



Ampreg 26

Epoxy Laminating System

- **Optimum mechanical properties**
- **High Tg's from elevated temperature cures**

Introduction

Ampreg 26 is SP-High Modulus' premium epoxy laminating system, and is particularly suitable for the manufacture of large, high performance composite structures. The product's high laminate mechanical properties and high Tg's achievable from modest postcures, make it well suited for heavily loaded applications, particularly those where a little extra thermal performance is required. Ampreg 26 is optimised for use in hand-lay up and vacuum bagging processes, but can also be used in other processes such as RTM, vacuum infusion, pultrusion and filament winding.

Ampreg 26 is recognised worldwide as the premium laminating system for the manufacture of racing sailboats, and high performance, one-off cruising boats. It has been selected by the RNLI in the UK for the wet lay-up components of their high-speed coastal rescue vessels, and it is in use on the VSV rapid troop insertion craft, in service with the UK's SBS and US Marine Corps.

Ampreg 26 may also be used with the separate Ampreg Ultra Slow hardener to provide flow times under vacuum of up to 9 hours at 20°C.

Instructions for Use

Workshop Conditions

Ampreg 26 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 (see corresponding table in this datasheet). Maximum relative humidity for use is 70%.

Mixing and Handling

Ampreg 26 resin is combined with Ampreg 26 slow hardener, or fast hardener, or any pre-mixed combination of the two hardeners, in the following ratio:

Ampreg 26 resin : Ampreg 26 hardener

100 : 33 (by weight)

It is important that the resin and hardener components are measured out accurately and electronic scales are recommended for this purpose. The resin/hardener mixture should be well mixed paying particular attention to the sides and bottom of the mixing vessel. Then, the mixture should be transferred to a shallow tray in order to reduce the exothermic heat build up which would reduce pot life and working time. Accurate measurement of the components and thorough mixing are essential. Deviating from the prescribed mix ratio will not accelerate or inhibit the cure and can seriously degrade the properties of the system.

The ability to pre-mix the two hardeners in any combination gives a range of handling characteristics to the system. Blends of the two hardeners can be made to give intermediate working times.

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.

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 the first layers put down and faster hardeners in the later layers. In this way the whole thickness laid down remains workable for approximately the same time. Thicker laminates may require a periodic debulk before further laminating and final consolidation. If in doubt please contact Technical Services.

Ampreg Ultra Slow Hardener

This hardener gives an extended working time (8-10 hours), and is used at a mix ratio of 100:33.3 (3:1) by weight. Details of the post cure schedules required are given in the separate Instruction Sheet available for this product.

Pregel

Ampreg Pregel is a thixotropic resin modifier that can be used with Ampreg 26 hardeners. It must be mixed with the chosen Ampreg 26 hardener at the ratio indicated in the Ampreg Pregel datasheet. It can then be added to an Ampreg 26 Resin/Hardener mix, and used in the following situations:-

- As a resin modifier to reduce drainage in laminates.
- As an adhesive mix for bonding core materials to Ampreg 26 laminate skins.
- For the secondary bonding of pre-formed Ampreg 26 laminate components.

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 laminate working time, as excessive flow and resin starved laminates may result. Heating can be economically and effectively achieved with either space heaters under an insulation tent or heated blankets with insulation over. If vacuum is applied earlier, such as in debulk operations, only 30-50% vacuum should be used. Details of the various types of system are available from Technical Services.

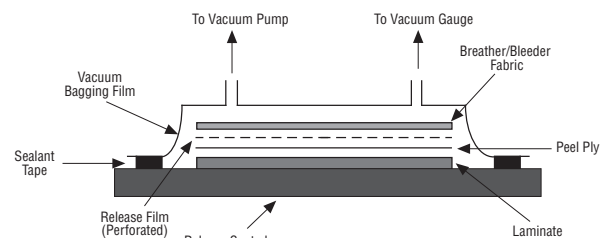


Figure 1

Ampreg 26 resin with either Slow or Ultra Slow hardener is best suited. Do not expose wet laminates to excessive vacuum pressures - keep below 0.8 bar (80% vacuum). SP-High Modulus supplies a range of Tygavac vacuum bag materials and ancillaries. For details of effective vacuum bag consolidation, please contact Technical Services.

Bonding Techniques & Peel Ply

Where it is necessary for a bonding operation to be carried out following the cure of the Ampreg 26 laminate, a suitable Peel Ply can be applied to the surface to be bonded during the lay-up process. 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 can reduce the labour of keying the surface by sanding.

