SP Systems

Composite
Engineering
Materials

Frequently Asked Questions

SP Systems produces a wide range of products for both marine and other markets. The products are mainly intended for building and repair applications and in the marine market they are distributed both to professional boatbuilders and to retail outlets where amateur users can buy the products. Most of the queries we receive are from private individuals who are inevitably not experienced in using the products and often have difficulty buying the correct product.

These notes have been compiled for the user to both obtain an improved understanding of SP epoxy products which will complement reading the data sheets and also, perhaps more importantly, to address the most common problems the user may experience.

General question categories:

- **Bonding**
- **Coating**
- **Filling**
- **Laminating**

Each category contains questions covering:-

1. **Product selection/feasibility related to general product type**
2. **Typical problems**

Bonding concerns glues, of which all produced by SP Systems are epoxy, and glueing applications.

Coating covers both epoxy and polyurethane systems.

Filling deals with epoxy fillers, either formulated types such as SP S-Fill or the use of filler powders with solvent-free resin system.

Laminating refers to using resin as a matrix for fibre reinforcement.

Bonding

a. "I need to bond wood to grp. Have you got a product I can use?"

This will depend on the type of grp - polyester, vinylester or epoxy. Dealing with polyester first, bonding with epoxy is only suitable if the polyester is well-cured. In some component manufacture, wax is omitted from the catalysed polyester mix to be used on the final interior laminate which leaves the polyester resin surface slightly tacky and undercured, but ideal for bonding with polyester. Epoxy cannot be used reliably for high strength bonding on such a surface. To ascertain whether a full cure has taken place is difficult but as a general rule-of-thumb one or two months should have elapsed before bonding with epoxy can even be considered.

When bonding to either polyester or epoxy laminates, correct preparation is essential and for straightforward adhesive bonding the best adhesive epoxy should be selected. SP Spabond 120 or 125 will give the best bond strength and have the greatest resilience rather than SP 106, SP 320 systems or direct competitors.

Bonding items with glass tape reinforcement, such as bulkheads or any metal fitting, can be done with Spabond 120 or 125 system. This is often referred to as laminating.

If the polyester laminate surface is not sufficiently cured to use an epoxy then SP Epacryn is the best alternative as a laminating/ bonding system. It is considerably superior to using polyester but shares its easy working properties.

b. "I would like to use epoxy to build my wooden boat but I only have an unheated workshop. Can I still use SP products?"

The answer is, 'yes', but conditionally. 'Normal' room temperature is important both to ensure accurate metering of the epoxy adhesive components and to allow them to mix together effectively when stirred as a warm temperature has a significant effect on reducing viscosity. The heat only needs to be local. Arranging for a polythene tent over the work area is the first thing to do. Heating is then more economic and can be achieved with either a gas heater (vented to outside the tent), space heater or, ideally, electrically if power is available.

It is worth mentioning that other types of glue, e.g. resorcinol, are much more sensitive to temperature effects than epoxies. They will not provide an adequate bond if the temperature drops below approximately 16°C. Epoxies may cure more slowly below this temperature but at least the cure reaction will proceed at normal rates if the temperature is raised later and there will be no adverse long-term effect.

c. "I am gluing wood. What product do I use from your range?"

If it is Teak - Use Spabond 120 or 125.

If it is Oak - Use Spabond 120 or 125, but wash timber with alkaline solution first

Any other wood -
1. Use preferably Spabond 120 or 125
2. SP 106, SP 320 if also coating
3. Even Ampreg 20 if readily available

- Unsuitable SP products include SP 115 or any solvent-based product (e.g. Eposeal 300)

Generally it is best to use a multi-purpose type of product (e.g. SP 106) that does a lot of different types of job (e.g. gluing and coating, etc.), rather than a specific glue like Spabond 120 or 125. The Spabond systems are a little restricted as one cannot use them as a coating or with reinforcements. Spabond 120 or 125 can be used as the resin base for epoxy filler mixes though.

Reserve Spabond 120 or 125 for large boat building projects using wood - it gives lots of working time and is easy to mix in large volumes using graduated cups. Spabond 120 or 125 also has more shear strength than other epoxies making it more suitable for use with higher strength woods and for gluing other types of materials, e.g. metals.

