AMPREG 3X AP RESIN

EPOXY TO VINYLESTER ADHESION PROMOTER

- Improves adhesion between vinylester (VE) and epoxy resins
- Improves the toughness at the VE/epoxy interface
- Uses existing range of Ampreg 3X hardeners
- Low Toxicity Hardener Formulations
  - Improved Hazard Labelling
  - CMR, SVHC & AEP** Free
  - Environmentally Non-hazardous

INTRODUCTION

Ampreg 3X Adhesion Promoter (AP) is a unique resin system formulated to promote the adhesion between epoxy and vinylester resin. This allows production boatbuilders to use existing polyester gelcoats with higher performance epoxy resins supplied by Gurit.

Benefits include:

- Longer lasting hulls & decks
- Better aesthetic finish
- Reduced production processes
- Improved secondary bonding

SYSTEM PROPERTIES AT 25°C		MIXED VISCOSITY*	EARLIEST TIME TO APPLY VACUUM*	LATEST TIME TO APPLY VACUUM*	PAGE
Ampreg 3X AP Resin	Product Information, Instructions for Use and Health & Safety				2
	Slow Hardener	610 cP	6 ½ hours	8 ½ hours	3
	Extra-slow Hardener	490 cP	8 ½ hours	11 hours	4

**working time properties are highly subjective to ambient conditions and should be used an approximate guideline for all Ampreg Adhesion Promoter systems at 20°C. Please refer to the correspondaing page of this document for specific testing methods used.*

*** CMR = Substances classified as Carcinogenic, Mutagenic or toxic for Reproduction*
SVHC = Substances of Very High Concern
AEP = Commonly used fast epoxy curing agent classified as CMR

PRODUCT INFORMATION

AVAILABILITY

The product is available in a number of formats please contact your local customer support representative for more information.

TRANSPORT & STORAGE

The resin and hardeners 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	10 – 25°C
Ampreg 3X AP Resin	months	24
Ampreg 3X Hardeners	months	24

Adequate long term storage conditions will result in a shelf life of 2 years for both the resin and hardeners. Storage should be in a warm dry place out of direct sunlight and protected from frost. The storage temperature should be kept constant between 10°C and 25°C, cyclic fluctuations in temperature can cause crystallization. Containers should be firmly closed. Hardeners, in particular, will suffer serious degradation if left exposed to air.

INSTRUCTIONS FOR USE

The product is optimised for use at temperatures between 18 and 25°C. At lower temperatures the product thickens and may become unworkable. At higher temperatures working times will be significantly reduced. Maximum relative humidity for use is 70%.

MOULD RELEASE

Smooth metal and GFRP mould tests have shown that suitable release can be obtained by use of 5-6 waxings of a carnauba based wax e.g. Polywax. Use PVA for less well prepared or more complex surfaces. The highest quality surface can normally be generated by using semi-permanent release systems like TR 920 (TR Industries) or PMR EZ (Chemlease).

Before the application of the release agent onto a new mould it should sealed and primed, this is also true if an old mould have had its released agents stripped and a new system applied. It is suggested that a complete system is purchased from a single manufacture to ensure there are no compatibility issues. A low VOC (Volatile Organic Chemical) option is water based systems like chemlease 5051W or 5016W which will not generate class A surface finish but will help to reduce VOC release in moulding areas. Whichever mould release is proposed it is recommended that a test laminate is laid up under production conditions and time scales, in order to ensure an adequate and effective part release.

MIXING AND HANDLING

Accurate measurement and thorough mixing are essential when using this system, and any deviation from the prescribed mix ratios will seriously degrade the physical properties of the cured system. The resin and hardener must be stirred well for two minutes or more, with particular attention being paid to the sides and bottom of the container. As soon as the material is mixed the reaction begins. This reaction produces heat

(exothermic), which will in turn accelerate the reaction. If this mixed material is left in a confined mixing vessel the heat cannot disperse and the reaction will become uncontrollable.

APPLICATION: A TYPICAL BUILD SCHEDULE

1. Apply polyester gelcoat as per manufacturers' recommendations and allow to cure.
2. Using the vinylester resin, wet laminate 2 layers of 225gsm CSM onto the back of the polyester gelcoat. Based on tests at Gurit we recommend the vinylester should be backed up with the epoxy resin between 6 & 24 hours; 24 hrs should not be exceed.
3. Apply a thin layer (300g/m2) of Ampreg 3X AP to the surface of the vinylester skincoat.
4. Complete the laminate schedule using Ampreg 30, 31 or 36 resins and Slow or Extra-slow hardeners.
5. It is recommended that the laminate is vacuum bagged to aid the removal of any air entrapment between the VE tiecoat and the epoxy laminate. Please refer to the Ampreg 3X TDS on working times and recommended vacuum times.
6. The laminate should then be post-cured for a minimum of 16hrs at 50°C to achieve the optimum adhesion between the VE skincoat and the epoxy backing laminate. This also increases the strength and toughness of the epoxy resin. To achieve the best surface finish it is recommended to perform the postcure whilst the part is still in the mould.