Peel Ply is 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.

SP-High Modulus recommends the use of its NPP80 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 Technical Services.

Core Materials

SP-High Modulus 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 26 system. For further information on the use of core materials with Ampreg 26 system, please contact Technical Services.

Cure Schedule

Ambient Temperature Cure - Ampreg 26 has been developed to return good mechanical properties after cure at ambient temperatures, the minimum recommended temperature being 18°C, and excellent properties after a slightly elevated temperature post-cure.

An initial cure of at least 36 hours (with slow hardener) or 16 hours (with fast hardener) at 18°C is recommended before demoulding. Laminates subjected to an ambient temperature cure should be allowed 14 days before the system can be considered to be adequately cured and they should be kept in a warm dry environment during this period. When using the Slow Hardener or Ultra Slow Hardener exclusively an elevated temperature cure is strongly recommended.

Elevated Temperature Cure

Post curing the laminate will greatly increase mechanical properties. The Ampreg 26 system will achieve similar properties with a cure of either 5 hours at 80°C or 16 hours at 50°C but the cure has been optimised for 50°C. The latter temperatures are 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. However, it is recommended that elevated temperature curing should be completed before any 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.

Properties

Component Properties				
	Resin	Fast Hardener	Slow Hardener	Ampreg Ultra Slow Hardener
Mix Ratio (by weight)	100	33.3	33.3	33.3
Mix Ratio (by volume)	100	36.9	39.9	40.1
Viscosity @ 15°C (cP)	3220	4000	137	57
Viscosity @ 20°C (cP)	1840	2560	104	47
Viscosity @ 25°C (cP)	1050	1620	78	38
Viscosity @ 30°C (cP)	585	1020	59	32
Shelf Life (months)	24	24	24	24
Colour (Gardner)	1	4	1	blue
Mixed Colour (Gardner)	-	2	1	blue
Component Dens. (g/cm ³)	1.160	1.046	0.969	0.963
Mixed Density (g/cm ³)	-	1.132	1.112	1.111
Hazard Definition	Xi, N	C, N	C	C

Properties (cont'd)

Working Properties vs. Temperature												
	Resin / Fast Hardener				Resin / Slow Hardener				Resin / Ultra Slow Hardener			
	15°C	20°C	25°C	30°C	15°C	20°C	25°C	30°C	15°C	20°C	25°C	30°C
Initial Mixed Viscosity (cP)	2430	1680	1150	773	845	565	378	251	618	426	292	203
†Gel Time - 150g Mix in water (hrs:mins)	-	0:21	0:13	0:09	-	7:00	5:00	3:10	-	9:30	6:20	4:10
†Pot Life - 500g Mix in air (hrs:mins)	-	0:16	-	0:11	-	2:45	-	1:15	-	6:00	-	1:50
†Latest Vacuum Flow Time (hrs:mins)	2:20	1:40	1:10	0:45	11:00	7:10	4:30	2:50	11:00	9:00	7:10	5:50
†Earliest Vacuum Off Time (hrs:mins)	3:30	2:30	1:45	1:15	39:00	18:00	8:25	3:40	43:00	27:00	17:00	11:00
Demould Time (hrs:mins)	3:30	2:30	1:50	1:15	102:00	36:00	13:00	4:40	90:00	57:00	34:00	21:00