Most wood boatbuilders want a multi-purpose type of product - those familiar with WEST will be able to use the similar SP product SP 106, while those who want the additional benefits of a clear coating product, will use SP 320.

d. "My glue (or coating) has not 'gone off' "

This is the reaction to one of two possible types of phenomenon - either:

i) Coatings - the surface is sticky but the rest of the thickness of the coating is hard.

ii) Glues and coatings - the resin is still rubbery or even sticky throughout.

Any SP solvent-free system using fast hardener should be hard after 8 -12 hours at room temperature and can hardly be marked by a finger nail, with the exception of Handipack which can be noticeably rubbery after this time. Anything that is soft all the way through or cannot be sanded is due to undercure - usually attributable to using incorrect mix ratio. The "not gone off" syndrome is best represented by Table 1.

In a case of a major dispute with a customer who believes the product is at fault it is always possible to ascertain what mix ratio was used by running a DSC/DMTA test in the SP Systems' R & D lab. All that is needed is a small 'bit' of the semi-cured material - a 'drip' size resin piece will do. The outcome of this has always settled any dispute.

Table 1

Application	Symptom	Cause
Coating	Greasy film	Reaction of the surface with air at low temperature and/or high humidity > "by-product"[1]
Coating & glues	Rubbery cure	Received or using wrong hardener[2] Incorrect/inadequate mixing - not stirred long enough[3] - sides/base of container not scraped[3] Incorrect measuring of components - mix ratio incorrect - poor measuring[3] - faulty pumps[3]

Note[1] - By-product from SP 106 or Ampreg 20 can be removed with Solvent C; SP 320 by-product can be removed by wet sanding
Note[2] - resin will harden to correct state eventually, if correctly mixed
Note[3] - resin will never achieve correct hardness and properties.

e. "My resin has 'gone off' in the pot"

The handling of the epoxy system after mixing the components is indicated in the data sheet. The general rule of thumb for solvent-free epoxies is only mix up enough epoxy for glueing or coating that one can use in 5-10 minutes (using Fast hardener). If one mixed up too much in one go or left it in a container where the heat build up (exotherm) could not dissipate - eg in the mixing pot - the heat generated in the chemical reaction would accelerate the reaction producing more heat, and therefore a further acceleration, and so on. Transfer to a wide mouth vessel or tray after mixing is best rather than retaining the mix in a narrow type of container. When coating using SP 320, three or four pumpfuls is about all one can manage within the working time of the product at 20-25°C.

The speed of the reaction is affected by environmental temperature, and while it may be difficult for a person to sense the difference between 17°C and 21°C, this will give several minutes difference in pot life for most SP solvent-free epoxies, This is often why it may be felt that there is something wrong with the product.

Coating

a. "I would like to coat my old wooden boat with epoxy to reduce maintenance - can I do this?"

In general this can only be achieved if the hull is of glued construction - cold-moulded, ply, glued carvel, strip-planked, or glued clinker. If epoxy is used over any non-glued joints where there can be movement, the epoxy film will crack. Traditionally-built boats require traditional, more flexible coatings but even these eventually crack along joint lines and lead to annual maintenance. On some hulls where there is a very close fit between hardwood planking, a more flexible type of epoxy, SP Eposeal 300 can be used successfully in the same way as Universal Clear Primer, followed by a varnish or paint system.

Some old wooden boats which were not originally of glued construction can be made virtually 'maintenance-free' but the full restoration procedure must be followed (see SP Restoration Guide for Wooden Craft). This involves thorough drying of all wood, bonding the hull planking to create a uniform structure and then stabilizing the wood by coating with a suitable thickness of epoxy. SP Systems has information on this procedure.

b. "I want to use high performance varnish on my wooden deck"

This will depend on whether the surface is bare wood, or, if not, what it has been coated with. If this is a single component varnish then SP Ultravar 2000 or any other two-pack varnish cannot be used unless the existing coating is first stripped off. This must be done with either a hot air-stripper or water-based Nitromors. The bare wood must then be washed with SP Solvent E (or any other two-pack poly solvent). If the previous coating is a two-pack polyurethane then Ultravar 2000 will be compatible.

With the wood stripped back to bare, this is the best opportunity to suggest priming first with Eposeal 300 since this product is more tolerant than other SP epoxies to any contaminants left in the wood.

c. "I want to stain some wood or add preservatives, then coat the surface with epoxy - can I do this?"

