

RENUVO™ PP / MPS

UV CURING COMPOSITE REPAIR PATCH

Gurit has a range of blade repair products which are approved by blade OEM's and DNV-GL and globally available to deliver fast, efficient wind turbine repair.

These focus on achieving:

- Minimum turbine down time
- Consistent repair quality
- Ease of application
- Maximum weather window for application
- Minimum environmental impact from waste
- Maximizing operator health and safety

Through:

- Market leading product health and safety
- Practical repair packaging, dispensing
- Mixing solutions for easy processing
- Robust repairs in challenging conditions
- Technical support help line
- Two product streams, heat and UV cured



Our composite repair solutions maximise the wind repair window:

	Prepreg + Primer	Application Temperature Range						
	OEM Qualified	5°C	10°C	15°C	20°C	25°C	30°C	55°C
	RENUVO™ PP	+	+	+	+	+	+	+
	RENUVO™ MPS	+	+	+	+	+	+	+

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RENUVO™ PP / MPS	PA51-5529	RENUVO +5-+30C/EGL/600/400/35±3%/2DPE	3
	PA21-5331	RENUVO +5-+30C/XE600/35±3%/400/2DPE	
RENUVO™ MPS	A525-001	RENUVO MPS +5-+30C 310ml CART / BOX 20	4
RENUVO™ PP / MPS	Main steps for a RENUVO repair: 1. Initial preparations (similar to any repair scenario) 2. Preparation of repair patch and vacuum consolidation of stacked repair patch (down-tower operation) 3. Repair area preparation for patch application (up-tower operation) 4. Application and cure of repair patch to damaged area (up-tower operation, - MPS method not requiring vacuum on repair position) 5. Finishing operations (similar to any repair scenario)		5

PRODUCT INFORMATION

AVAILABILITY

The product is available in several formats please contact your local customer support for more information.

TRANSPORT & STORAGE

The products 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).

COMPONENT	UNITS	-18°C to +21°C
RENUVO™ PP	months	18
RENUVO™ MPS	months	18

Storage should be in a dry place out of direct sunlight and ambient light, since the prepreg is sensitive to UV light. The recommended storage temperature should be between -18°C and 21°C (0°F and +70°F). Whilst storage at higher temperatures between +5°C and 30°C (+41°F and +86°F) prior to application will not adversely affect the product shelf-life, it may cause problems such as distortions of the prepreg and excess resin bleed. It is recommended that the prepreg is stored in its original sealed plastic wrapper and box to protect it from ambient UV light.

HEALTH AND SAFETY

The following points must be considered:

- Using UV curing equipment:
 - Eye-protection: UV filter function of class 2 or 2C as described in EN166 Personal eye Protection – specifications and EN170 Personal eye-protection, also with shade number of 1.7 up to 2.5.
 - Skin protection: Gloves (of a UV blocking material); Wear long sleeves. UV blocking clothing to cover all exposed skin directly in contact with the UV source.
 - Do NOT point the lamp directly at any skin, any eyes or any other personnel.
- Skin contact must be avoided by wearing protective gloves. Gurit recommends the use of disposable nitrile gloves for most applications. The use of barrier creams is not recommended, but to preserve skin condition a moisturising cream should be used after washing.
- Overalls or other protective clothing should be worn when mixing, laminating or sanding. Contaminated work clothes should be thoroughly cleaned before re-use.
- Eye protection should be worn if there is a risk of resin, hardener, solvent or dust entering the eyes. If this occurs flush the eye with water for 15 minutes, holding the eyelid open, and seek medical attention.
- Ensure adequate ventilation in work areas. Respiratory protection should be worn if there is insufficient ventilation. Solvent vapours should not be inhaled as they can cause dizziness, headaches, loss of consciousness and can have long term health effects.
- If the skin becomes contaminated, then the area must be immediately cleansed. The use of resin-removing cleansers is recommended. To finish, wash with soap and warm water. The use of solvents on the skin to remove resins etc must be avoided.
Washing should be part of routine practice:
 - before eating or drinking
 - before smoking
 - before using the lavatory
 - after finishing work
- The inhalation of sanding dust should be avoided and if it settles on the skin then it should be washed off. After more extensive sanding operations a shower/bath and hair wash is advised.

APPLICABLE RISK & SAFETY PHRASES

Gurit produces a separate full Safety Data Sheet for all hazardous products. Please ensure that you have the correct SDS to hand for the materials you are using before commencing work.

RENUVO™ PP (PREPREG)

This 1-page product summary is intended for use in conjunction with further advice provided in the remainder of this document. All data has been generated from typical production material and does not constitute a product specification. Using the RENUVO™ method, requires specialist training and equipment. It is recommended that all users are familiar with the processes, materials and equipment required before commencing any repair. A test repair patch should be conducted to ensure a sufficient level of adhesion using all materials, equipment and processes that will be used in practice, reflecting also the ambient conditions (e.g. temperature, humidity & sunlight exposure).