Cured System Properties									
	Room Temperature Cure (28 days @ 21°C)			Post Cured (24 hrs @ 21°C + 16 hours @ 50°C)			Post Cured (24 hrs @ 21°C + 5 hours @ 80°C)		
	Fast	Slow*	Ultra Slow*	Fast	Slow	Ultra Slow	Fast	Slow	Ultra Slow
Tg DMTA (Peak Tan δ)(°C)	78.3	62.5	63.0	86.3	82.2	82.7	99.3	103.6	102.1
Tg Ult - DMTA (°C)	98.4	106.3	109.3	98.4	106.3	109.3	98.4	106.3	109.3
ΔH - DSC (J/g)	42	57	46	9	11	3	0	0	0
Tg1 - DMTA (°C)	65.0	56.3	55.1	76.5	73.9	74.6	87.2	92.4	93.2
Est. HDT (°C)	63	48	48	71	67	68	84	89	87
Mositure Absorption (%)	1.31	1.05	1.12	1.10	0.93	0.91	-	-	-
Cured Density (g/cm³)	1.183	1.159	1.158	1.183	1.160	1.159	-	-	-
Linear Shrinkage (%)	1.6	1.6	1.6	1.6	1.6	1.6	-	-	-
Barcol Hardness	37	27	29	37	28	30	-	-	-
