Epoxy doesn’t have to be hard work, but, it’s your choice.

Epiglass Epoxy wets out better than other epoxies. The better an epoxy wets out, the easier it is to work with, the better it penetrates fabric and wood, the quicker you get the job done. Epiglass Epoxy is a more versatile, multipurpose system. So, whatever the job, whether you’re filling a screw hole or building a yacht, for below the waterline or above, for blister or structural repair, and for laminating, fairing or gluing, Epiglass Epoxy is the easiest way.

The Easy Way

Test material: 18 oz fiberglass woven roving used for boat building and repair.

Epiglass Epoxy doesn’t have to be hard work, but it’s your choice.}

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Epiglass Epoxy Resin System

Introduction

This application guide is designed to give information on how to get the best results using Epiglass® Epoxy. It is also designed with the professional user in mind.

Epiglass has always been at the forefront in the supply of epoxy resin products to the marine industry. As far back as the 1950s, Epiglass resin technology was amongst the first to be developed in New Zealand specifically for marine use. Since this time, Interlux® has developed new, easier-to-use products with an even higher performance. These products have been relied upon in the most demanding environments, including the America’s Cup and Volvo Round the World races. Interlux has consistently set new standards of performance in Epiglass epoxy resins through a total commitment to research and manufacturing quality.

For those just starting to use epoxies, Section 1 is a must. The underlying principles of epoxies, coupled with an introduction to the various uses and components of the system are covered along with a glossary of common terms.

Epiglass Resin is a polymer-based material. It comes in two parts: A (the resin) and B (the hardener). The hardener must be mixed with resin to effect a cure at a 4:1 ratio (by volume). There are some one-part epoxies, but Epiglass needs the addition of the hardener before it can be used. Epiglass is a light straw color with a light sheen to it. When the hardener is mixed with the resin a chemical reaction takes place that makes the mixture harden or cure. Once hardened, it can never become liquid again. The polymer is a “thermoset” plastic because heat is given off during the chemical reaction. The chemical reaction forms a three-dimensional cross-linked matrix that gives the epoxy its spectacular strength.

The more advanced user familiar with this type of product will find Section 2 most valuable. Discussion of use of the system for various projects and some special application notes will give insight into how Epiglass can be an important part of boatyard activity. This section includes the ways that Epiglass Epoxy combines with the rest of the range to give total project approach.

For semi-production and custom boatbuilders, Section 3 is probably the most useful. Here the use of Epiglass in both composite and wooden building is covered along with a glossary of terms, and some discussion on choice of laminate reinforcement fibers and wood construction types.

Osmosis continues to be a challenge for boats made with polyester resin, and Epiglass Epoxy can be the best solution; turn to Section 4.

In Section 5 you will find all the facts and figures as well as safety information and frequently asked questions, including where you can use Epiglass away from the boatyard.

We hope you will find this guide useful and if you need further assistance, please contact Interlux technical service. ROGER MARSHALL

The EPIGLASS® EPOXY RESIN SYSTEM

Epiglass Epoxy is a resin system that can be used to bond two materials together. The materials can be wood, fiberglass, metal, and many plastics. Epiglass Epoxy is a resin that hardens it’s a varnish, a filler and a glue. It can be used to repair older wooden boats, to repair fiberglass boats, to coat wood like a varnish for good protection against the elements, to glue two dissimilar materials together, or simply as protection against osmotic blisters on the outside of a fiberglass hull. It can be thickened with the addition of powders to enable it to be used as a filler, a glue and fairing compound. It is water-resistant when cured and is part of the Interlux® family of high-quality coatings. In short, Epiglass Epoxy Resin is a highly versatile and effective resin system with a myriad of uses.

THE ADVANTAGES OF USING EPIGLASS

Epiglass is part of the entire Interlux® family of coatings and as such is compatible with the entire line of lining compounds, primers, bottom paints, and topside paints. This is a major advantage when building a wooden or fiberglass boat where some epoxies may react with the primer or topside.

The cure rate of Epiglass can be adjusted to suit the job. Epoxies, in general, have a more gradual cure process as they change from liquid resin to solid, than poly- or vinyl esters, making them easier to use. They are also stronger than these resins and have additional health and safety benefits. Epiglass Epoxy is styrene free which does not involve the use of dangerous peroxides, and represents a lower fire risk and environmental impact as it has no VOC’s (volatile organic compounds).

Epiglass is easy to use, and comes in a number of different sizes, with two different extender powders. Epiglass HT 9000 is available in a variety of convenient pack sizes, suited for projects or restoration jobs. Special calibrated pumps are available to enable exact measurement of the required amount of resin and hardener every time. When mixing Epiglass, mix only that amount of resin that you can use within the pot life time. Mixing larger batches means increased wastage. When mixing a large batch in a pot beware of heat build-up in the pot. Heat build-up indicates that the material is curing and will soon be unusable. When mixing large batches pour the mixture into a shallow flat container such as a paint tray to prolong its working life.
**WHY ARE THERE 3 HARDENERS?**

Epiglass® offers a "fast" hardener that sets up within ten minutes or so, and a "standard" hardener used for larger jobs that might take 20 to 30 minutes to set up. There is also a slow hardener available for use where an even longer working life is required, eg, in hotter climates.

Epiglass hardeners can be mixed together to get intermediate stages of cure. Mixing two hardeners together to adjust the cure rate will not necessarily give you a linear difference in pot life or cure time. You will need to experiment with the faster and slower hardeners to adjust the cure rate. For example, you need less fast hardener and more standard hardener to slow the cure rate to about half. By adjusting the ratios of fast and standard hardeners carefully you can get set up rates that vary from about ten minutes to thirty minutes or more. **Do not, however, vary the ratio of hardener to resin.** With Epiglass, these ratios are four to one by volume. Also, do not mix hardeners from other manufacturers with Epiglass. Other manufacturers have different resin to hardener ratios and may have a different chemical composition than Epiglass. Typically, small jobs require the use of fast hardener, allowing you to put the parts together, clamp them, and walk away. For larger jobs that require the application of large areas of epoxy, standard hardener allows you to coat the surface, apply the laminate, and get the job set up before the epoxy starts to cure. If the job starts to cure before all the materials are in place, the best option is to remove the partially cured material, let the cure finish, sand everything back, and start over.

**DIFFERENT STAGES OF CURE**

When you mix epoxy resin and hardener properly, the setting process is initiated. This process is irreversible and will continue until the mixture is set hard (cured). But during the curing process the material goes through several stages.

**A-STAGE**

The first stage, sometimes known as the A-stage, is when the chemical reaction is just starting. As the chemical reaction takes place, heat is generated, but if the resin mix is spread over a large surface, any heat disperses harmlessly into the atmosphere. The Epiglass Epoxy Resin mix can be used and applied during this stage. If the mixture is held in bulk, the heat may become too great, prematurely curing the pot. This is often referred to as an exothermic reaction.

**B-STAGE**

B-Staging of an epoxy resin is that point at which the resin will not cure any further without the addition of heat. This is caused generally by the individual molecules not having sufficient energy to fully cross link. It mainly affects heat cured epoxy resins where, if insufficient heat is applied, the mix does not cure far enough to generate any useful mechanical properties.

**FULL CURE**

Epiglass will have most of its strength in about a week after it has been applied unless post curing has occurred. However, this time can vary according to the temperature and humidity levels under which the epoxy is curing. The epoxy should not be put under load during this time because the epoxy may not have achieved full strength.

Such properties are utilized in some pre-pregs where the end user applies further heat to fully cure the resin. Room temperature cured epoxies used well below their designated curing temperature range will B-Stage to varying degrees. Once the temperature is raised to the epoxies required curing temperature range then the reaction will proceed further.

**ALMOST TACK-FREE**

At this stage an additional coat of epoxy can be applied to the first and it will still chemically bond to the original layer. At the almost tack-free stage fingerprints can be left in the surface without any slickness but most of the material is hard. This stage is also known as ‘tacky’ and is the last stage at which new epoxy can be applied and get a good bond.

**TACK-FREE**

At the tack-free stage touching the surface leaves no mark. Typically this is 3 to 6 hours after the mixture has been made up. Even though the mixture looks cured, it will take another 24 hours to one week to gain 80 to 90% of its strength. This stage is sometimes known as “hardening”.

**MINIMUM SANDING TIME**

The minimum sanding time is important to know for a job that needs to be done quickly. With Epiglass® the minimum sanding time is about 12 to 24 hours. If applying heat to the minimum sanding time can be reduced.

**CLAMP TIME**

After this time the piece can be released from any clamps or assembly jigs. Full strength has not been achieved, so care must be taken when handling and full loads should not be applied.

**DE-MOLD TIME**

Similar to clamp time. After this point, a component can be removed from the mold without high risk of damage or distortion.

**FULL CURE**

Epiglass will have most of its strength in about a week after it has been applied unless post curing has occurred. However, this time can vary according to the temperature and humidity levels under which the epoxy is curing. The epoxy should not be put under load during this time because the epoxy may not have achieved full strength.
**EPOXY TERMINOLOGY**

**MIXING**

The resin and hardener should be mixed completely before any extenders or pigments are added to the mix. It is generally assumed that it takes one to two minutes of hard mixing to get the materials fully mixed.

**POST CURE**

By raising the temperature after the resin has partly cured, increased strength properties can be obtained. There are three components to a post cure cycle: how much heat you apply to the part, how long you apply it for, and how fast you let the job cool down. As a general rule, increasing the temperature by 2-4 °F (1-2 °C) per minute and decreasing it at 5-6°F (3-4 °C) per minute is safe. Too fast and distortion can occur. If mixed in a post cure oven, a post cure period is recommended on the resin. It is generally assumed that it takes one to two minutes of hard mixing to get the materials fully mixed.

**RESIN**

The resin mixture usually contains the epoxy resin and an acceleration. It's often listed as Part A and must be thoroughly mixed with a hardener before it can be used.

