

Ampreg 21FR

FIRE RETARDANT EPOXY WET LAMINATING SYSTEM

- **FST performance evaluated against UL 94 and BS476**
- **Range of working times**
- **Capable of ambient only cures**
- **Ideal for wet laminating large composite structures**

INTRODUCTION

Ampreg 21FR has been optimised for the manufacture of large composite structures using hand layup, and vacuum bagging techniques.

Ampreg 21FR has been designed to give excellent mechanical and thermal properties from both ambient temperature cures, and moderate temperature postcures (50°C).

This system is available with a range of hardener speeds, from Fast to Ultra Slow.

INSTRUCTIONS FOR USE

WORKSHOP CONDITIONS

Ampreg 21FR is optimised for use between 18 - 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%.

MIXING AND HANDLING

Ampreg 21FR should be mixed at the following ratios:

Resin	Hardener (Fast, Standard, Slow, Extra Slow)
100	: 21 (by weight)
100	: 29 (by volume)

Resin	Hardener (Ultra Slow)
100	: 18 (by weight)
100	: 26 (by volume)

It is important that the resin and hardener components are measured out accurately. Measurement by weight and electronic scales are recommended for this purpose. The two components must be mixed thoroughly. If mixing by hand particular attention should be paid to the side and bottom of the mixing vessel. All solvent free epoxy systems have limited pot-life so use from the pot quickly or transfer to a shallow vessel with large surface area to allow the heat of the resin/hardener reaction to dissipate and prolong the working life of the system. Do not mix more than can be used within the working time of the particular resin/hardener system.

MOULD RELEASE

From smooth metal or grp moulds 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 complex surfaces. Whichever mould release is proposed it is recommended that a test laminate is laid up in the mould to be used, with the mould release proposed, in order to ensure an adequate and effective part release. It is recommended to use a high solids sealer such as Chemlease RPM712N (Europe) or MP117 (USA) to seal new moulds, prior to application of the release agent.

APPLICATION

The mixed system is usually applied by foam roller from a roller tray (which also serves to increase exothermic heat release, as described above). High and accurate fibre volume fractions can be obtained by applying known weight of mixed resin/hardener to each fabric / fibre layer. As a general rule of thumb, resin weight per square metre must be no more than, and preferably less than, the area weight of the fabric being wet out. If the laminate is particularly thick, it is recommended that slower hardeners are used for laminating the first layers and faster hardeners in the later layers. In this way the whole thickness laid down remains workable for approximately the same time. For further advice, please contact Gurit Technical Support.

BONDING TECHNIQUES & PEEL PLY

It is recommended to use nylon peel ply for any secondary bonding applications. Peel Ply is typically used on laminate surfaces which need to be left to cure or partially cure before further laminating or bonding operations. The peel ply serves two functions - preventing the surface from becoming contaminated and / or damaged, and providing a 'textured' surface that can reduce the level of preparation required for the secondary laminating or bonding operations. After curing and just prior to bonding, the Peel Ply is stripped off leaving a clean, dust and grease free surface, with an already 'textured' surface which makes the 'keying' process less time consuming.

Gurit recommends the use of its Stitch Ply A peel ply, or suitable Tygavac product. Any proposed peel ply should be tested prior to use to ensure that it not only releases adequately from the laminated surface but also does not leave any residues behind which may impair adhesion. If in doubt please contact Gurit Technical Support.

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.

CORE MATERIALS

Gurit supplies Corecell™ SAN closed cell foam for sandwich laminate construction. Other core materials such as PVC foam, Nomex honeycomb and end grain balsa, are also suitable for use with Ampreg 21FR. For further information on the use of core materials with Ampreg 21FR, please contact Gurit Technical Support.

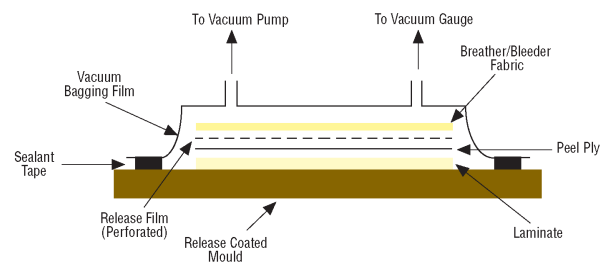


Figure 1

CURING SCHEDULE

AMBIENT TEMPERATURE CURE

The system has been developed to provide good mechanical properties after an ambient only cure. The minimum recommended cure temperature is 18°C. Excellent mechanical/thermal properties can be achieved after a slightly elevated temperature post-cure. An initial cure of 42 hours (with ultra slow hardener) or 16 hours (with fast hardener) at 20°C is recommended before demoulding.

When using the Extra Slow or Ultra Slow Hardener, an elevated temperature postcure of 40°C for 16 hours, is strongly recommended.

ELEVATED TEMPERATURE 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°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.

