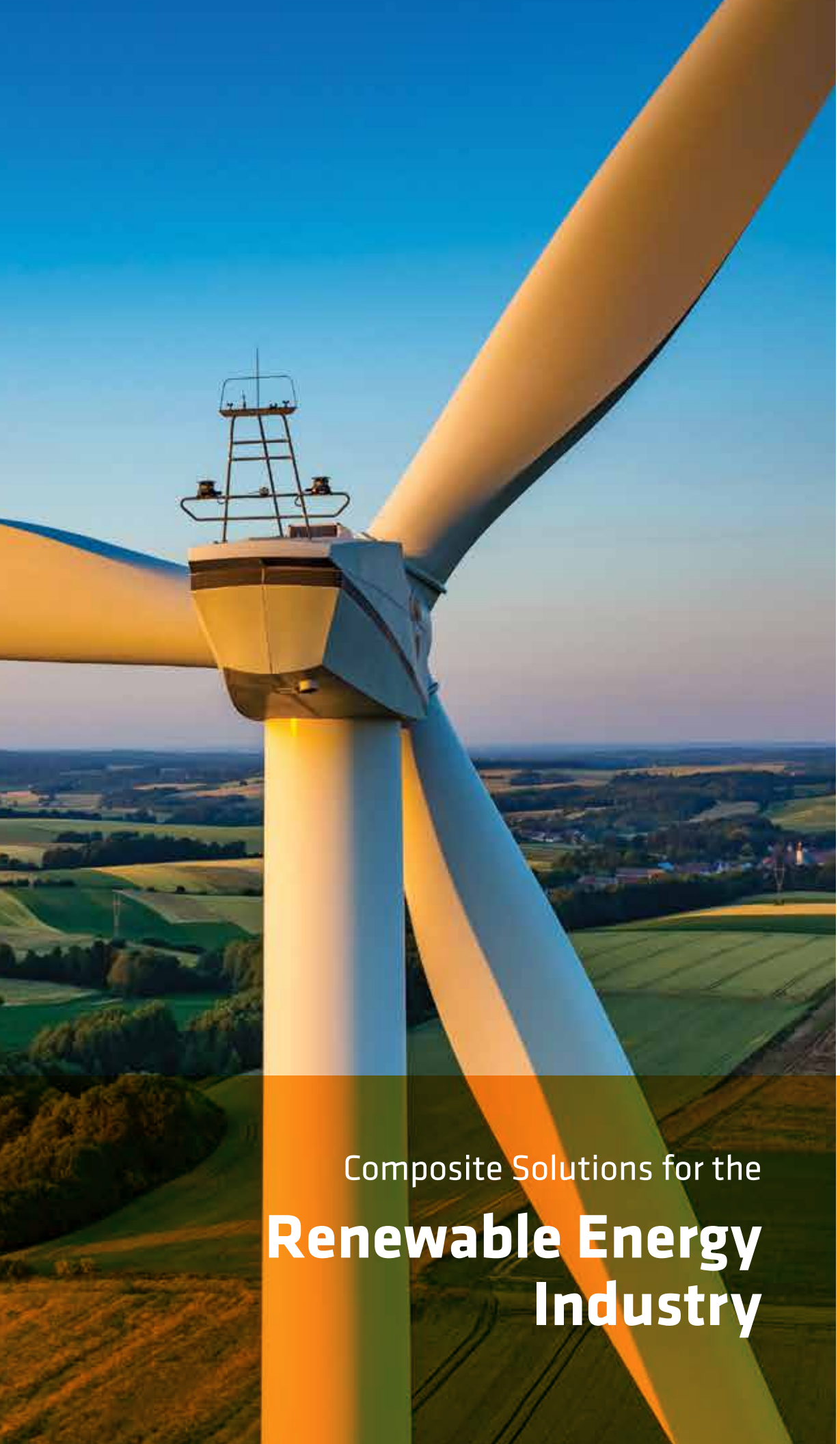


SOLVAY

asking more from chemistry®

Composite Solutions for the

Renewable Energy Industry

COMPOSITE MATERIALS

Solvay is engaged in a continuous development program aimed at introducing new cost-effective performance materials for composite structures in the renewable energy markets.