**TEMPERATURE**

You can accelerate the resin curing time by increasing the heat applied to the part. Unless you can tolerate the curing time by reducing the heat applied to the part. Epiglass is usable over a wide range of temperatures from 58 to 100 °F (15 to 32 °C). Fast cure will even cure at temperatures down to 41 °F (5 °C). However, application properties are always better at temperatures of 70°F (21°C) or so. The ideal is around 72°F (22°C). See “Working Temperature.”

**VISCOSITY**

Viscosity is the runniness of the resin. A low viscosity resin such as Epiglass has a thickness similar to maple syrup or salad oil. Low viscosity resins have good penetration into fiberglass laminates. They spread well and can be easily rolled out. Epiglass also has a slightly thinner viscosity than many low viscosity resins. This is important in the build-up of the resin and helps prevent the epoxy from draining out of thick laminates. Higher viscosity resins have more viscous resin like ketchup or oiled dressing. They do not penetrate into fiberglass composites as well, so they are less easy to handle easily. Low viscosity resins can be easily thinned to the consistency of peanut butter by adding various extenders such as glue powder, filler powder, or fairing compounds.

Armored temperature will also affect the viscosity of the mix. For example in cooler conditions the mix will appear like ketchup, which is thinner and temperature, the slower the cure time.

**STORAGE OF EPIGLASS**

Cold is the enemy of epoxies. Storing epoxies in a cold environment thickens the resin and hardener, making them difficult to measure and to pour. In extreme conditions, crystallization may occur. To reverse this, gently heat the mix to 75 to 90 °F (24 to 32 °C) by putting the mix in a bath of warm water. Epiglass works best when the temperature is around 72°F (22°C). If you store your epoxy in a cold area, the resin will be more errant to store it warm and ready for use.

**MEASURING AND DISPENSING PUMPS**

Always mix any epoxy and hardener in the proportions suggested by the manufacturer. Epiglass is mixed in the ratio of 4:1 by volume as measured by the pumps that are available. If you do not have a pump, you can use a measuring cup or a measuring stick dipped in a cup of resin and measure that against another cup or stick dipped in a cup of hardener. Alternatively, a graduated mixing cup is usually effective, especially if it is a flexible plastic and can be re-used.

**HOW TO MIX & USE THE EPIGLASS® EPOXY RESIN**

Joining materials together with epoxy is relatively easy provided certain precautions are taken. Just like you would not paint over a surface with flaking paint, epoxy surfaces should be clean, oil-free, and ready to be glued. If you glue two previously painted surfaces together, the strength of the joint is not in the strength of the epoxy, but in the strength of the original paint. Consequently, to make the strongest joints it is best to join unprimed, uncoated, and clean surfaces together. In addition, different surfaces require different preparation, so you need to be aware of the properties of epoxy relative to the material you are gluing.

Tools and materials should be organized before the epoxy is mixed so that you are not looking for a mallet or clamp while the epoxy is setting up. Workspaces should be clean and free of dust, sanding residue, other contaminants. With good preparation, the job can be done quickly and easily, and the results will be extremely satisfying.

**PREPARATION**

Before you can epoxy anything together, you need to make sure that the surfaces are carefully prepared.

**STEP-BY-STEP**

**STEP 1:**

Dowel the surface is clean and dry. Use detergent like YMA 601 or solvent like Special Thinner 216 or Fiberglass Solvent Wash 202 to clean surfaces.

**STEP 2:**

Sand the area to provide a surface ‘key’ for the resin to adhere to. For wood use 100-180 grit along the grain; for fiberglass use 80-120 grit; for metal, use a disk grinder.

**STEP 3:**

Dry the surface carefully, first by wiping with a clean cloth, and, if the job needs to be done quickly, with a heat lamp, hair dryer, or hot air gun. This will also remove any particles missed by the solvent, but be sure that any drying system is waterless.

**STEP 4:**

Brush or vacuum clean to remove sanding residue.

**STEP 5:**

Wipe clean with solvent, such as Special Thinner 216 or Fiberglass Solvent Wash 202 to remove any remaining sanding residue and any surface impurities.

**STEP 6:**

Dry the surface carefully, first by wiping with a clean cloth, and, if the job needs to be done quickly, with a heat lamp, hair dryer, or hot air gun. This will also remove any particles missed by the solvent, but be sure that any drying system is waterless.

When working outdoors, make sure that there is no chance of rain or fog, which might contaminate the bond. If you are working indoors, because of dust and dirt that might be disturbed before you have finished the job.
MEASURING AND MIXING STEP-BY-STEP

STEP 1:
If using pumps, prime the pumps to remove any air by pumping gently until the liquid starts to be dispensed. If you are using cups or measuring sticks, pour the resin into a pot, measure it, and then pour the hardener into another pot and measure it.

STEP 2:
Mix the resin and the hardener together by pouring the hardener into the resin. If using pumps, put the resin in the pump, then put the hardener in the pump and mix it with the pump. If you are using cups or measuring sticks, put the resin and hardener in separate cups, measure it, and then mix it thoroughly with a mixing stick or putty knife. If using pumps, put the resin in the pump, then put the hardener in the pump and mix it with the pump.

STEP 3:
Mix thoroughly for 1-2 minutes. Make sure you stir into the corners to get any unmixed resin.

WALL SURFACES

Wood surfaces should be clean and free of any contaminants. If you have any doubts about how clean the wood is, flick a little water onto the surface. If the water doesn’t soak in, but beaded up, the surface still has contaminants on it. If you find contaminants, wipe the surface with Fiberglass Solvent Wash 202.

For making wood parts, roughen the surface by scraping it or sanding it with 60 to 150 grit sandpaper across the grain. Blow or wipe all sandpaper residue off the surface before applying any epoxy. When laminating use a finer grade of sandpaper working with the grain as indicated in the Step-by-Step guide.

Some materials require special preparation. For example, teak is a very oily wood and is notoriously hard to glue or varnish. We recommend that you thoroughly wipe a teak surface with YTAM01 or Special Thinner 216 solvent to remove the oils and allow it to dry thoroughly before applying epoxy to it. Other woods to be careful of are Hinoki and White Oak. Sanding across the grain with these timbers is necessary to open up the wood surface to the epoxy. Most other woods, except for those resinous or oily woods, are relatively easy to glue provided basic cleanliness rules are observed.

FIBERGLASS

Quite often a boat’s topside has polish or salt water on it and needs to be cleaned thoroughly before epoxy can be applied. First, wash the surface completely with Fiberglass Solvent Wash 202 and wipe it dry. If you don’t use soap and water, use YMA01 Fiberglass Surface Prep. Then wipe the surface down with Fiberglass Solvent Wash 202. Work over small areas and keep checking to see if water beads up on the surface of the job. If it does, go over it with a solvent wash again.

Follow the Step-by-Step guide for preparation. Only after all these steps have been taken will you get a good bond to fiberglass.

METALS

Because epoxy does not penetrate metals very well, metals should be ground back to bright metal with a good surface profile or 50-75 microns (2-3 mil) or blasted to Sa 2½. Aluminum has an oxidation layer on the metal, which must be removed before it can be epoxied. Interlux recommends using a wet emery paper dipped in a resin and hardener mix and then leaving the residue to cure on the metal surface.

PLASTICS

Some plastics cannot be bonded using epoxy. This usually includes most thermoplastics, but ABS plastics and PVUs can be sanded thoroughly, cleaned with a solvent, dried, and epoxied. Before epoxying plastics together, try a sample piece to determine whether it can be epoxied.

MIXING

After dispensing both resin and hardener into a paper or non-plastic cup, you may find that the epoxy reacts with styrofoam or plastic cups, stir thoroughly for a few minutes to ensure that the two parts have mixed properly. Remember to scrape the bottom and corners of the cup. A poorly mixed resin will not set up properly and will have to be scraped off the job. Always mix the resin and hardener before adding any extender powders. That way you will be sure that the epoxy is a mixed properly.

Before starting work, determine how much epoxy mixture you will need and mix only that amount. Mixing large batches can lead to the resin setting up in the pot and generating a large amount of heat. In some cases the heat generated will melt the cup and has been known to start a fire.

Using the right hardener is important. Use ‘fast’ hardener for applications when gluing or bonding and a fast set time is needed, or when temperatures are between 50 and 70˚F (10 to 21˚C). Use ‘standard’ hardener when laminating and multi-coating, especially in temperatures of 65 to 80˚F (18 to 26˚C) because it has a longer profile and a longer overcoating window that allows for better adhesion of a second coat.

For climates where you would require an even drier cure, HT8003 is available and will ease application at temperatures between 68-90˚F (20 to 32˚C).

WOOD

FIBERGLASS

METALS

PLASTICS

MEASURING AND MIXING STEP-BY-STEP

STEP 1:
If using pumps, prime the pumps to remove any air by pumping gently until the liquid starts to be dispensed. If you are using cups or measuring sticks, pour the resin into a pot, measure it, and then pour the hardener into another pot and measure it.

STEP 2:
Mix the resin and the hardener together by pouring the hardener into the resin. If using pumps, put the resin in the mixing container first and then add the hardener. Count the number of pumps of resin and multiply the same number for the hardener. Remember, the pumps are calibrated so one stroke of each base and curing agent will provide you with the correct mix ratio.

STEP 3:
Mix thoroughly for 1-2 minutes. Make sure you stir into the corners to get any unmixed resin.

PUMPS RESIN (LEFT) & PUMP HARDENER (RIGHT)
WORKING WITH EXTENDER POWDERS

The low viscosity nature of Epiglass epoxy means that it is often necessary to add powder to make the glue mix you want. A straight resin/hardener mix will probably only be appropriate for close fitting joints between non-absorbent materials such as fiberglass or metal. There are two extender powders available to change the consistency of Epiglass. Make sure that every batch of epoxy is well mixed before adding extender powders. For a low viscosity mix, such as one that is used in joints for gluing and bonding, use Glue Powder HT120 blend in a one-to-one ratio by volume to thicken the mixture enough to stop it from running out of the joint.