Yes, but only water-based wood dyes can be used, not the usual type found in a hardware shop which are likely to be white-spirit (or similar) based. Organic solvents in these products do not fully evaporate, and if used, they would cause the epoxy coating to fish-eye. Surfboard builders spray-paint their foam with acrylic water-based paints before using SP 115 epoxy. These are the same type of paints we recommend for wood. The material is 'Palette wood dye' from:

Liberon Waxes Ltd
Tel: 01797 367555
Fax: 01797 367575

Wood treated with solvent-based wood preservatives such as 'Cuprinol' impose the same limitations as wood dyes for the subsequent use of epoxy therefore water-based preservatives can only be used.

If the wood has already been treated at some time in the past with conventional solvent-based stain or preservative then one *may* be able to use epoxy but only the solvent-based epoxy such as Eposeal 300 has any chance of success.

d. "When do I use SP 320 or SP 106 (solvent-free) rather than Eposeal 300 (solvent-based) for clear coating wood?"

Customers not familiar with our range of epoxies are often a bit confused why we have so many different epoxies and types of epoxy, which appear on paper to do the same thing. For clear coating, the choice ultimately is between solvent-free epoxies and solvent-based types.

Generally the choice will depend on the following main factors:

i) Type of Application
High build? - maximum waterproofing, lowest labour input
Low build? - maximum smoothness, multiple coats

ii) Skill of the User
How much experience with epoxies?
How much understanding of how they are used?

iii) Workshop Conditions
(or the conditions immediately surrounding the job during application of the product, and during curing)

The SP coating products which are Solvent-free or Solvent-based:

- **Solvent-free - SP 320, SP 106**
- **Solvent-based - Eposeal 300**

Sometimes the choice is immediately apparent - the customer knows what he wants to do and what to expect from the product.

With both of these types, solvent-free and solvent-based, they must be overcoated with Ultravar 2000 two-pack varnish for the protection it gives against long term deterioration caused by ultra-violet radiation.

Dealing with each type in turn and where each is appropriate:

- **Solvent-free - SP 320, SP 106**

These will be used where:

High coating thickness is required e.g. "heavy duty" applications to give the highest protection from either abrasion or moisture, e.g. underwater areas or high wear areas.

Glass or another fibre is required to reinforce the coating to give extra strength or stiffness.

Conditions for evaporation of solvent are poor, e.g. bilge areas of a new wooden boat.

A white or light coloured wood is to be coated e.g. sycamore. SP 320 is clearer than other epoxies.

The user is either experienced with epoxies generally, or has a full understanding of two-component products. Quite a high level of operator skill is necessary when handling solvent-free epoxies and equally important is the necessity for warm, dry conditions. The lack of either of these requirements can mean that the customer should not use this type of product or, where appropriate, should switch to a solvent-based type, eg Eposeal and accept the limitations of this type (low film build, less hardness).

It is important to remember that a 'lesser' product used well will always give a better result (and customer satisfaction) than a more 'high-tech' product used badly!

- **Solvent-based - Eposeal 300**

These can be used where:

Thin or low build epoxy films are required, e.g. decks of sailing dinghies which are not constantly immersed in water, or areas which do not receive too much wear, eg handrails, internal furniture, etc. These can be conveniently called "light-duty" applications.

Very little operator skill is required, certainly no more than when using conventional 2-pack paints. The pot-life is much longer and the coating is easier to apply and get a good finish.

The working conditions are poor or difficult to control (e.g. working outside). The products are fairly tolerant to cold conditions (less than 15°C) where they are still easy to apply and will cure well. If moisture does settle on the surface and causes a 'bloom' this can be removed easily by warming the surface gently with a hot-air gun until the transparency and gloss returns.

Some film shrinkage in service can be expected where this type of epoxy is used leading to a slight wood grain texturing of the surface after a few weeks. This is often acceptable.

e. "I have coated wood or an epoxy surface with SP320 (or SP106) and it has "fish eyed" (often described in other ways such as 'small holes', 'pulling away', etc) ."