Cast Tensile Strength (MPa)	84.9	58.3	61.1	84.7	80.3	78.8	-	-	-
Cast Tensile Modulus (GPa)	3.91	3.75	3.7	3.63	3.45	3.62	-	-	-
Cast Strain to Failure (%)	3.2	1.8	1.9	5.1	4.9	4.2	-	-	-
Lam. Comp. Strength (MPa)	498	499	484	489	421	560	461	564	475
Laminate T.V.M. Strain (%)	1.9	2.1	2.0	1.9	1.9	2.0	-	-	-
Laminate ILSS (MPa)	55.1	62.1	57.8	59.1	61.4	64.1	61.9	60.3	65.2
ILSS Wet Retention (%)	79	91	92	80	89	89	-	-	-

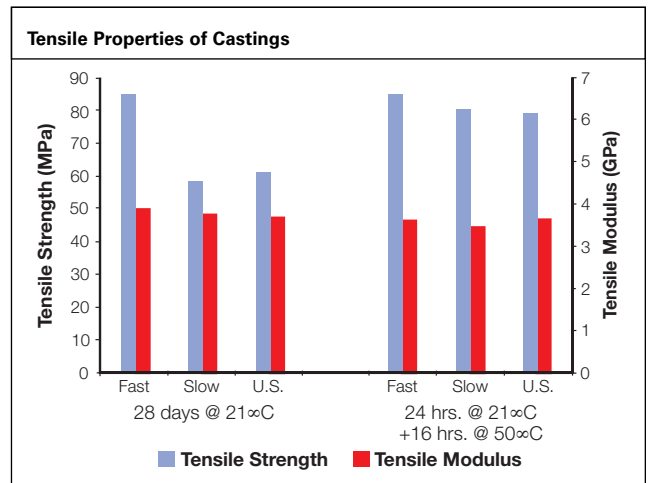
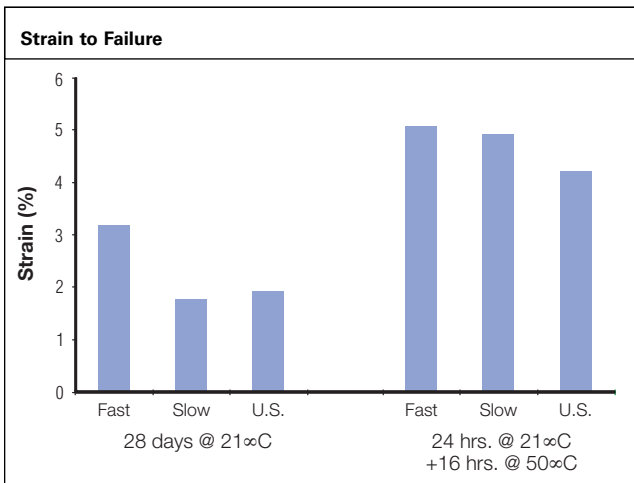
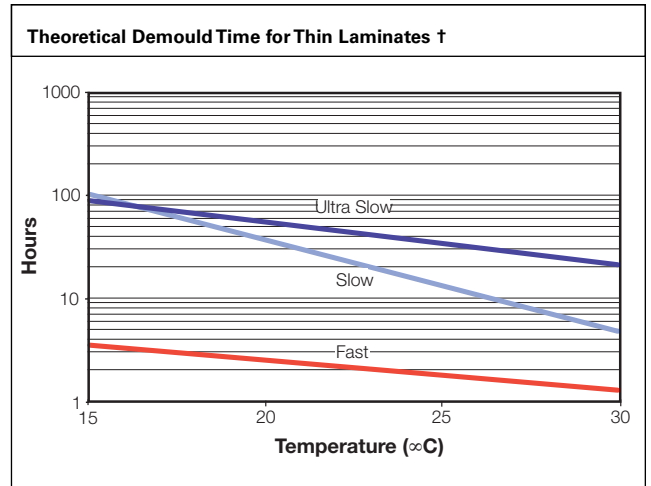
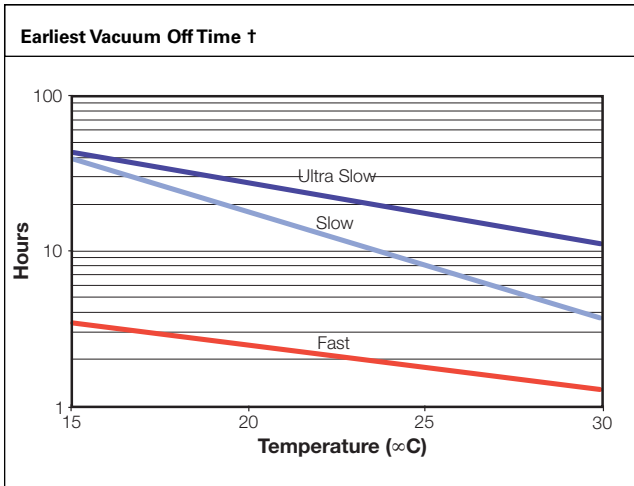
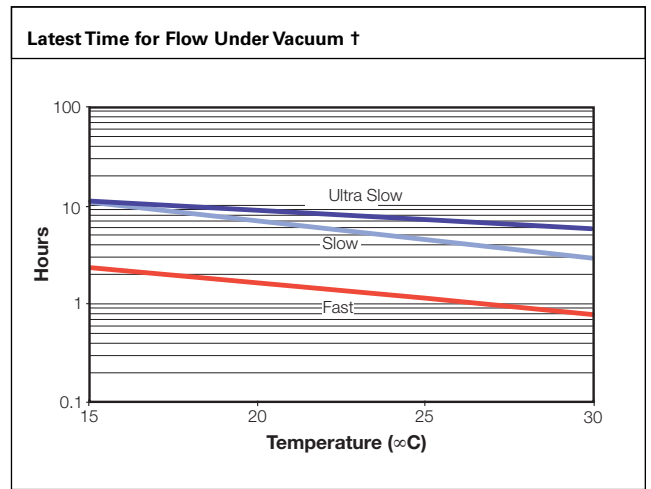
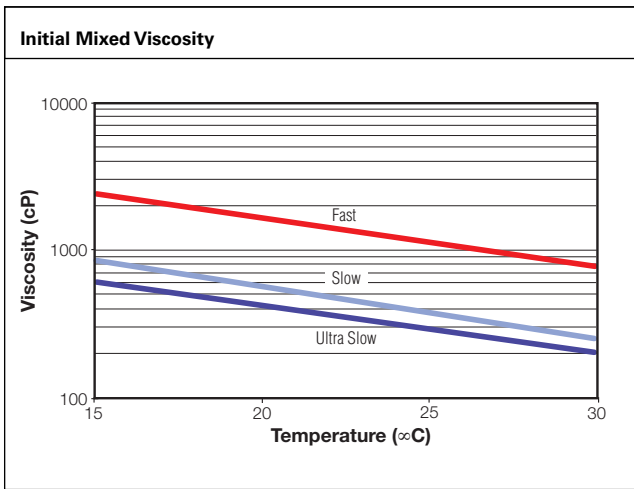
NOTES: For an explanation of test methods used see 'Formulated Products Technical Characteristics'.