For making a filling mixture, add the Glue Powder until it becomes a thicker ratio. The mixture will be thick enough to stand up in peaks when touched with the mixing stick. Similarly, for filling holes where wood may have rotted away, make up a mixture of Filler Powder HT450. Again the mixture will be stiff, but a little smoother. Filler Powder can be used above or below the waterline.

Epiglass and HT450 Filler Powder can be used for fairing too. A fairing powder mix is thick and creamy and should be worked on. It can also be applied with a smooth edged spatula or special fairing tools. Before the epoxy mixture sets up make sure that you have applied it as smooth as possible. Any unfair areas will need to be sanded back after the epoxy has cured.

<table>
<thead>
<tr>
<th></th>
<th>Fast Hardener</th>
<th>Standard Hardener</th>
<th>Slow Hardener</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot Life @ 77˚F</td>
<td>14 minutes</td>
<td>30 minutes</td>
<td>55 minutes</td>
</tr>
<tr>
<td>Application Temp.</td>
<td>59°F (15°C)</td>
<td>59°F (15°C)</td>
<td>75°F (25°C)</td>
</tr>
</tbody>
</table>

Epiglass® POT LIFE

COMMON USES OF EPIGLASS® EPOXY SYSTEM

<table>
<thead>
<tr>
<th></th>
<th>HT1000 Epiglass Resin Mix</th>
<th>HT120 Glue Blend</th>
<th>HT450 Filler Blend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HT120 GLUE POWDER</td>
<td>HT450 FILLER POWDER</td>
<td></td>
</tr>
<tr>
<td>Sealing fiberglass</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Laminating</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Sheathing</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Filling &amp; Fairing</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Bonding wood</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Filling above water</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Filling below water</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Type of mix requested by volume</td>
<td>HT1000 Epiglass Resin Mix</td>
<td>HT120 Glue Blend</td>
<td>HT450 Filler Blend</td>
</tr>
<tr>
<td>Low viscosity glue mix</td>
<td>1</td>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td>High viscosity glue mix/shot mix</td>
<td>1</td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td>Filling or fairing</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
When making up your mix with any of the extenders, it is best to make them a little thicker than you think you will need. As the Epiglass® mix goes through A-stage cure, the exothermic heat produced warms it and reduces its viscosity. This can lead to sags or slumping, which will take time to tidy up later.

In addition to using the powders, Epiglass can be used without these for applications other than gluing or bonding. All of these are discussed in more detail in the Project section.

**PREPARATION STEP-BY-STEP**

**STEPS:**
1. Ensure the surface is clean and dry.
2. Sand to provide a surface key for the resin to adhere to. (For wood use 100-180 grit, for fiberglass use 80-120 grit, for metal use 80 grit sanding disk.)
3. Brush or vacuum to remove sanding residue.
4. Wipe clean with Solvent 216 or 202 to remove any surface impurities.
5. If further sanding is required, repeat steps 2, 3, and 4.

**BEFORE YOU START**

Once Epiglass epoxy has been mixed, you don’t want to be searching around for spatulas and the right tools. You will need to have all this equipment nearby. Before you mix any epoxy, make sure the job is prepared properly, that the right gear is to hand, and that the ambient temperature is suitable.

**THE RIGHT TOOLS**

All the gear that you use once, such as gloves, wooden spatulas, mixing sticks, and mixing cups, and then throw out are classed as disposables. When working with epoxy, disposables are a large part of the overall expense. If a glove tears you should put on another. When measuring resin and hardener, use one measuring stick for the resin and another for the hardener. That way you will not inadvertently contaminate either container. Other disposables that you might want to have handy are: wooden spatulas for stirring, mixing or rough spreading of a mixture thickened with thinners, plastic or paper mixing cups (if you use plastic cups test them before starting to make sure that they do not react with Epiglass), plastic scrapers, spreaders, and spatulas to apply and fair the epoxy after it has been mixed with extenders, measuring cups for metering liquids and additives, and masking tape for protecting areas that you do not want to get covered with epoxy. If you are working with joints that have deteriorated or you might want to have an epoxy syringe handy to squirt glue into the joint. You’ll also need solvents for cleaning tools, paper wipes, and possibly a vacuum cleaner to get rid of sanding residues.

One important disposable for the professional is Peel Ply. This is a nylon or polyester fabric that is laid onto the surface of the Epiglass at the end of the application. When this is peeled off, a surface layer of Epiglass is removed. This leaves behind a chemically clean, texture-free surface that is ready for coatings, secondary bonding, or overcoating without the need for sanding. Peel Ply saves a significant amount of labor time, which generally outweighs the cost of the Peel Ply itself. Additionally, while the Peel Ply remains over the Epiglass, the surface is protected from contamination and light damage. There is some debate about the use of Peel Ply to replace sanding in such fine tolerance applications as America’s Cup racing yachts and so Interlux suggests additional coarse sanding for joints that are to be highly loaded. This will provide double assurance of a good bond.

---

**STEP-BY-STEP**

**STEP 1:**
Start with Epiglass® Resin mix of the required quantity in a mixing pot with enough space to add the volume of extender.

**STEP 2:**
Add the appropriate volume of powder as indicated in the Epiglass Mixing Guide on page 13.

**STEP 3:**
Mix slowly and carefully to incorporate all of the mixture.

**STEP 4:**
The mixture is now ready to use.

**STEP 5:**
When using larger mixtures, pour it into a paint tray to spread the mixture and maximize the working time.

---

**Advanced Techniques & Projects**

Epiglass® can be used for virtually any project that does not need to be taken apart again. For example, it can be used to fill holes drilled in a sandwich-cored deck to prevent moisture from getting in. It can also be used to glue any wood together, or to glue aluminum to steel, or wood to plastic. Note, however, that certain types of plastic cannot be epoxied together, but most can; it can be used to build new hulls and decks in wood or fiberglass. It can be used to repair hulls, to repair or stiffen spars, to make simple joints, or to sheath an entire boat hull. Whenever the project calls for permanently gluing two surfaces, together you can use Epiglass.

In order to work with any epoxy you need to have the right tools, the right protection, and know to the right techniques.

In this section we’ll cover protection, tools, and what you can or cannot do with epoxy. We’ll start with simple projects and work up to larger, more complex jobs. Of course, you might not want to know how to sheath the hull of your toy sailboat with Epiglass and fiberglass, but should you wish to prolong the life of a loved dinghy or larger boat, the method we explain here gives you that option.
As we saw earlier, there are certain procedures that are basic to every Epiglass® installation. All surfaces must be clean and dry, well sanded, and wiped down with solvent. To get good adhesion on less than perfect surfaces, prime the surfaces with Epiglass Epoxy Resin mix and allow it to go tacky. Thicken the Epiglass mix with glue powder to the required consistency before applying to the job. Make sure that you clean off as much mix as possible while the mixture is still soft. It will be a lot harder to clean after the mixture has set up. Epiglass works best with some glue thickness in the joint — about 1.2 mm (or 40 mils). Make sure all clamped surfaces are not clamped so tightly that they squeeze all the glue out of the joint. Finally, if desired, coat the joint with Epiglass Epoxy Resin mix to act as a water seal.

GLUING WITH EPIGLASS
You can use Epiglass as a glue anywhere a more conventional glue might be used. Epiglass gives a stronger, more stable joint. It is easy to clean up and easy to epoxy over. To glue using Epiglass make sure the surface is clean and prepared. If the area to be glues is large, wipe it down with solvent. Measure Epiglass and hardener and mix well. You might want to prime the areas to be glued with Epiglass Epoxy Resin. In general, the thicker the glue line the thicker the eposy mixture (viscosity) should be. Coat surfaces to be glued with Epiglass and assemble them. Clamp as required, but do not overclamp as you may squeeze a lot of Epiglass out of the joint and weaken it. Remove surplus glue mix before the joint cures. Allow enough time for the joint to cure properly before removing the clamps and making a final cleanup. When making joints, selecting the right design for the joint is important. Joints should be loaded in shear or tension. Peel stresses should be avoided at all costs.

GLUING STEP-BY-STEP

STEP 1: Follow standard surface preparation guidelines. (Refer to page 6)
STEP 2: Measure and mix Epiglass Epoxy Resin.
STEP 3: For absorbent surfaces such as wood, prime the surfaces with Epiglass Epoxy Resin (allow some extra mix for this when measuring).
STEP 4: Add glue powder to Epiglass Epoxy Resin at a ratio of 1:1 by volumes, and mix well to form the Epoxy glue mix.
STEP 5: Apply to the joint area and assemble the parts.
STEP 6: Tape or clamp components in position.
STEP 7: Remove excess glue mix with a spatula. Before the mix cures.
STEP 8: Wait until de-clamp time before moving the component.

FILLETING
T-joints are made by simply butting the end of a piece of plywood or composite against another and gluing the wood together. But without additional reinforcement, the joint does not provide enough strength. Should the joint be, as it might on a boat, the joint may fail. A Fillet fills the area on either side of the joint and stiffens it to help in metal cracking. Fillets may be found, for example, on boats where a wood bulkhead is joined to the hull. A Fillet can also be used to reinforce a joint where the strength of the joint is unknown and it is too difficult to take apart and re-glue it. Fillets can be used in any bulkhead to hull joint, any angle joint less than 90 degrees, and for fastening plywood less than 15 inch (3.8 mm) in thickness. As the panel thickness increases above this size the fillet becomes progressively bigger and consumes more material. In this situation, fiber reinforcement tape (glass or carbon) is often used, with the best type having the fibers at ±45˚ to the joint line.
Making a fillet is relatively easy, but keeping the job clean is more difficult. First, select the radius that you wish to use. The radius should be 1.5 to 5 times the timber thickness. (1.5 might be used for a high density fillet, and 5 for a low density fillet to spread the load over a larger area.) For example, if you wish to join a 3/8 inch (12 mm) bulkhead to the hull, the radius should be no smaller than 5 inch (18 mm), but it could go up to 2½ inches (62 mm) if the bulkhead were to be a Nomex corot, carbon reinforced material. Select or make a suitable radius tool. Most people use a large diameter spatula with rounded ends although the effect can be changed with a flat or oval ended spatula.