There are several possible reasons:

a) Fish eyes are commonly reported when applying the second coat of a solvent-free epoxy (SP 106 or SP 320) on to a sanded surface. Remaining by-product and insufficient sanding of the first coat are very common causes. If SP 106 has been used

then either warm water or SP Solvent C will remove by-product and a Scotchbrite pad is helpful instead of an ordinary cloth. For SP 320, where the by-product can be slightly more 'tacky', then warm water is the best method for its removal, again using a Scotchbrite pad. Sanding wet achieves by-product removal and gives a good key. When sanding dry it is especially important to remove by-product as it will only clog the sand paper. Use 80-120 grit.

b) If the work has been cleaned down with SP Solvent A immediately before recoating epoxy or after sanding bare wood then some solvent may have remained on the surface. Acetone or cellulose thinners are not as good as cleaning materials because they may be contaminated and their use sometimes leads to problems.

c) Check whether cleaning rag was contaminated with other types of solvent. It is likely that if other solvents, e.g. Solvent E were supplied, the customer may have inadvertantly used one such as this to clean the surface.

d) If the work was wiped down with White Spirit - this is really bad news as it means that epoxy then cannot be used unless all traces are removed, which is almost impossible, except with lots of SP Solvent A.

e) Wrong resin-hardener mix ratio can also give the same symptoms in some cases.

f) Traces of contaminant in the atmosphere - e.g. mould release agent aerosols, wax polishes, etc.

(g) Some types of pigment (though not SP Pigment) dispersed in epoxy resin, may make the problem worse especially when coating is applied in a thin film.

h) Direct heat from the sun may also make problem worse.

i) Syringes can cause this problem if not cleaned out first. This is quite a common cause with 'A' pack users particularly if the warning is not read when the syringes are purchased. Mixing cups or pumps do not have any surface contaminants.

j) If "fish-eyeing" is persistent when coating bare wood see next question.

f. ***"I am coating bare wood, I followed all your instructions regarding preparation and I get "fish-eye" effects."***

If eveything listed above has been done correctly then it may be one of those rare cases where the resin in the wood is causing the problem, even after the surface has been solvent-wiped. With some woods, such as oak, it is always difficult to wet out the surface and fish-eyes form readily.

Note that oak is recognized as being a 'difficult' timber to glue. Resorcinol won't work at all so epoxy is always the best alternative. If coating oak or if other problems persist, please contact SP Systems Technical Services Department.

g. "I have coated with SP 320 and it's still tacky after 3 days! What's wrong?"

Having metered and mixed the resin and hardener correctly and used it at a reasonable temperature then the only explanation is surface by-product, which, in the case of SP 320, is a 'tacky' one. The SP 320 surface will feel less tacky on dry days than wet ones as moisture in the atmosphere will be attracted to the surface.

The by-product is easily removed by either wet sanding or wiping with a wet cloth or "Scotchbrite" pad (most effective). The resin underneath will be hard and tack-free and can be relatively easily sanded.

h. "My SP 320 has gone 'cloudy'"

This is not very common and the most likely cause is that moisture has settled on the surface by-product causing a surface 'blooming'. This can be rubbed off with a Scotchbrite pad and water before giving it a good sanding with dry or wet abrasive paper.

Another explanation could be that moisture has been drawn up to the surface of the wood and reacted with the 'wet' epoxy before it has set hard. This will cause cloudiness with all types of coatings.

Fillers

a. "What fillers do I use to make a glue?"

For wood to wood - Use Microfibres
For wood to grp - Use Microfibres and Colloidal Silica

If customer only has silica then the wood surface should be precoated with unfilled resin mix first in order to achieve the best adhesion. The thick filled mix should then be applied immediately afterwards.

For fillet joints:-

Highest strength	-	Use Microfibres/Silica mix
Lower strength type (maybe adequate though for bonding)	-	Use Microballoons (or Glass Bubbles) with Colloidal Silica.

See the SP Guide to Fillers for the quantities to use.

b. "I am confused regarding your range of fillers. How do the fillers work?"

Microfibres (MF)	-	Absorb resin, helps prevent joints be coming resin starved.
Microballoons (MB) or Glass bubbles (GB)	-	Hollow mineral spheres which displace resin, and therefore extend it. Do not soak up resin - therefore mixes are of lighter weight and are easier to sand.
Colloidal silica (CS)	-	A thixotrope - to give non-drip properties, inhibiting penetration into substrate. Usually used with the fillers mentioned above.