We are experts in the formulation and manufacture of composite materials, adhesive films and vacuum bagging materials for the wind, wave and tidal energy markets. With close associations with companies in the industry, we continue to develop new products to fulfill the needs of next generation systems, regardless of scale, type or environment.

Our advanced materials are specifically developed to manufacture:

- Turbine blade spars and skins
- Supporting structures
- Components

Tailored Solutions for the Industry

- Structural and tooling prepregs
- Film adhesives
- Reusable soft tooling
- Vacuum bagging consumables
- Process materials customization including manufacture, welding (for large sheet vacuum line), perforating, kitting
- Design and manufacture of reusable vacuum systems to suit specific tooling requirements
- Design assistance with resin infusion networks

Composite Materials

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

Composite Materials Product Selector Guide for Tidal Energy

Category	Resin System	Out Life (days)	Min. Cure °F (°C)	Available Formats	Notes
Structural Spars	MTM® 57	30	176 (80)	UD/Woven/Multiaxial 2/X-ply	Component prepreg, flexible processing and wide range of handling characteristics
	VTM® 264	30	149 (65)	UD/Woven/Multiaxial / ZPREG®/X-ply	Low temperature curing prepreg for large structures, good balance of toughness versus strength
	VTM® 266	30	149 (65)	UD/Woven/Multiaxial	High tack variant VTM® 264 - use with metal tooling or in cold environment
	MTM® 57-2	30	176 (80)	UD/Woven/Multiaxial	Low tack - supplied single-sided, where reinforcement is dry with a resin film on one side
Blade Skins	MTM® 57-2	30	176 (80)	UD/Woven/Multiaxial	Low tack - supplied single-sided, where reinforcement is dry with a resin film on one side
	VTM® 266	30	149 (65)	UD/Woven/Multiaxial	High tack variant VTM® 264 - use with metal tooling or in cold environment
	VTM® 267	21	149 (65)	Woven/Multiaxial /ZPREG®	Lower tack/flow compared to VTM® 264 - used on differentially coated products / heavyweight reinforcements where the resin is predominantly on the surface

Composite Materials Product Selector Guide for Wind Energy

Category	Resin System	Out Life (days)	Min. Cure °F (°C)	Available Formats	Notes
Structural Spars	MTM® 57	30	176 (80)	UD/Woven/Multiaxial/ X-ply	Component prepreg, flexible processing and wide range of handling characteristics
	MTM® 57-3*	30	176 (80)	UD/Woven/Multiaxial/ ZPREG®	Reduced tack for sided impregnation
	VTM® 264	30	149 (65)	UD/Woven/Multiaxial/ ZPREG®/X-ply	Low temperature curing prepreg for large structures, good balance of toughness versus strength
	VTM® 266	30	149 (65)	UD/Woven/Multiaxial	High tack variant VTM® 264 - use with metal tooling or in cold environment
	CYCOM® 823 RTM	4–5	255 (125)	Infuses UD/Woven/ Multiaxial	One-part liquid epoxy resin, room temperature injectable
	CYCOM® 754	21	160 (70)	UD/Woven	Low temperature curing prepreg for thick laminates
Blade Skins	MTM® 57-2	30	176 (80)	UD/Woven/Multiaxial	Low tack - supplied single-sided, where reinforcement is dry with a resin film on one side
	MTM® 57-3*	30	176 (80)	Woven/Multiaxial/ ZPREG®	Reduced tack for sided impregnation
	VTM® 266	30	149 (65)	UD/Woven/Multiaxial	High tack variant VTM® 264 - use with metal tooling or in cold environment
	VTM® 267	21	149 (65)	Woven/Multiaxial/ ZPREG®	Lower tack/flow compared to VTM® 264 - used on differentially coated products / heavyweight reinforcements where the resin is predominantly on the surface
	MTM® 21S	60	176 (80)	UD/Woven/Multiaxial	Styrene free, polyester matrix resin for low cost component manufacture
	CYCOM® 823 RTM	4–5	255 (125)	Infuses UD/Woven/ Multiaxial	One-part liquid resin, room temperature injectable