To keep edges of the joint clean you should mask off the joint on each side at a tangent point of the fillet radius from the corner. This will help to prevent getting filler on the adjoining wood. Wipe the masked-off area with solvent and dry-fill the parts to make sure everything goes together properly. If any surfaces are especially absorbent, prime them with Epiglass® Peel off and allow them to go tacky.

Make up your mixture by mixing Epiglass Epoxy Resin and hardener, then adding filler powder until the mixture is about the consistency of creamy peanut butter. Trowel the mix into the joint and use the spatula to fair the mixture until it is smooth and the joint is filled properly. Peel off the masking tape just before the mixture starts to cure. (If you leave the masking tape until the mix has cured, it will not come off easily.) When the job is cured you can sand it and overcoat with a watercoat of Epiglass and undercoat or varnish.

### Making a Fillet

**STEP 1:** Mask off the job, as shown here.

**STEP 2:** Mix Epiglass® resin and add the filler powder until the mixture is the consistency of creamy peanut butter.

**STEP 3:** Trowel the mixture into the corner. Run the spatula down the joint to get a nice even finish.

**STEP 4:** Leave the mixture to set for a few minutes before peeling off the masking tape. If you leave the tape until the epoxy has hardened it will be glued in place and may never come off.

**STEP 5:** The finished fillet.

### Volume Calculation

Approximate volume (fl.oz or grams) of fluid mix: radius (inches or mm) x length x 1.5 (fl. or 0.5 gm)

**Radius Diagram**

### Epoxy Resin and Hardener

- Mix the epoxy according to the instructions. Add a little glue powder to increase the viscosity and pour the mix into an epoxy syringe. Use the syringe to inject epoxy into the joint. Once the epoxy has penetrated the joint completely clamp it down any overflows, and leave it until the epoxy has set.

### Step 1:

- Prepare the damaged area. Remove any loose material and sand or grind it back to solid material. If the crack is narrow and small repairs, routing out the damaged area may be appropriate. Be sure to coarse sandpaper the groove to provide a key.

### Step 2:

- Make sure the job is clean by wiping the entire area with solvent. Next accurately mix a batch of epoxy to suit the area to be covered. Add glue powder to thicken the mixture and then add filler powder or lightweight fairing powder until it reaches the consistency of creamy peanut butter.

Trowel the mix into the damaged area or crack. Build up the layers until the surface is level. Try not to get drips down the sides of the boat or onto yourself. After the Epiglass has set up, sand it smooth with 120 to 180 grit wet or dry paper. If necessary, repeat the process until the area is smoothly faired and indistinguishable from the surrounding area. Finish the repair with Interlux® primers, undercoats and topcoats. Larger jobs take a little more effort. The area should be sanded first to give the epoxy a rough area to hold onto. Then repeat with solvent. To thicken the Epiglass, use glue powder and fairing compound for a lightweight filler. Finish the repair with Interlux primers, undercoats, and topcoats. (See Section 2 for more information on primers, undercoats, and topcoats.)

### TIP:

- To get a really smooth result with no sanding after removing solvent. Next accurately mix a batch of epoxy to suit the area to be covered. Add glue powder to thicken the mixture and then add filler powder or lightweight fairing powder until it reaches the consistency of creamy peanut butter.
CREATING THREADED HOLES
To create a threaded hole you first need to drill out the hole as outlined above and fill it with epoxy. Then install a bolt or screw coated with beeswax in the wet epoxy. The beeswax enables the bolt or screw to be removed without damaging the epoxy thread created when the Epiglass hardens.

WORKING WITH WOOD
Unlike varnish, Epiglass can be used to give wood total protection from rot but it has no UV protection. Four factors that cause wood to rot are moisture, rot spores, darkness, and warmth. Eliminating any one factor eliminates rot. If all the factors are present wood will rot. You can’t do much about warmth, but by totally encapsulating a piece of wood in Epiglass resin mix and allowing it to harden completely, rot spores are sealed off from the atmosphere they need to survive and moisture is kept out of the wood. Consequently, the life of the wood is prolonged.

Before coating wood with Epiglass it should be dried to less than 13% moisture content. In some conditions this is hard to do, but in most cases where wood is kept undercover, the moisture content is usually lower than 13% and sealing with Epiglass can be done quickly and easily. Simply prepare the wood surface as outlined above, mix a batch of Epiglass, and brush it on like varnish. You can thin it slightly with glue powder if you wish. Build up several layers and that’s it. Job done. Epiglass is more durable than varnish but it will need overcoating with a varnish or paint to protect it from UV break down (cracking and/or chalking).

WORKING WITH PREVIOUSLY INSTALLED WOOD
When you are working on a boat restoration, you may have to make new joints or coat a piece of wooden equipment with epoxy. Often old wood contains salt residues and old varnish must be removed with a stripper like Interlux®299E or light sanding. Once the job has been cleared of old varnish, the wood should be dried to the required moisture content (less than 13%) and wiped with solvent to remove salt and other deposits. Typically, the old wood is coated on one side only to allow the wood to ‘breathe’, but there is often no reason why it cannot be totally encapsulated.

If you are covering a large flat area, such as a deckhouse or hatch, the Epiglass glue powder can be poured onto the job and squeegeed around to get the maximum coverage in the quickest possible time.

INSTALLING HARDWARE WITH EPIGLASS
Often on the deck of a boat a part gets moved, or an old piece of gear is removed and a new piece added. The holes in the deck should be tightly sealed to prevent water getting into the deck core and causing rot or degradation. To fill holes in the hull or deck, apply tape over the hole on the underside of the deck. Mix Epiglass in a normal ratio and add the fibre powder. Put the mixture in a polyethylene bag with one corner cut off (like an ice bag) and squirt it into the hole. If you have more than one hole, use the bag to fill each hole working around the boat. When you have finished put the mixture down outside the workshop until it has set up, and when it is cured dispose of it properly.

If you are installing deck gear and need to drill holes in a cored deck, you may be exposing the deck core to moisture. The deck core will not rot or degrade (unlike from impact) while it is totally sealed between layers of fiberglass. It is when holes or cracks let water into the core that rot starts. To make sure that rot cannot start, first drill an oversize hole for the deck gear you are about to install. Fill that hole with Epiglass mixture thickened to a smooth paste and let it set up hard. Now drill the correct sized hole through the hard Epiglass. By installing deck gear and carefully sealing the hole you should never experience problems with the deck core.

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WORKING WITH PREVIOUSLY INSTALLED WOOD
When you are working on a boat restoration, you may have to make new joints or coat a piece of wooden equipment with epoxy. Often old wood contains salt residues and old varnish that first need to be removed. On most surfaces the job can often be sanded back, but some jobs are slightly more delicate and the old varnish must be removed with a stripper like Interlux®298E or light sanding. Once the job has been cleared of old varnish, the wood should be dried to the required moisture content (less than 13%) and wiped with solvent to remove salt and other deposits. Typically, the old wood is coated on one side only to allow the wood to ‘breathe’, but there is often no reason why it cannot be totally encapsulated.

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MAJOR PROJECTS

Not only can Epiglass® be used to repair smaller jobs, but, by adjusting the ratio at which the glue mix cures, a longer working window can be opened and Epiglass can be used on much larger jobs. These jobs can take many forms, from lathing the hull of a large power yacht to putting a perfect finish on a racing sailboat’s keel, to building a carbon fiber spar or simply stiffening a wooden boom. Not only do sailboats benefit, but powerboat hulls can be coated with epoxy, wooden hulls can be sheathed with epoxy and fiberglass, and completely new boats can be built using fiberglass or wood with epoxy.

FAIRING LARGE PROJECTS WITH EPIGLASS®

If you have a large area to be faired, prepare the surface by sanding with 80 grit sandpaper. When you have finished sanding, wipe the entire area with solvent. Make up a small amount of Epiglass mixture, stir it well and brush on a thin tack coat to ensure adhesion. When this gets to the tacky stage, make another batch of resin and blend in glue powder to thicken it. Add lightweight fairing powder and blend it in well. Use a trowel or spreader to spread the mixture over the surface. Fair the mixture by using a long flexible batten (battens can be made from thin strips of wood or ½ inch (12 mm) or more PVC piping. For flat surfaces, a blade spreader gives best results, while PVC pipe is best for compound curves. Getting the mixture as smooth as possible at this stage will save sanding time later. After the mixture is set, sand it back using 120 to 150 grit wet or dry paper and finish the job with Interlux® primers, undercoats, and topcoats as described in Section 2.

FAIRING WITH EPIGLASS

If you have a large area to be faired, Epiglass can be used to mix together a filler compound tailored to your application style and preferences.

STEP 1: Follow standard surface preparation guidelines. (Refer to page 9)

STEP 2: Measure and mix Epiglass Epoxy Resin mix.

NOTE: Getting the mixture as smooth as possible at this stage will save sanding time later. A blade spreader will give the cleanest result, but a PVC pipe is very good for compound curves.

STEP 3: Make up the Epiglass mixture, stir it well, and blend in glue powder to thicken it. Refer to filler addition chart in Section 1.

STEP 4: Use a trowel or spreader to spread the mixture over the surface.

STEP 5: Use a long flexible batten (battens can be made from thin strips of wood or ½ inch (12 mm) PVC piping) to fair the mixture.

STEP 6: Smooth out any ridges with a sanding block. Use a sanding block to remove any imperfections.

FAIRING KEELS AND RUDDERS

Fairing keels and rudders is more exacting than fairing hull sides. To get the optimum performance from any appendage, be it keel or rudder, the section shape needs to be very accurate, especially around the nose and the front one-third where laminar flow is established. To get an accurate section shape you need to find out from the boat’s designer what sectional shape was used for this keel. Typically, it is a NACA 650 series or NACA 64, although later keels might have a flat laminar flow section shape. When you know the section shape, you should make wooden or cardboard templates of the keel sections at three or four places. Use ⅛ inch (2 mm) or thinner plywood for the templates or very stiff cardboard. Typically, a designer provides a root, mid, and tip chord section, but if the appendage is five or six feet long, you might ask for intermediate sections so that you do not have long gaps between sections. In general, a section at each 12 to 15 inches (300 to 600 mm) is best. Make separate section shapes for the rounded leading edge of the keel that go from the 20% chord on one side to the 25% chord on the other side. This ensures that you get the critical leading edge faired properly. Make a second set of templates for when you get resin mixture on the first set.