Glass Bubbles and Microballoons are interchangeable - Microballoons are darker, lighter in weight and easier to sand.

c. "How much of the fillers do I need?"

When ordering, consult the 'Filler Guide', i.e.

For gluing work - one will need approximately 1 x 0.5 kg per 3 kg pack of SP106

For filling & fairing (using hollow sphere type) - 3 x 0.3 kg filler goes with a 3 kg pack

When the customer is ordering a product, the filler quantities worked out on a percentage by weight from the filler guide are useful since the resin is sold by weight. When the customer is using the fillers in a practical situation, he will find it more convenient to add the fillers on a volume basis and these details are given in the resin system data sheets.

Laminating

a. "Is polyester resin compatible with cured epoxy?"

Polyester resin should not be used over cured epoxy as the cure of polyester will be inhibited if the epoxy is not fully cured and prepared. Also the bond strength will, at best, be poor as polyester is not a good adhesive.

b. "I'm doing a laminating repair on old grp. What resin do I use?"

Resin - Use Ampreg 20 (professional/trade) or SP 320 (amateur/private). SP 320 is better if the repair is not to be painted, as it has better light stability.

Hardener - Fast hardeners are hardly ever used (except with SP 320 on very small jobs).

Ampreg 20 Standard hardener is most common, or SP 320 slow hardener (the Ampreg 20 will give longer working times and pot life).

c. "How much resin do I use with fabrics?"

This can be approximately derived from the weight of the fabric being used, as follows:

Glass - 2 x the weight of the fabric per m^2.
Carbon - 1.5 x the weight of the fabric per m^2.
Aramid - 1.5 x the weight of the fabric per m^2.

In each case this will give roughly 1:1 by volume of resin:fibre. The ideal situation is to have approximately 60% fibre by volume but this can only normally be achieved by professional laminators.

d. "How can I reinforce the wooden surface (hull, deck) of my boat?"

This process is known as 'sheathing' and we have a leaflet about it, which describes how to do it, what materials to use and how much.

e. "Can I use chopped strand mat (CSM) with epoxy resins?"

The simple answer is 'no' - for two reasons. Firstly CSM is used to reinforce the resin in GRP structure, where the resin usually makes up two thirds of the GRP and takes as much of the load as the glass fibre. The reverse is true with epoxy resins. The fibres usually make up two thirds of the volume of the laminate. The primarily role of the epoxy is to hold the fibres in place and transfer the load evenly across the fibres, which bear the majority of the load.

The CSM can only effectively be used with an "excess" of resin, because of its structure. The open nature of CSM means that it is very difficult to achieve a high fibre volume fraction.

Secondly, the glass surface in CSM is treated to bond well to polyester resin. It *can* bond to epoxy but it is not so compatible and in some cases a cloudy resin results because of this incompatability.

Notice

The policy of SP Systems is one of continual development and improvement. Therefore the right is reserved to alter specifications and prices without prior notice. Any information or advice contained in this publication or obtained from SP Systems by other means and whether relating to SP Systems' materials or other materials, is given in good faith. However, it remains at all times the responsibility of the customer to ensure that SP Systems' materials are suitable for the particular process used and purpose intended.

SP Systems therefore strongly recommend that representative test panels and component sections are built and tested by the user in order to define the best process and materials to use for the desired component. This should be done under conditions as close as possible to those that will be used on the final component.

SP Systems' guides are being continuously reviewed and updated. Please ensure that you have the current version before using the product, by contacting SP Systems' Marketing Services and quoting the revision number in the bottom left-hand corner of this page.

Structural Polymer Systems Limited
St Cross Business Park . Newport . Isle of Wight . PO30 5WU . United Kingdom
Tel: +44 (0)1983 828000 . Fax: +44 (0)1983 828100
E mail: info@spsystems.com . Web site: http://www.spsystems.com

SP Systems (Australia) Ltd
4b Wilmette Place . Mona Vale . Sydney . NSW 2103 . Australia
Tel: +61 2 9979 7248 . Fax: +61 2 9979 6378
E mail: simongrosser@compuserve.com

SP Systems is a trade mark of Structural Polymer Systems Limited

Rev: UKCSTI-6-298-6