UNCURED PREPREG PROPERTIES

PROPERTY	UNITS	PA51-5529	PA21-5331	TEST METHOD
Format	-	0° Unidirectional Prepreg	±45° Biaxial Prepreg	-
Nominal Resin Content (by weight)	%	35	35	EN 2329
Nominal Fibre Weight	g/m ²	600	600	
Nominal Prepreg Areal Weight	g/m ²	924	924	
Stitching Type	-	N/A	Textured Polyester	-
Sizing Type	-	Epoxy Compatible	Epoxy Compatible	EN 2331
Backer	-	2 x 50µm MDPE	2 x 50µm MDPE	-
Recommended ply drop length	mm	30	7.5	-

PROCESSING, HANDLING & CURING PROPERTIES*

The product should be applied out of direct sunlight to extend the working time. The cure time and method will be dependant on the UV light source used. Please contact Gurit Technical Support for further information.

PROPERTY	UNITS	300mW/cm ²	2500mW/cm ²	TEST METHOD
Recommended Handling Temperature	°C	+5 to +55		-
Maximum Relative Humidity	%	90		-
Working time	-	The product should be applied out of direct sunlight to extend working time.		-
Cure Time	min:sec	03:00*	00:20*	395nm UV-A Light Source*
Cure Height	mm	30*	1*	395nm UV-A Light Source*
Maximum laminate thickness per cure	-	4 x 924g/m ² prepreg plies		-

CURED LAMINATE MECHANICAL PROPERTIES*

PROPERTIES	SYMBOL	UNITS	PA51-5529	PA21-5331	TEST STANDARD
Cure Schedule	-	-	180 seconds at 30mm height using 300mW/cm ² lamp		395nm UV-A Light Source*
Cured Laminate Colour	-	-	3 - 5		Gardner
Glass Transition Temperature	T _{g1}	°C	95		ASTM D7028
Cured Ply Thickness	t _{CPT}	Mm	0.48	0.49	-
Cured Ply Thickness Tolerance	-	Mm	+/- 0.03	+/- 0.03	-
Fibre Volume Fraction	FVF	%	53	53	ASTM D 3171 Method II
0° Tensile Strength**	X _{T11}	MPa	900	427	ISO 527-4
0° Tensile Modulus**	E _{T11}	GPa	41	27	ISO 527-4
0° Tensile Strain**	ε _{T11}	%	1.1	2.0	ISO 527-4
90° Tensile Strength**	X _{T22}	MPa	26	-	ISO 527-4
90° Tensile Modulus**	E _{T22}	GPa	13	-	ISO 527-4
0° Flexural Strength**	X _F	MPa	1140	455	ISO 14125
0° Flexural Modulus**	E _{F11}	GPa	36	17	ISO 14125
0° Inter-laminar Shear Strength**	X _{ILSS}	MPa	69	25	ISO 14130
0° Compressive Strength**	X _{C11}	MPa	966	607	SACMA SRM1-94

*The cure will depend on the type of UV lamp used to conduct the repair. Please contact Gurit Technical Support for advice.

**Mechanical test direction evaluated relative to the 0° to fibre direction

RENUVO™ MPS (MONOCOMPONENT PASTE) PRIMER

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COMPONENT PROPERTIES

PROPERTY	UNITS	RENUVO™ MPS	TEST METHOD
Density	g/cm ³	1.2	ISO 1183-1B
Viscosity at 25°C	Pa.s	40	EN 2329
Coverage at 2mm	m ²	1.4	Theoretical: 1 x 310ml Cartridge
Coverage at 4mm	m ²	0.7	Theoretical: 1 x 310ml Cartridge

PROCESSING, HANDLING & CURING PROPERTIES*

The product should be applied out of direct sunlight to extend the working time.

PROPERTY	UNITS	300mW/cm ²	2500mW/cm ²	TEST METHOD
Recommended Handling Temperature	°C	+5 to +55		-
Maximum Relative Humidity	%	90		-
Working time	-	The product should be applied out of direct sunlight to extend working time.		-
Cure Time	min:sec	03:00*	00:20*	395nm UV-A Light Source*
Cure Height	mm	30*	1*	395nm UV-A Light Source*
Maximum laminate thickness per cure	-	3mm		-
Cured Laminate Colour	-	3 - 5		Gardner
Dry T _{g1} (DMA)	°C	107		ASTM D7028

CURED RESIN MECHANICAL PROPERTIES*

PROPERTIES	SYMBOL	UNITS	RENUVO™ MPS	TEST STANDARD
Cure Schedule	-	-	180 seconds at 30mm height using 300mW/cm ² lamp	395nm UV-A Light Source*
Cured Laminate Colour	-	-	3 - 5	Gardner
Glass Transition Temperature	T _{g1}	°C	107	ASTM D7028
Linear Shrinkage	-	%	1.7	ISO 3521
Shore D Hardness	-	-	88	ISO 7619
Tensile Strength	σ _T	MPa	67	ISO 527-2
Tensile Modulus	E _T	GPa	4.0	ISO 527-2
Tensile Strain	E _T	%	3.8	ISO 527-2
Flexural Strength	σ _F	MPa	121	ISO 14125
Flexural Modulus	E _F	GPa	3.8	ISO 14125

*The cure will depend on the type of UV lamp used to conduct the repair. Please contact Gurit Technical Support for advice.