You might want to square off the bottom of the keel. A square bottom is reputed to be more effective than a rounded tip, although a tapered tip has the lowest drag. If the keel is bulbous, you should fair the bulb into the keel as per the designer’s instructions. Getting under the keel might be a little difficult, but you can usually get your bowdoyard to lift the boat in slings overnight while you fair the keel bottom. As most vortices come off the bottom trailing edge of the keel, getting it smooth is very important.

To sand, the area with sandpaper dipped in Epiglass Epoxy Resin mixed with a little glue powder. Paint first with epoxy sealer and then paint with Interlux® bottom paint products. After the mixture is set, sand it back using 120 to 180 grit wet or dry paper and finish the job with Interlux® primers, undercoats, and topcoats as described in Section 2.
Work down the hull and at least six inches (150 mm) around the transom. Try to overlap the sheathing at chines, stem, and transom corners where the hull may get abraded. If you are adding several layers of sheathing, put the joint of the second layer in the middle of the first layer so that there is no area with only resin. Having said that, try to avoid having a seam in the middle of the topsides where it might be easily seen or require a lot of fairing to hide it.

When working on a boat upside down, it is often easiest to work from sheer line to sheer line on a 45 degree angle, and then from sheer line to sheer line on a 45 degree angle at the root of the keel. On a boat that is upright, the sheathing must be started at the sheerline and taken to the keel.

Typically, a number of thin layers of woven cloth, such as a 6 ounce (170 grams) cloth, are applied when a clear or 'bright' finish is required, but if the fiberglass sheathing is to be smoothed and painted, heavier glass cloth or even carbon and Kevlar laminates are more likely to be used. Where the hull has lost some structural or watertight integrity by deforming due to rigging loads, a sheathing with carbon fiber might be used to absorb some of the loads on the outer skin. If impact resistance is required, Kevlar might be used as a sheathing material even though it is difficult to cut and handle.

To sheath a hull, the surface must first be prepared. Preparing the hull of an older boat entails removing all the old paint, filler, and varnish, and taking the surface back to bare wood. While the boat is being sanded back, check the fastenings to make sure they are sound. Any unsound fastenings should be replaced before the hull is sheathed. Depending on the size of the hull, you may be able to complete the sanding part of the job in a day or two. Be careful that you do not drag grout in the hull while sanding it.

Sheathing CROSSWAYS WITH CRAFT RIGHT UP

Cloth widths set out from transom (pale of cloth with tape used)

Pre-fired deadwood – permanently fasten after sheathing

WORKING ON A BOAT UPSIDE DOWN

When all the old paint and varnish has been removed from the hull or on a new hull when the final sanding has been completed, the hull should be wiped down with solvent and primed with Epiglass Epoxy Primer mix. This sets up the hull to be sheathed. Depending on how large the hull is, you can work in sections or on smaller boats do it all at once. Roll out a section with Epiglass resin mix, thinned slightly with a 2:1 mix of Epiglass hardener and the resin is laid down. Roll out a second layer on top of the first and then roll on the sheathing material. Mix a new batch of resin to cover the sheathing material and take the top layer of cloth down. Roll out a second layer and then roll on the sheathing material to cover the second layer. Roll on a third layer and continue until the hull is completed. The final layer should be applied with a cloth that will give a slightly larger width than the bare cloth. It is important to have the correct cloth setup and give a slightly wider width than the bare fiberglass material. The cloth setup is applied to provide a slightly larger width than the bare fiberglass material.
After it has been sheathed, let the hull cure for a day or so. Then coat it, if you are going to paint over the sheathing, fair the entire hull with Epiglass mixed with fitting powder. Sand everything back and prime with Epoxy Primercoat. Paint the topsides with Brightside® or Perfection® and the hull bottom with an antifouling paint.

SHEATHING HINTS

1. In cold weather stand the bucket of resin in warm water for 30 minutes before applying it.
2. Store resin and hardener out of direct sunlight on hot days.
3. On hot days, try to start work before sunlight warms the substrate.
4. Make a number of small mixes rather than fewer large mixes.
5. Clean your tools as soon as you finish sheathing.
6. Keep rollers soft by frequently cleaning them with Interlux 2316.

SEALEING AND SHEATHING

Epiglass® can protect a wooden spar from the elements better than any ordinary paint system. Seal and sheath as already described and then finish off with either Perfection® or Schooner Varnishes. The Epiglass and Perfection combine to give the ultimate protection, while Schooner gives a warm traditional color and can be re-coated as required with varnish. Ensure any amine blush on the surface has been removed before you apply the varnish.

PROTECTION IN HIGH WEAR AREAS

Most gaff rig boats and a few other rigs have a yoke resting against the mast instead of being held by a gooseneck. The yoke or gaff jaws chafe against the mast and quickly wear through most coatings systems. A few layers of glass, Kevlar® or Twaron® cloth can be applied to this area to provide long-term protection. The thickness of glass necessary or the color of the Kevlar will not give a clear finished result, so a band of color or white paint will be necessary to make the job look finished smartly.

ADDING STIFFNESS

To make a wooden mast stiffer without making it bigger requires a careful approach. If possible, an existing mast needs to be either dismantled or cut in half and epoxied back together. Typically, a sectional mast is made up of 4, 6, or 8 parts carefully taped and glued together. While not quite as strong as epoxying carbon fiber to the outside of the spar, strips of unidirectional can be epoxied to the interior face of the spar to increase its stiffness. The amount to apply depends upon the sectional area of the mast, the thickness of the wood, and the rig loads. You should get a qualified structural mast engineer to calculate this requirement.

SHEATHING

STEP 1: Ensure that the hull surface is free of dirt, dust, and contamination. To make it easy to apply the sheathing, make sure that keels, rudder, propellers, spay rails and other appendages have been removed.
STEP 2: Wipe down the hull with solvent and a clean rag.
STEP 3: Before applying any resin to the hull, cut the cloth to length by laying it on the hull. Iron the preliminary sizing with tape or staples backfed through strips of wood.
STEP 4: Mix the Epiglass®.
STEP 5: Apply the resin to the hull with a 3/8 inch solvent-resistant roller and lay the cloth over the resin. Fold the cloth to allow the resin to penetrate the cloth.
STEP 6: Repeat steps 4 and 5 for each length of fiberglass cloth.
STEP 7: Try to finish the top side layer under a rub rail or overal to ensure that no seam shows.
STEP 8: Allow 5 to 6 hours at 77˚F (about 25˚C) for the resin to set up.
STEP 9: Scrape off any surface ribs or exposed flaments and start laying a second coat of resin and cloth.

SHEATHING HINTS

1. In cold weather stand the bucket of resin in warm water for 30 minutes before applying it.
2. Store resin and hardener out of direct sunlight on hot days.
3. On hot days, try to start work before sunlight warms the substrate.
4. Make a number of small mixes rather than fewer large mixes.
5. Clean your tools as soon as you finish sheathing.
6. Keep rollers soft by frequently cleaning them with Interlux 2316.
Cut the new carbon into patch-sized pieces to match the ground back laminates. Using a sheet of polythene on a workbench, wet out each patch and apply it to the damaged area. With a brush and roller, roll out any excess air bubbles and apply Peel Ply over the whole repair. If possible, use a vacuum bag to apply pressure to the surface, or wrap polythene sheets and bend tightly with string. Once the repair has cured, remove the polythene and carefully pull off the Peel Ply. Twist out the PVC tube and apply a coat of Epiglass® over the entire damaged area. Sand and paint to match the original spar.

MAKING AN ANCHOR LOCKER WATERTIGHT

Making an anchor locker watertight is a very demanding operation, but the techniques described here can be used to fix any bulkhead-to-hull cracks or separation. The weight of the anchor and chain bouncing up and down in the bow of the boat can strain the seams and joints of the anchor locker in any boat, regardless of the material used in its construction. Often this leads to cracks forming and the locker leaks into the boat rather than draining over the side.

To fix this, the locker walls and floors should be sealed (if they are not metal) and the joints filleted to spread the load. In more serious cases, the entire joint may need to be reinforced with fiberglass tape. For total protection of the locker itself from wear and tear, sanding with fiberglass or Kevlar® gives a strong, secure finish. Filling, sealing, and sheathing with fiberglass have been discussed earlier except for taping the fillet joint. The key to a smooth execution is in the sequence of tasks that comprise the job.

STEP 1: Prepare all surfaces, sand, and wipe with solvent.
STEP 2: Prime the fillet area with Epiglass applied sparingly.
STEP 3: Apply filler over all the corner joints.
STEP 4: Apply glass tape to fillet. This is applied in the same way as the sheathing operation, with a brush and possibly a roller. To make the job easy and neat, allow the filler to cure in a gelled stage (8 stages). Apply the tape while the filler is still tacky so that you will not run the filler. By applying the tape now, you avoid the need to sand to obtain a good bond.
STEP 5: Prime and seal the whole locker area with Epiglass.
STEP 6: Apply the reinforcement where required, and work in the resin with a brush and a roller. (Note: Keep drain holes clear by inserting a PVC tube coated with mould release wax.)
STEP 7: Rake off with an epoxy primer such as InterProtect®. This will give you a hard-wearing surface that is easily overcoated in later life.

Steps 2, 3, 4, and 5 may be included or omitted depending on the job.

WORKING WITH WOOD

As we mentioned earlier, Epiglass can give wood total protection from rot. Wood should be dried to less than 13% moisture content before it is coated, by being brushed with Epiglass just like a slightly thick coat of varnish. By building up several layers a hard-wearing, durable Epiglass surface can be obtained and when the surface is scratched or damaged, it can be sanded it back and recoated with Epiglass.