VACUUM BAG TECHNIQUES

Consolidation of the laminate can be obtained either by hand using paddle rollers or by vacuum or pressure bags. A typical vacuum bag arrangement is shown in figure 1. It is important when using high vacuums and using the slower hardeners that vacuum is not applied until at least 50% into the mixed system working time, as applying the vacuum earlier may result in excessive resin flow and resin starved laminates. For advice on effective vacuum bag consolidation, please contact Gurit Technical Support.

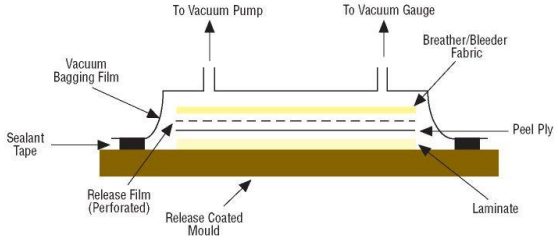

Figure 1

CURING SCHEDULE

ELEVATED TEMPERATURE POST-CURE

Post curing the laminate will greatly increase mechanical/thermal properties. The system will achieve similar properties with a cure of 5 hours at 70 - 80°C or 16 hours at 50°C. The latter temperature is easily achievable with low cost heating and insulation techniques.
The post cure need not be carried out immediately after laminating. It is possible to assemble several composite components and post-cure the entire assembly together. It is recommended, however, that elevated temperature curing should be completed before any further painting / finishing operations. Furthermore, care should be taken to adequately support the laminate if it is to be post cured after demoulding, and the laminate must be allowed to cool before the support is removed.

When postcuring it is recommended to use a ramp rate of 10°C/hour when heating from ambient to the postcure temperature, to ensure that the thermal performance of the laminate stays ahead of the oven temperature. Higher ramp rates may result in the resin softening and distortion of the part.

TEST PANEL CONSTRUCTION

It is recommended to produce test panels to verify the performance of the laminate and to define the manufacture route. It is important to use open times and environmental conditions that are representative of workshop conditions. Test panels should be visually inspected for surface quality and tests should be performed to assess the gelcoat adhesion.

The gelcoat adhesion can be assessed by using a knife to score and then prise the gelcoat off the surface of the laminate. In addition test panels can be supplied to Gurit to determine the gelcoat adhesion. The table below gives some indicative cleavage results from tests performed at Gurit.

GELCOAT	TIECOAT	LAMINATE	CLEAVAGE STRENGTH (N)	FAILURE MODE
Polyester	Dion 9100-700 Vinylester	Dion 9100-700 Vinylester	2080	Within laminate
Polyester	Dion 9100-700 Vinylester	Ampreg 30 + A3X Slow Hardener	3670	Interface
Polyester	Dion 9100-700 Vinylester	Ampreg 3X AP + A3X Slow Hardener	4220	Within laminate

The failure mode gives an important indication about the level of adhesion. Ideally failure should occur within the laminate. Typically a cleavage load of 2500-3000N indicates that a good bond has been achieved between polyester gelcoat and the backing laminate. The style of fabric reinforcement has an effect on the failure mode and test result. Heavier weight woven and biaxial reinforcements (greater than 500g/m^2) give higher cleavage results when compared to CSM or lightweight fabrics.

HEALTH AND SAFETY

The following points must be considered:

1. 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.
2. Overalls or other protective clothing should be worn when mixing, laminating or sanding. Contaminated work clothes should be thoroughly cleaned before re-use.
3. 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.
4. 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.
5. 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
6. 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.

AMPREG 3X ADHESION PROMOTER RESIN & SLOW HARDENER

This 1 page product summary is intended for use in conjunction with further advice provided under the Instructions for Use section. All data has been generated from typical production material and does not constitute a product specification.

MIXING AND HANDLING

PROPERTY	UNITS	AMPREG 3X AP	SLOW HARDENER	MIXED SYSTEM	TEST METHOD
Colour	-	Dark Yellow	Burnt Orange	Dark Yellow / Light Orange	-
Mix ratio by weight	Parts by weight	100	26	-	-
Mix ratio by volume	Parts by volume	100	31	-	-
Density at 21 °C	g/cm^3	1.13	0.90 – 1.10	1.09	ISO 1183-1B

COMPONENT & MIXED SYSTEM PROPERTIES*

PROPERTY	UNITS	15˚C	20˚C	25˚C	30˚C	40˚C	TEST METHOD
Ampreg 3X AP Resin Viscosity	P	26	15	10	6.3	3.2	-
Slow Hardener Viscosity	P	34 - 42	24 - 34	20 - 30	14 - 20	8 - 16	-
Initial Mixed System Viscosity	P	-	6.1	-	2.8	-	-
Earliest Time To Apply Vacuum	hrs:min	-	06:25	-	04:05	-	Internal Gurit Method
Latest Time To Apply Vacuum	hrs:min	-	08:25	-	05:05	-	Internal Gurit Method