* GL approved

Adhesives and Surfacing Product Selector Guide

Resin System	Out Life (days)	Min. Cure °F (°C)	Available Formats	Notes
VTF 266	30	149 (65)	Supported/ unsupported film	Surface improvement film compatible with VTM® 260 series prepregs. Molds to a sandable, paint ready finish
VTA® 260	30	149 (65)	Supported/ unsupported adhesive film	Use VTM®/MTM® prepregs. Available with reinforcement carrier to aid placement or non-supported as a resin film
MTA® 240	30	176 (80)	Supported/ unsupported film	Structural adhesive film; formulated for cure compatibility with many structural prepreg matrices
FM® 73	15–30	250 (120)	Supported/ unsupported film	Structural adhesive film; formulated to bond metals and many composite systems
FM® 94	30	250 (120)	Supported/ unsupported film	Structural adhesive film offering a combination of high-temperature performance, toughness, and moisture resistance

Process Materials

We offer a range of process materials custom-formulated for the renewable energy sector. We co-extrude and transform a range of extruded polymers at our film manufacturing site. We also formulate and manufacture multi-layer customized films using blown and cast film processing techniques.

Our process materials portfolio provides all of the products needed for composite production, and we tailor our development and production techniques using a variety of processes, including prepreg and resin infusion technologies.

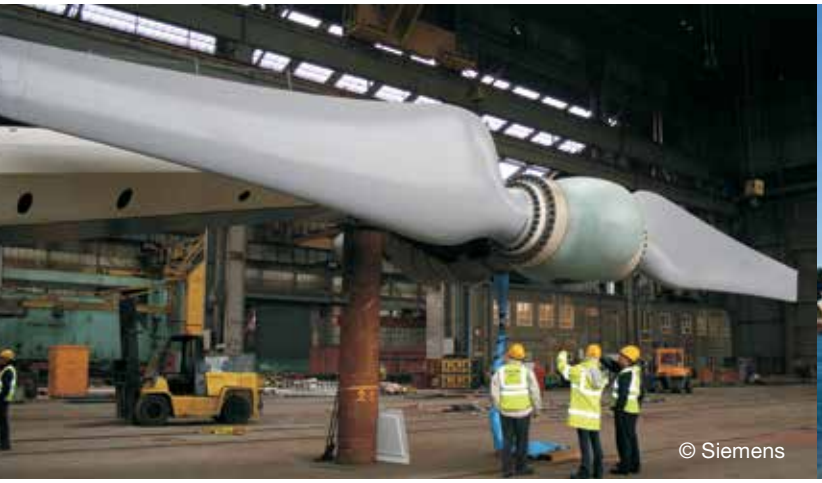
A key service offering to this industry is our innovative labor-saving and waste-reducing kitting service (in Santa Fe Springs, California and Toulouse, France). This encompasses the pre-cutting of consumables to simple, predetermined shapes through to the assembly of complex multi-layer integrated vacuum bags assemblies. By starting with the customer's CAD design, we are able to produce a customized kit solution that is right-first-time-every-time, ensuring repeatable processing and improving blade or spar quality in addition to reducing process cost.

Process Materials Product Selector Guide

Resin System	Bagging Film	Release Film	Sealant Tape	Peel Ply	Infusion Mesh	Tapes	Hose/ Lines
Epoxy Base	VACFILM™ 800G VACFILM™ 465B VACFILM™ 400Y VACFILM™ 450V Kitting Format	A2000 A2500 A2200 E2760	LTS90B UCS180	A100PS A85PS B100	Vi1 slow Vi5 fast Vi2S INFUPLY	GFMT iTape FlashTapes	TUB12 SW12 FW12 VMS3
Polyester base	VACFILM™ 400Y VACFILM™ 450V VACFILM™ 200G Kitting Format	A2000 A2200	LTS90B UCS180	A100PS A85PS B100	Vi1 slow Vi5 fast Vi2S INFUPLY	GFMT iTape FlashTapes	TUB12 SW12 FW12 VMS3

On-Site Technical Support

We offer material science, polymer chemistry, processing science, technical service and application engineering, e.g. design assistance with resin infusion networks, bagging film pre-cut format (shell and web), design for manufacturing, crashworthiness and intrusion analysis.