LAYING A DECK ON WOODEN BEAMS

Traditional wooden craft have deck planks laid directly to the transverse beams using a fastening process that required a 45 degree angle through the jointing rebate (rabbit) and then into the beam (see diagram).
On the project boat illustrated here (1), the transom was cut about 3 inches inside the outer edges of the old transom and the fiberglass transom laminate was removed in one piece. The old rotted plywood transom was removed by chiseling the delaminated wood away. The transom is left with a fiberglass laminate with a three inch flange around the edge. This flange will need grinding back to a tapered wedge shape to allow new laminations to be built up when the transom is replaced. The transom laminate removed from the boat will also need to have a tapered edge ground into it. Grinding it back is a messy job, but one that will make all the difference to the strength of the new fiberglass joint (2).

With the fiberglass tapered it is time to cut new marine grade plywood to fit the space left by the removal of the old wood. Note that if you do not want this problem to reappear use high density (60 pounds or higher) foam instead of marine grade plywood. Use large pieces of cardboard to make an accurate template of the new foam or wood insert (3). By offering the template up to the transom you can check it carefully to ensure that the new filler will reach the edges of the hole. If a flange is present as shown on this project, you will be forced to make the plywood in two or more pieces. For example, in the project shown here the transom used two ½ inch pieces of plywood for a total thickness of 1 ½ inches. Both layers were cut into three parts the cuts being as far away from each other as possible. Before gluing anything, offer all the pieces up to the job to make sure they fit properly. If you have to hammer a piece into place, don’t do it until you make the final glued up fit (4).

FITTING THE NEW PLYWOOD OR FOAM TRANSOM

It helps to have two or three people at work when the job is to be done. If the daytime temperature is over 60 degrees use a slow hardener to give yourself time to fit everything before it starts to cure. The order of battle is:

STEP 1: Have one person ready to mix Epiglass® and paint the inner faces of the fiberglass transom laminate and the matching faces of the plywood or foam. Use a toothed spreader or comb. This spreader can be made from a piece of suitable plastic, such as polypropylene. Many types of spreaders are also available from tile and handyman stores. The teeth of the spreader should be triangular and have a depth spacing of 3-4 mm (0.12 inches - 0.16 inches). This gives a glue line of 1.5-2 mm (0.06 inches - 0.08 inches). The standard Epiglass glue mix is suitable, but if you make it a little thicker by adding 50% more glue powder, the application will be easier. Once the glue mix is applied, lay the deck as before, but apply a thin priming coat to the underside of each piece as it is laid. This helps prevent any dry joint areas. Be sure that some surplus glue is squeezed up between the planks. (It can be cleaned off later.) This indicates that the planks are laid firmly onto the deck foundation.

STEP 2: Have a second person ready to make up a stiff Epiglass mix of glue powder. This mix should be put into an empty caulking tube and squirted into the corners of the transom. The idea is to fill any voids between the new plywood and the existing transom. For a more secure deck, marine-grade plywood is often laid first, and teak decking back screwed to the plywood. To use Epiglass with this method, the approach is slightly different. Preparation of the surface includes a thin priming coat made directly onto the plywood subdeck. Instead of applying glue to the deck beams, an even layer of glue mix should be applied to the entire plywood subdeck surface with a toothed spreader or comb. This spreader can be made from a piece of suitable plastic, such as polypropylene. Many types of spreaders are also available from tile and handyman stores. The teeth of the spreader should be triangular and have a depth spacing of 3-4 mm (0.12 inches - 0.16 inches). This gives a glue line of 1.5-2 mm (0.06 inches - 0.08 inches). The standard Epiglass glue mix is suitable, but if you make it a little thicker by adding 50% more glue powder, the application will be easier. Once the glue mix is applied, lay the deck as before, but apply a thin priming coat to the underside of each piece as it is laid. This helps prevent any dry joint areas. Be sure that some surplus glue is squeezed up between the planks. (It can be cleaned off later.) This indicates that the planks are laid firmly onto the deck foundation.
ABS, Lloyd’s, DNV, Bureau Veritas, RINA all have recommendations for the amount of fiberglass to use, but if the stiffener has failed prematurely or the strength is to be increased, 25% to 40% more fiberglass than the original. Over-stiffening the capping may result in problems, so if you want to prepare for very rough seas or impacts consider either adding more stiffeners or consult a qualified structural engineer. Carbon unidirectional fiber is surprisingly cheap and offers significantly more stiffness for the same laminate weight or reduced weight of laminate for matching fiberglass stiffness. Strengthening undamaged stiffeners requires only the basic surface preparation, surface priming with Epiglass, and while still wet, the application of the capping fiber and a final overlying fiberglass cloth.

Wipe the job down with solvent and prime the whole area with Epiglass® Epoxy Resin mix. Prepare the reinforcement fiberglass or carbon fiber. The ideal cloth for the stiffener shell is a ±45˚ biaxial cloth.

This is available in a variety of weights. The heavier cloth will be quicker to apply because fewer layers will be required. With Epiglass you can easily wet-out cloth up to 16 ounces (510.3 grams) with a brush or a hand roller. Whatever weight you use, you will need to have a minimum of 2 layers if any capping reinforcement is being applied.

Ordinary glass cloth or woven rovings can also be used, but 50% more glass weight is required because of the 0/90˚ fiber configuration unless you cut diagonal strips from the roll. If the original stiffener is made from a heavy laminate with polyester or vinyl ester resin and a lot of chopped strand mat (CSM) has been applied to give a thickness, above 5 mm it will be necessary to achieve at least 15% of the thickness with the new laminate. Below 5 mm you need not focus on the thickness but should ensure that a similar weight of glass is used.

### STRENGTHENING AND REPAIRING FIBERGLASS FIBER FLOORS

Occasionally, a boat comes into contact with the sea floor with sufficient force that the floors or hull bottom stiffeners become damaged or detached from the hull shell. Alternatively, some sailboats may have their keel configuration altered, requiring new or reinforced keel floors.

Most stiffening beams made from composite or fiberglass have a low density, low strength core with a fiberglass shell and possibly an additional capping laminate. To repair damaged floors/stiffeners, locate the damaged section and remove or grind out the broken or cracked laminate. Sand the area with 80 grit sandpaper, and vacuum or brush clean. If the core material is damaged, cut out the affected area and graft in a replacement piece, shaping it to suit the original profile.

**TIP:** You can inject through the screw holes until the Epiglass mixture oozes out of other holes on the same level. If it comes out of holes lower down, tape the holes over until the mixture has set.

Put the inner wood layer in place and screw through the inner fiberglass laminate to hold the plywood firmly to the inner laminate (5). Paint the outer face of the plywood with epoxy and set the next layer of plywood in place. Screw it to the inner layer with screws about every six or eight inches (vertically and horizontally). The screws should not penetrate the inner fiberglass laminate. When the plywood or foam is in place and screwed down, paint the outer face of the new plywood and the inner face of the transom laminate with Epiglass® mix and screw it to the plywood. Clamp the edges of the transom where possible to ensure that most of the air is squeezed out. You should have a gap about the thickness of a saw blade all around the transom. Leave the entire job to set up in a warm temperature. If you want to vacuum bag the job, now is the time to do it.

When everything has cured, remove the screws from the outer and inner fiberglass laminate. Tap the entire laminate gently listening for voids. If you find any, use a syringe to inject more Epiglass mix into the void.

The tapered joint that was created when you ground back the edges of the transom laminate now need to be fiberglassed in place using tape and filler. It makes the joint much smoother. If you fill the saw blade sized gap with Epiglass mixed to the consistency of peanut butter, before you apply any fiberglass. Start with a 1 or 2 inch (25 to 50 mm) wide tape around the joint, and gradually increase the width of the tape to about 6 inches (150 mm) as you increase the thickness of the laminate.

The final job is to fair the entire laminate to get a smooth transom once more. Don’t hurry the fairing part of the project because this is the portion that people will see. Fairing is explained in other parts of this booklet. Once the fairing is complete, use an epoxy primer, rub it down with 400 grit sandpaper and paint on a topcoat to match the existing hull color.

**FIG I**

**FIG II**

**FIG III**

**FIG IV**
THE ULTIMATE FINISH

Getting the ultimate finish on a boat takes a little work, but when you start with Epiglass® and finish with Interlux®, you can make the boat look outstanding. Using Interlux products you can build, fill, seal, prime, and topcoat. Only Interlux offers a complete line of finishing products that are compatible throughout the entire range. Here’s how to go about getting a superb finish that will enhance a boat’s value for years to come.

GETTING A GREAT FINISH ON A FIBERGLASS BOAT

Prior to any work inspect the gelcoat close up. If it shows signs of a chalky surface or any pin holing, it is best to seal it with Epiglass®. If the surface is merely dull or discolored, this step is optional.

Wash the surface with Fiberglass Solvent Wash 202. Before the liquid dries, wipe with a clean dry cloth. Sand with 180 grit sandpaper to a matte finish. Don’t get overenthusiastic with the sanding on a fiberglass hull, you can go right through the gel coat and into the structural fiberglass.

Stand back and take a look. At this stage you can go in several directions depending on the amount of fairing that needs to be done. If very little fairing is required, you can simply overcoat with Epoxy Primekote or InterProtect® 2000E followed by Interprime 880 Epoxy Finish Primer. If the fairing work is slightly more extensive you can use Interfill. If you intend to paint the hull later, use InterProtect 2000E. It sands well but also serves as a holding primer/sealer with long overcoating windows.

Depending on what you decide to do, select the right primer, paint the hull, and sand it back with 320 or 400 grit sandpaper to a nice smooth finish. Remember, the smoother the finish at this point, the better your final job will be. Work it over again if you feel that the finish is not quite good enough.

Apply the topcoat.

GETTING A QUALITY TOPSIDE FINISH ON A WOODEN BOAT

First sand back the hull to get rid of the existing paint. Fill any cracks, dings, or dents with Epiglass mixed with fairing powder after making sure that the damage does not affect the hull’s structural integrity. Sand back the filled areas with 120 grit sandpaper. Wipe the entire hull with 202 Solvent to ensure that it is clean of grease, wax, and impurities. Touch up any areas that are still not quite perfect.