RENUVO™ PP / MPS UV CURING COMPOSITE REPAIR PATCH SOLUTION

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INSTRUCTIONS FOR USE

Main steps for a RENUVO repair using RENUVO™ MPS as a primer:

INITIAL PREPARATIONS (SIMILAR TO ANY REPAIR SCENARIO UP-TOWER)

- Remove damaged material
- Pre-grind with grit 40 sandpaper
- Measure largest prepreg ply and determine the ply drop offs

PREPARATION OF REPAIR PATCH (DOWN-TOWER OPERATION)

- Use a non-stick surface (such as the reverse side of melamine chipboard) for cutting and spiking of RENUVO PP plies
- Cut prepreg plies to pre-measured dimensions & spike roll each ply individually before stacking (keep backers on for UV protection)
- Cut adhesive resin film (RENUVO™ SA) to the size of the largest ply & spike roll surfaces – this will be the “primer” layer
- Stack the prepreg plies, starting with the smallest patch and observing the correct ply drop-off (BIAX, then UD or BIAx and so on) ensuring that all black backer is removed from each ply of laminate, removing air between each ply using plastic spatula and roller
- Add Peel ply to top surface (being the largest ply)
- Re-add cut black backer sheet (temporarily affix with adhesive tape and mark top of stack with a “T”) to ensure UV protection
- Spike roller the entire surface of patch to ensure air path from interlaminated plies

VACUUM CONSOLIDATION OF STACKED REPAIR PATCH (DOWN-TOWER OPERATION)

- Use a clean, non-stick surface (such as melamine board) as base for the vacuum consolidation
- Affix silicone vacuum heater mat to melamine board and place Teflon sheet/release film at patch position
- Place repair patch on Teflon/release film and add breather over the top of patch, extending to the vacuum suction position.
- Apply vacuum (drop test min 80%)
- Apply heat and ramp to 40 °C
- Heat consolidate for 20mins at 40 °C, remove vacuum bag (black backer must remain applied)
- The repair patch is now ready for application

REPAIR AREA PREPARATION FOR PATCH APPLICATION (UP-TOWER OPERATION)

- Grind with 40 grit sand paper
- De-dust using clean cotton cloth with IPA → ready to apply patch

APPLICATION AND CURE OF REPAIR PATCH TO DAMAGED AREA (UP-TOWER OPERATION)

- Apply MPS evenly to the surface of the repair, ensuring that the area is 100% wetted by the MPS.
- Remove black backer and transfer stack onto repair area and spike roll patch.
- Roller the stack into the repair to adhere firmly and ensure to remove air entrapment (gently heat with heat gun to assist drape)
- Peel off top black backer (visual check for air entrapment)
- Pass the UV lamp over the repair, 10-15 cm above the surface to harden the patch until tack-free avoid resin transfer to the lamp
- With the UV lamp in contact with the top ply, commence with recommended UV Cure cycle, moving the lamp at max 20mm/sec – for 20 passes, lamp dependent. Index lamp, ensuring overlap.
- Peel off peel ply
- Repeat UV Cure cycle, moving the lamp at max 300mm/sec – for 20 passes, lamp dependent. ***

FINISHING OPERATIONS (SIMILAR TO ANY REPAIR SCENARIO)

- Grind edges / perhaps seal edges with MPS and UV cure
- Finish repair with filler and coatings
- Patch need to rest for ca 1 hour before any testing

ADHESION TO SUBSTRATE*

MECHANICAL PROPERTIES	SYMBOL	UNITS	EPOXY GFRP*	POLYESTER FRP*	TEST STANDARD
Cure Schedule	-	-	180 seconds at 30mm height using 300mW/cm ² lamp		395nm UV-A Light Source*
Lap shear Strength	τ_{FRP}	MPa	10	11	BS 5350 Part C5

*Surface preparation is critical: grind surface with 80 grit sand paper and all dust, grease and residue removed. Adequate UV exposure is required to deliver adhesion strength.

**Cure cycle is for a 3 x 600 gsm prepreg patch incl MPS using a 5W 395nm UV lamp source

NOTICE

All advice, instruction or recommendation is given in good faith but the selling Gurit entity (the Company) only warrants that advice in writing is given with reasonable skill and care. No further duty or responsibility is accepted by the Company. All advice is given subject to the terms and conditions of sale (the Conditions) which are available on request from the Company or may be viewed at Gurit's Website: www.gurit.com/terms-and-conditions.aspx

The Company strongly recommends that Customers make test panels in the final process conditions and conduct appropriate testing of any goods or materials supplied by the Company prior to final use 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. Due to the varied nature of end-use applications, the Company does, in particular, not warrant that the test panels in the final process conditions and/or the final component pass any fire standards.

The Company reserves the right to change specifications and prices 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.

Gurit is continuously reviewing and updating literature. Please ensure that you have the current version by contacting your sales contact and quoting the revision number in the bottom left-hand corner of this page.

TECHNICAL CONTACT INFORMATION

For all other enquiries such as technical queries:

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24-HOUR CHEMICAL EMERGENCY NUMBER

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