SeaGen composite blades, manufactured by Aviation Enterprises Ltd, made from Solvay's VTM® 260 series prepregs

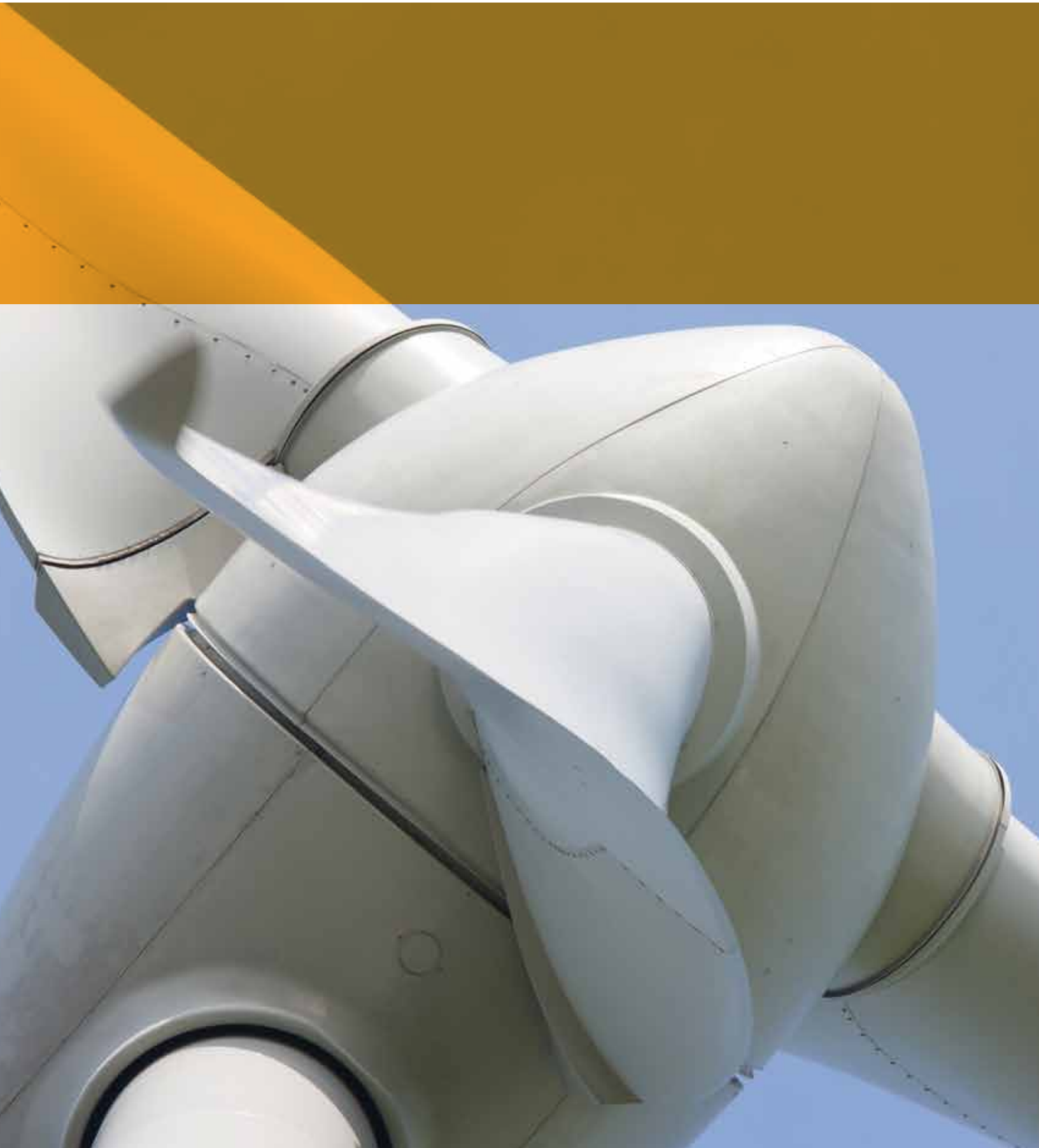
Siemens 1.2MW SeaGen tidal turbine in Strangford Lough, Northern Ireland

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
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)	Vacuum/ Autoclave
LTS 317	Syntactic Core	21	302 (150)	24 hours at 150 (65) or 1 hour at 248 (120) Post-cure 2 hours at 356 (180)	Vacuum/ 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
LTF318B/ LTF 318U	Epoxy Prepreg	7	356 (180)	16 hours at 150 (65) or 5 hours at 176 (80) Post-cure 15 minutes at 392 (200) plus 8 hours at 374 (190)	Vacuum/ Autoclave



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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

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www.solvay.com