Remember, that the final smooth finish is based on the primer and the fairing job. Any blemishes that appear in the primer or fairing will also appear in the final job. If you want a really good finish, put a lot of effort into getting the fairing perfect and applying primer properly. Sanding back the primer and applying the topcoat are of equal importance.

CHOOSING THE VARNISH

<table>
<thead>
<tr>
<th>Product</th>
<th>Appearance</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>Perfection® Varnish</td>
<td>Clear/Bright/High gloss 2-component</td>
<td>Hard wearing, excellent chemical and abrasion resistance. Long lasting aesthetic appeal and superb UV protection.</td>
</tr>
<tr>
<td>Goldspar® Clear</td>
<td>Clear/High gloss</td>
<td>Great for interior or exterior use. Also available in satin finish.</td>
</tr>
<tr>
<td>Schooner®</td>
<td>Golds/High gloss</td>
<td>Traditional tung oil varnish. Easy to repair and re-coat. Rich, golden color and deep gloss.</td>
</tr>
</tbody>
</table>

FINISHING A STEEL BOAT

Because of steel’s tendency to oxidize or rust, it requires a different preparation than fiberglass or wood. Before any paint or epoxy can be applied to steel it must be sandblasted to remove all rust, dirt, and scale. Epiglass contains aluminum in the resin mixture which can react with steel. If the Epiglass resin mix does not get a good bond, there is a possibility that the finish could crack or craze.

Once the surface is coated, and dried it should be faired in the same manner as any fiberglass surface. If the welding is done well and little fairing is required, you can use Interfill. In regards to priming use InterProtect 2000E or Epoxy Primekote 404. See the note in the fiberglass section.

MAKE ALUMINUM LOOK GOOD

Aluminum has a layer of oxidation on the surface that must be removed to get good adhesion. To get the best adhesion the surface should be sanded with 80 grit sandpaper dipped in rain leaving the residue on the surface to cure. Once the rain has cured, you can build up the fairing surfaces as for steel or fiberglass. If the fairing is in good condition and the boat has been sanded, simply coat with Epiglass and build up the surface as for steel or fiberglass.

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Apply the topcoat.
All over the world, many boats are built using epoxy resins. The Epiglass® Epoxy Resin System offers greater tensile strength and the material’s cure time can be changed within limits to suit the local conditions. It is a material with no known limits on the time it will last, and a material that can be used by amateurs and professionals alike. Its properties can be improved by curing it under heat and pressure, and once set up it will never become liquid again. It can be used with wood, fiberglass, carbon or other high-tensile fibers and excels as a boat building material.

COMPOSITE CONSTRUCTION

Fiberglass is made by drawing molten glass through very fine holes to form filaments. Filaments are then formed into tows or yarns, and the yarns may be woven into cloth, made into chopper strips, mats, or any of the other multitude of cloth, weaves and fabrics that fiberglass can be obtained in today. Fiberglass is not rigid on its own. In virtually every cloth, yarn or weave it simply collapses over the object that is placed in it. When building a boat the fiberglass is placed in a mold and then coated with resin. The fibers must be held together with some form of glue in order to become effective. All the major types of ‘glue’ or resins in the marine business are polyester, vinyl ester, and epoxy. Of the three, epoxy is far the strongest.

FIBERGLASS RESINS

The major resin used in boat building is polyester resin, but the use of polyester has declined since osmotic blisters were discovered on older boats. When polyester became a problem many boat builders switched to an epoxy or vinylester external barrier coat. Some builders now use epoxy or vinylester throughout the laminate, while others switch back to polyester after the barrier coat is in place. The basic chemical used in polyester laminating resin is orthophthalic acid, making the resin an orthophthalic laminating resin. Another type of polyester resin uses isophthalic acid and is known as an isophthalic resin. A third kind of polyester uses cyclopentadiene or OCP to speed up the cure rate. The acids react with other chemicals in the mix to form long chain polymers. These resin work well because they shrink very little, coat the fiberglass effectively and once set up, they last a long time.

Unlike epoxy, polyester resin is comprised of the resin, the catalyst, and the accelerator. Usually the accelerator comes ready mixed with the resin and the catalyst is added. By adding the catalyst to the resin just this stage the resin is about the consistency of maple syrup and pecora is a thin, syrupy liquid) and mixing the two components, some heat is given off and the mixture sets up in a solid lump, never again to become liquid. Also unlike epoxies, the speed of cure can be adjusted by varying the amount of accelerator in the mixture. Epoxies need to be mixed in strict proportions for best results. Polyesters generally use styrene as the solvent for the polyester and can be identified by their characteristic styrene odor.

Vinyler is a styrene-based polyester with higher interlamellar and flexural properties than polyester (fleural is a combination of compressive, tensile, and shear properties). Interlamellar is important for laminates without chopped strand in between the cloth layers. Methyl-ethyl-ketone peroxide (MEKP) is used as the initiator of the polymer chain reaction in vinylester and polyester. Vinylester resins are stronger, provide better adhesion, and have less shrinkage than polyester, but they are also more expensive.

THE BASICS

Fiberglass is not rigid on its own. In virtually every cloth, yarn or weave it simply collapses over the object that is placed in it. When building a boat the fiberglass is placed in a mold and then coated with resin. The fibers must be held together with some form of glue in order to become effective. All the major types of ‘glue’ or resins in the marine business are polyester, vinyl ester, and epoxy. Of the three, epoxy is far the strongest.

POLYESTER AND VINYLESTER RESINS

Epiglass can be used to laminate with fiberglass, carbon, Kevlar® and Twaron® reinforcing fibers. It has extremely good wetting out capabilities, is extremely strong when cured, protects against osmotic blistering, and dries without leaving the waxy film that polyester resins often do. It also has good secondary bonding capabilities that polyester resins often have problems with.

AUTOCLAVING

After a mast or boat part has been laid up it is cured under a plastic airtight cloth that is sucked tightly onto the laminate. The pressure exerted on the laminate is so high that the laminate is vacuum bagged or autoclaved.

RESIN TRANSFER MOLDING

Resin transfer molding is a relatively recent technique originally developed to reduce the number of VOCs getting into the air. There are several methods available. The most popular one being SMART is an airless technique, the laminate is built up dry, and a bag rather like a vacuum bag is placed over the mold containing the resin laminate. A vacuum up to 17.2kPa is generated and the resin valves are opened. The resin is sucked into the laminate. The entire laminate is then cured under pressure.

VEC

Vacuum bagging is used to reduce the number of VOCs in the laminate and to compact the laminate to get better strength. The pressures achieved when vacuum bagging are usually not as high as those used in an autoclave.
To show how far boats using high-tech laminates have come, maxi-sized sailboats (about 84 feet overall) in the 1970s weighed in around 60,000 to 70,000 lbs (27,000 to 31,000 kgs), some as heavy as 100,000 lbs (45,000 kgs). In the ‘80s their weight was down around 50,000 lbs (22,000 kgs) and in the ‘90s lightweight maxis (sleds) are being built weighing 30,000 lbs (13,600 kgs).

Epiglass fits into this picture because it is a high quality epoxy resin which has a cure time that can be adjusted to suit the time available to laminate the boat. For example, you may be laid up dry and epoxy resin forced into them using a resin injection system known as VARTM or Vacuum Assisted Resin Transfer Molding. A boatbuilder may favor any of the above methods. One leading edge builder uses epoxy in an in-house impregnating machine. That way the builder controls exactly how much epoxy is in the laminate.

**USING EPIGLASS® EPOXY AS A LAMINATING RESIN**

Epoxy can be used as a laminating resin. It has lower viscosity than many similar resins and wets out very easily. With the addition of fillers the viscosity of Epiglass can be adjusted to suit the job.

When Epiglass is used as a laminating resin, a general user can expect to achieve a resin to fiberglass ratio of about 60 to 40, while a specialist should be able to attain a 40 to 60 ratio. Some high-tech builders use additional pressure and heat to get a high-strength lightweight laminate and can get a ratio with about 35% resin and 65% composite reinforcement.

When a hull is laminated, the first step is to coat the mold with mold release wax or release agent to enable the finished hull to be easily removed. An exterior layer of resin about 20 to 40 mils (thousandths of an inch) thick is sprayed over the mold release wax to form the outer skin of the hull. (Note: polyester boats this layer is referred to as the gel coat and while it was originally a polyester resin, it is more likely to be an epoxy or vinyl ester resin today.) Depending on the laminate design, a layer of chopped strand mat is placed on the gel coat to reduce ‘print-through’ and provide an even backing. Print-through occurs when the resin seeps through the weave of a fiberglass cloth shows through the gel coat. A high tech laminate may eliminate the chopped strand and rely on a thick layer of epoxy or paint to cover print through. Once the outer layers have been laid in the mold, the remainder of the laminate is laid in place and wet out layer by layer.

When fiberglass boats were first built they were almost universally made of layers of fiberglass bonded with polyester resin. When composites turned up in boat hulls, most production builders introduced a vinyl ester or epoxy barrier coat. Some went the whole hog and switched over to using vinlyster or epoxy throughout the laminate. Along with change in resins and epoxies came changes in fiberglass materials. Biaxial and triaxial cloths replaced chopped strand and woven rovings. Graphite and Kevlar® cloths became part of a composite laminate. In other boats, coring hulls were used instead of a single-skin laminate. Since that time, the state of the art for racing boat hulls has become graphite (carbon-fiber) with epoxy resin, while cruising boats still use fiberglass and vinylester or polyester. More exotic boats might have a laminate of graphite, Kevlar and S-glass laminated using prepreg epoxy laminates and be autoclaved. Laminates may be laid up wet, they may be pre-preg, they may be laid up dry and epoxy resin forced into them using a resin injection system known as VARTM or Vacuum Assisted Resin Transfer Molding. A boatbuilder may favor any of the above methods. One leading edge builder uses epoxy in an in-house impregnating machine. That way the builder controls exactly how much epoxy is in the laminate.