All figures quoted are indicative of the properties of the product concerned. Some batch to batch variation may occur.

†All times are measured from when resin and hardener are first mixed together

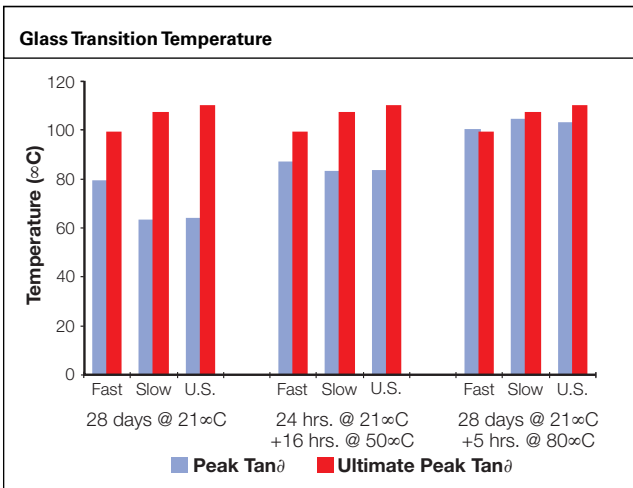
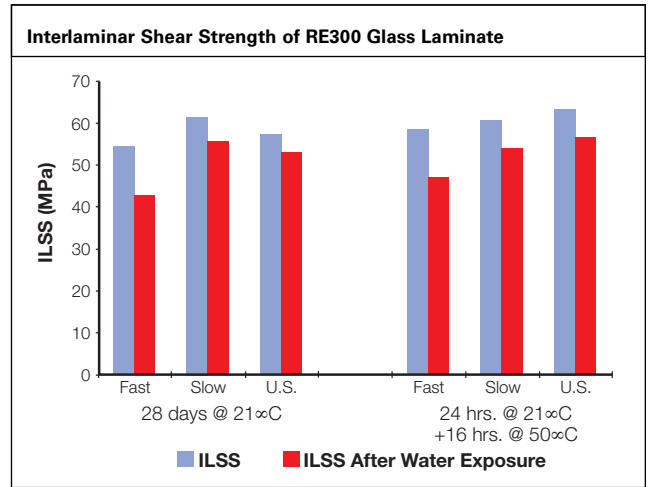
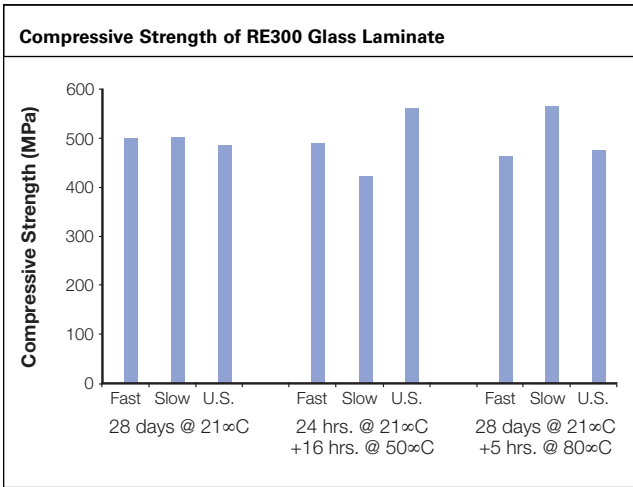
*Ambient temperature cure alone is not recommended with this hardener.

Properties (cont'd)



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Health and Safety

The following points must be considered:

1. Skin contact must be avoided by wearing protective gloves. SP-High Modulus 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.

SP-High Modulus produces a separate full Material Safety Data Sheet for all hazardous products. Please ensure that you have the correct MSDS to hand for the materials you are using before commencing work. A more detailed guide for the safe use of SP resin systems is also available from Gurit, and can be found at www.gurit.com

Applicable Risk & Safety Phrases

Resin

R 36/38, 43, 51/53
S 23, 24, 26, 28, 37/39, 57

Fast Hardener

R 21/22, 34, 43, 62, 51/53, 63
S 20, 23, 26, 36/37/39, 45, 57

Slow Hardener

R 20/21/22, 35, 37, 43, 52/53
S 9, 20, 26, 36/37/39, 45, 61

Ultra Slow Hardener

R 22, 35, 37, 43
S 20, 26, 28, 36/37/39, 45



Transport & Storage

Ampreg 26 resin and hardener 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 for both materials will result in shelf lives of two years for both the resin and the hardeners. Storage should be in a warm dry place out of direct sunlight and protected from frost. The temperature should be between 15°C and 30°C. Containers should be firmly closed. Hardeners, in particular, will suffer serious degradation if left exposed to air.

Notice

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UK

St Cross Business Park
Newport, Isle of Wight
United Kingdom PO30 5WU

T +44 (0) 1983 828 000
F +44 (0) 1983 828 100
E marine@gurit.com
W www.gurit.com

Australia

Unit 1A / 81 Bassett Street,
Mona Vale, 2103 NSW,
Australia

T +61 (0) 2 9979 7248
F +61 (0) 2 9979 6378
E sales-au@gurit.com
W www.gurit.com

New Zealand

32 Canaveral Drive, Albany,
Private Box 302-191,
North Harbour, 0751
Auckland, New Zealand

T +64 (0) 9 415 6262
F +64 (0) 9 415 7262
W www.gurit.com

Canada

175 rue Péladeau,
Magog, (Québec)
J1X 5G9, Canada

T +1 819 847 2182
F +1 819 847 2572
E info-na@gurit.com
W www.gurit.com