PROPERTIES

Component Properties						
	Resin	Hardener				
		Fast	Standard	Slow	Extra Slow	Ultra Slow
Mix Ratio (by weight)	100	21				18
Mix Ratio (by volume)	100	29				26
Viscosity @ 15°C (cP)	23300	1830	164	193	180	34
Viscosity @ 20°C (cP)	11600	1222	121	111	120	22
Viscosity @ 25°C (cP)	5500	762	90	63	60	14
Viscosity @ 30°C (cP)	3800	560	66	45	40	9
Viscosity @ 40°C (cP)	2000	212	36	16	30	-
Shelf Life (months)	12	12	12	12	12	12
Colour (Gardner Index)	white	5	7	8	9	blue
Component Dens. (g/cm ³)	1.34	1.02	1.01	0.98	0.97	0.94
Mixed Density (g/cm ³)	-	1.27	1.27	1.26	1.26	1.26
Hazard Definition	Refer to SDS					

FST Performance			
Fire Performance / Standard	Test laminate Description	Rating	Report Number
UL 94 5th Edition – 2001	A21FR / Slow Hardener / 8 x plies WRE581T / 40% RC	V-0	172274
UL 94 5th Edition – 2001	A21FR / Ultra Slow Hardener / 5 x plies WRE581T / 45% RC	V-0	180120
UL 94 5th Edition – 2001	A21FR / Extra Slow Hardener / 8 x plies WRE581T / 40% RC	V-0	172275
BS476 Part 6 Fire Propagation - 1989 + A1: 2009	A21FR / Ultra Slow Hardener / 5 x plies WRE581T / 50% RC	l = 12.25 i1 = 1.68 i2 = 9.66 i3 = 0.91	312302
BS476 Part 7 Surface Spread of Flame - 1997	A21FR / Ultra Slow Hardener / 5 x plies WRE581T / 50% RC	Class 2	312304

PROPERTIES (CONT'D)

Working Properties												
	Resin/ Std Hardener			Resin/ Slow Hardener			Resin/ Extra Slow Hardener*			Resin/ Ultra Slow Hardener*		
	25°C	30°C	40°C	25°C	30°C	40°C	25°C	30°C	40°C	25°C	30°C	40°C
Initial Mixed Viscosity (P)	12.1	9.1	4.3	11.5	8.3	3.7	11.6	8.1	3.6	7.0	5.3	2.5
Gel Time - 150g Mix in water (hrs:mins)	-	-	-	3:00	-	-	3:56	-	-	7:30	-	-
Pot Life - 500g Mix in air (hrs:mins)	-	0:25	0:12	1:00	0:48	0:23	1:45	1:27	0:54	3:00	2:30	1:20
Earliest Time To Apply Vacuum (hrs:mins)	-	0:50	-	3:11	2:30	1:00	4:22	3:00	1:30	7:40	5:00	3:30
Latest Time To Apply Vacuum (hrs:mins)	-	1:30	-	4:26	3:30	1:30	6:04	4:20	2:10	10:00	6:10	3:40
Earliest Time To Turn Off Vacuum (hrs:mins)	-	3:00	-	8:49	4:36	4:00	16:00	8:30	6:00	35:00	12:30	7:45
Demould Time (hrs:mins)	-	7.5	-	16:22	11:10	7:00	31:29	16:46	7:55	74:00	24:00	10:00

* It is recommended to postcure laminates for 16 hours at 40°C, when manufactured using Extra Slow or Ultra Slow Hardeners.

Cured System Properties				
	Post Cured 16hrs 50°C			
	Resin / Std Hardener	Resin / Slow Hardener	Resin / Extra Slow Hardener	Resin / Ultra Slow Hardener *
Tg Ult - Tg1 by DMA (°C)	93.8	100.3	101.2	101.1
Tg2 - DSC (°C)	71.9	66.8	67.9	75.5
Tg1 - DMA (°C)	79.6	64.0	70.0	75.6
Cured density (g/cc)	1.26	1.28	1.3	1.28
Resin cast tensile strength (MPa)	37.3	42.2	47.3	46.2
Resin cast tensile modulus (GPa)	4.3	4.8	4.5	4.3
Resin cast strain to failure (%)	1.1	1.2	1.3	1.4
Laminate ILSS (MPa)	34.5	33	31	30

* Postcure 4 hours at 70°C

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.

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. A more detailed guide for the safe use of Gurit resin systems is also available from Gurit, and can be found at www.gurit.com

APPLICABLE RISK & SAFETY PHRASES

Please refer to product SDS for up to date information specific to this product.

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).

Adequate long term storage conditions will result in a shelf life of 12 months for both the resin and hardeners. Storage should be in a warm dry place out of direct sunlight and protected from frost. The temperature should be between 10°C and 25°C. Containers should be firmly closed. Hardeners, in particular, will suffer serious degradation if left exposed to air.

NOTICE

All advice, instruction or recommendation is given in good faith but Gurit AG (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 the Company's Website: <http://www.gurit.com/terms-and-conditions.aspx>

The Company strongly recommends that Customers make test panels and conduct appropriate testing of any goods or materials supplied by the Company 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. 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 are continuously reviewing and updating literature. Please ensure that you have the current version, by contacting Gurit Marketing Communications or your sales contact and quoting the revision number in the bottom right-hand corner of this page.

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