CURED RESIN MECHANICAL AND THERMAL PROPERTIES

PROPERTIES	SYMBOL	UNITS	16 HOURS AT 50°C**	TEST STANDARD
Glass Transition Temperature	Tg_2	°C	69.4	ISO 11357 (DSC)
Ultimate Glass Transition Temp.	UTg_2	°C	73.7	ISO 11357 (DSC)
Glass Transition Temperature	Tg_1	°C	66.7	ISO 6721 (DMA)
Ultimate Glass Transition Temp.	UTg_1	°C	75.5	ISO 6721 (DMA)
Cured Density	ρ_{CURED}	g/cm^3	1.15	ISO 1183-1A
Linear Shrinkage	-	%	1.61	ISO 1183-1A
Tensile Strength	σ_T	MPa	48.8	ISO 527-2
Tensile Modulus	E_T	GPa	2.68	ISO 527-2
Tensile Strain	ε_T	%	7.05	ISO 527-2
3-point flexural strength	σ_F	MPa	46.9	ISO 178
3-point flexural modulus	E_F	GPa	2.7	ISO 178
3-point flexural Strain	ε_F	%	10.7	ISO 178

CURED LAMINATE MECHANICAL PROPERTIES

PROPERTIES	SYMBOL	UNITS	16 HOURS AT 50°C**	TEST STANDARD
ILSS***	X_{ILSS}	MPa	37.9	ISO 14130
ILSS (after 7 days in water)***	X_{ILSS}	MPa	37.9	ISO 14130

**working time properties are highly subjective to ambient conditions and should be used as an approximate guideline for all Ampreg Adhesion Promoter systems*
***initial cure of 24 hours at 21°C*
****laminate construction: 8 plies of RE301H8, 50% resin content by weight*

AMPREG 3X ADHESION PROMOTER RESIN & EXTRA-SLOW HARDENER

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MIXING AND HANDLING

PROPERTY	UNITS	AMPREG 3X AP	EXTRA-SLOW HARDENER	MIXED SYSTEM	TEST METHOD
Colour	-	Dark Yellow	Colourless / Very Pale Yellow	Dark Yellow	-
Mix ratio by weight	Parts by weight	100	26	-	-
Mix ratio by volume	Parts by volume	100	31	-	-
Density at 21 °C	g/cm^3	1.13	0.85 – 1.05	1.09	ISO 1183-1B

COMPONENT & MIXED SYSTEM PROPERTIES*

PROPERTY	UNITS	15˚C	20˚C	25˚C	30˚C	40˚C	TEST METHOD
Ampreg 3X AP Resin Viscosity	cP	26	15	10	6.3	3.2	-
Extra-Slow Hardener Viscosity	cP	18 - 28	15 - 20	5 - 15	5 – 10	4 - 8	-
Initial Mixed System Viscosity	cP	-	4.9	-	2.2	-	-
Earliest Time To Apply Vacuum	hrs:min	-	08:30	-	05:20	-	Internal Gurit Method
Latest Time To Apply Vacuum	hrs:min	-	10:55	-	06:40	-	Internal Gurit Method

CURED RESIN MECHANICAL AND THERMAL PROPERTIES

PROPERTIES	SYMBOL	UNITS	16 HOURS AT 50°C**	TEST STANDARD
Glass Transition Temperature	Tg_2	°C	63.0	ISO 11357 (DSC)
Ultimate Glass Transition Temp.	UTg_2	°C	69.6	ISO 11357 (DSC)
Glass Transition Temperature	Tg_1	°C	63.2	ISO 6721 (DMA)
Ultimate Glass Transition Temp.	UTg_1	°C	71.6	ISO 6721 (DMA)
Cured Density	ρ_{CURED}	g/cm^3	1.14	ISO 1183-1A
Linear Shrinkage	-	%	1.59	ISO 1183-1A
Tensile Strength	σ_T	MPa	46.9	ISO 527-2
Tensile Modulus	E_T	GPa	2.70	ISO 527-2
Tensile Strain	ε_T	%	11.1	ISO 527-2
3-point flexural strength	σ_F	MPa	82.5	ISO 178
3-point flexural modulus	E_F	GPa	2.55	ISO 178
3-point flexural Strain	ε_F	%	10.3	ISO 178

CURED LAMINATE MECHANICAL PROPERTIES

PROPERTIES	SYMBOL	UNITS	16 HOURS AT 50°C**	TEST STANDARD
ILSS***	X_{ILSS}	MPa	40.0	ISO 14130
ILSS (after 7 days in water)***	X_{ILSS}	MPa	39.7	ISO 14130

**working time properties are highly subjective to ambient conditions and should be used as an approximate guideline for all Ampreg Adhesion Promoter systems*
***initial cure of 24 hours at 21°C*
****laminate construction: 8 plies of RE301H8, 50% resin content by weight*

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:

Telephone	+ 44 1983 828000 (08:30 – 17:00 GMT)
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24-HOUR CHEMICAL EMERGENCY NUMBER

For advice on chemical emergencies, spillages, fires or exposures:

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