On smaller boats the entire laminate may be laid up wet-on-wet – that is, a wet or impregnated cloth is laid on another wet cloth – and post cured in an oven. But ovens and autoclaves are expensive and are usually only used for small boats or parts. A typical leading edge laminate on a high-tech boat might have a 35% epoxy to fiber ratio and may use sophisticated techniques such as B-staged pre-preg cured in an autoclave using 100+ degree post cure and 4-6 atmospheres. The builder can also vary the thickness of the epoxy layer. For example, many builders make the outer layer thicker than inner layers for increased strength and abrasion protection. Inner layers usually have less epoxy resin and a higher resin/glass ratio. One builder comments that if you are going to use high-performance carbon fiber, you should lay high performance epoxies to get a complete high-performance composite.

To show how far boats using high-tech laminates have come, maxi-sized sailboats (about 84 feet overall) in the 1970s weighed in around 60,000 to 70,000 lbs (27,000 to 31,000 kgs), some as heavy as 100,000 lbs (45,000 kgs). In the ‘80s their weight was down around 50,000 lbs (22,000 kgs) and in the ‘90s lightweight maxis (sleds) are being built weighing 30,000 lbs (13,600 kgs).

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**USING CORE MATERIALS**

Core materials can also be incorporated into a laminate to improve its strength. Think of using a core material as similar to building an ‘I’ beam. The core material represents the vertical portion of the ‘I’ and the exterior laminates represent the top and bottom of the ‘I’. The core holds the exterior laminates apart. The further the laminates are apart, the stiffer the ‘I’ beam is.

A cored hull is made by laying the exterior laminate up in the mold and while it is still wet, laying the core material over it. Foam cores should be bonded in a slurry of Epiglass glue. To increase the strength of the laminate it is usually vacuum-bagged to eliminate voids. Generally, the core material should be fairly high density, but if a low-density core is used, it should be primed with an Epiglass glue mix before being applied to the job. The vacuum-bagged job is left to cure before the exterior laminate is applied and vacuum-bagged into place. If foam cores are cut or grooved to increase flexibility, care must be taken to ensure the gaps are filled with Epiglass mixed with lightweight fairing compound, as air gaps will lead to early failure of the panel.

**RESIN RATIOS**

Use these formulations to establish what weight of glass has been used in the laminate you are repairing or replacing:

**FOR CSM LAMINATES: Fiber Resin Ratio = 1:2.33**

\[
\text{Fiber content} = \frac{\text{Sample weight in grams}}{10,000} \times \frac{1}{3.33} \times \frac{\text{Sample area in cm}^2}{100}\, \text{cm}^2
\]

**FOR CLOTH LAMINATES: Fiber Resin Ratio = 1:1**

\[
\text{Fiber content} = \frac{\text{Sample weight in grams}}{10,000} \times \frac{2}{\text{Sample area in cm}^2}
\]

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\[
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\]
WOOD CONSTRUCTION

The days of building wooden boats using planks carefully shaped and fitted into the hull are long gone. The vast majority of builders now build a wooden hull using either strip planks or diagonally laid planks or a combination of the two. Often a layer of fiberglass will be laminated over the outside of the hull to provide abrasion and impact resistance. In this type of construction the glue used is epoxy. It encapsulates each piece of wood and seals it against moisture and rot.

Another method of building a wooden boat is to build it using marine grade plywood. Typically this method is used for small skiffs and dinghies, although it has been used for larger sailing shemes and some fairly high-performance powerboats.

STRIP PLANKING: METHODS AND TECHNIQUES

To build a new wooden boat the builder first makes sections representing the shape of the hull. These sections are set vertically on a foundation (or strongback depending on what part of the world you are building the boat). Often the major bulkheads are set up in between the sections and in some cases premade furniture is set in place before the hull shell is installed.

Once the sections (and bulkheads or furniture) have been tapered the outer skin of the hull is usually laid up by placing strips of wooden planks anywhere between 7 inches (10 mm) and 11 inches (28 mm) thick, and 1 inch (12 mm) to 1 1/2 inches (35 to 50 mm) wide longitudinally down the hull. These strip planks are coated with Epiglass® along one edge and on the furniture or bulkheads. Each section, which will be stripped out and later is protected with a strip of polyethylene so that the epoxy will not adhere to it. Many builders start planning in the middle of the hull and work toward the keel and to the sheer line by inserting tapered planks to fill the increased hull girth in the middle of the vessel. Other builders start at the sheer and work toward the keel installing shorter, tapered planks near the keel. The planks are often temporarily tapered through a double or triple thickness of polyethylene sheet to hold them in place while the epoxy dries and to make it easy to remove them after the Epiglass has cured. Other builders use bronze staples and leave them in place after the glue has cured. Leaving the staples in place makes it easier to sand and fasten the strip planking before covering it with diagonally laid wood or fiberglass. In general, permanent fasteners such as nails or staples are only left in place in bulkheads or furniture that will remain inside the boat after the boat is built.

Typical woods used in strip planked construction might be Western Red Cedar, Port Orford Cedar, White Pine, Mahogany, or other woods with a reasonably long life and ease of gluing. The wood is virtually encapsulated in epoxy, and is usually impermeable to moisture, however, poorly made strip planked boats have been known to rot, so it is important to have the wood at less than 15% moisture content, totally encapsulate it, and make sure it is protected from abasement both inside and outside the hull.

To protect against abrasion on the outside of the strip planked hull a builder might place two or three layers of fiberglass cloth. In effect, shaping the entire hull. If fiberglass is not desired on the outside, two or more layers of wood about 4 inches (100 mm) wide and 1 inch (3 mm) thick might be laid over the strip planking. If wood is used, generally, it is laid at a 45 degree diagonal from sheer line to sheer line with the diagonals crossing at 90 degrees. A third layer with the grain longitudinally oriented gives a good cosmetic result if the boat is to be finished with varnish or varnish paint.

No matter what parts of the interior are included, the outward edges of the sections need to be tapered to suit the curvature of the hull. For smaller craft that use a wood thickness of less than 1/8 inch (3 mm) might be laid over the chine and left to set up. Depending on the builder the ties may be stripped out or removed after the glue sets up with the ties be finished with a layer of or two of clear epoxy. If a painted hull is desired, the entire hull can be sanded and coated with fiberglass and primer with Epoxy Barrier Kote 404/414 or Interprime 880 and finished with an Interlux topcoat.

When the hull is finished it is turned over and the sections stripped off and discarded. The main bulkheads are left in place and form the foundation for the interior joinery. The deck may be built separately, but is usually built directly onto the hull using conventional deck beams with plywood coated with Epiglass and screwed to the deck beams. Teak deck planking can be fastened and epoxy to the plywood deck to give an attractive finish. The entire structure forms a strong waterproof, not resistant, monocoque shell that can be finished with a number of Interlux painting systems.

This method of construction gives a strong, lightweight hull, is easy to fasten for a Gloss system and epoxy that has cured is much easier. Sanding Epiglass or any epoxy that has cured is hard work especially on the inside of a chine. Having a chine log gives two advantages. First, there is something to screw the plywood to, and second the chine log helps to protect the end grain of the plywood. Plywood panels are coated with Epiglass and screwed to the chine log and the entire chine is covered with fiberglass tape and fixed in place using Epiglass. Once the hull has been assembled it is faired.

But in areas where the wood is heavily bent, you may have to apply short lengths of tape between the ties to hold the wood together before removing them. When the Epiglass is cured, the ties are removed and the entire chine taped outside. With the hull formed, all the ties are removed, the outside is faired using Epiglass fairing mix and sanded back ready to be finished as explained in Section 2. Larger craft over 30 feet (over 9 meters) are usually built with ‘chine logs’ – that is, wooden logs at each chine, at the stem, and at the transom corners. 

When using Epiglass, it is good practice to keep the work area clean, scrape off or remove an epoxy drips or runs before the glue sets up, and to use the minimum amount of epoxy to glue tape down or to make a fillet. When taping, marking the surrounding area will help to prevent epoxy dripping to other parts of the hull and causing extensive cleaning. The less sanding and cleanup work you need to do the better the Epiglass is set, makes your work much easier. Sanding Epiglass or any epoxy that has cured is hard work especially on the inside of a chine.

At the end of the day make sure that all of containers of curing epoxy are disposed of in a way that the heat they emit during curing will not ignite other waste. Clean tools and rollers before epoxy has time to set up and make sure that flammable supplies and other materials are stored well away from the job.
When water is present within the laminate this process goes into reverse. One of the products of this reversal is an acid, which attacks the polyester, producing a chemical reaction and the telltale gel coat blisters. The only way to eliminate the possibility of blistering is to make the outer gel coat totally impervious to water. At this time most builders use either vinyl ester resin or epoxy as the external barrier to water penetration because it is most impervious to water.

REPAIRING HULL BLISTERS

Treating a blistered hull has four key steps; removing the blisters, re-laminating to replace laminate that has been peeled or ground off, re-fairing to restore the original hull and repainting to the finish desired.

The first step in repairing blisters is to determine the extent of the blister damage. Once this is known the decision as to whether to remove the entire surface or coat the underwater portion with Epiglass® Epoxy can be made. Typically, if you see a single blister, the entire hull needs work. A blister shows that water has been present in the hull for a long time and bubbles are starting to form. The moisture level in the hull should be measured to ascertain how much work needs to be done. If blisters have yet to form, but a moisture meter indicates that the laminate contains moisture, it should be peeled and recoated. Only if you have achieved the low moisture level should an epoxy barrier coat be applied.

Once the hull has been peeled, the hull must be dried. This can often take a few weeks. A moisture meter indicates that the laminate contains moisture, it should be peeled and recoated. Only if you have achieved the low moisture level should an epoxy barrier coat be applied.

OSMOSIS REPAIR STEP-BY-STEP

STEP 1: Peel or sandblast the bottom of the boat

STEP 2: Rinse the hull repeatedly with fresh water

STEP 5: Wash and let dry

OSMOSIS REPAIR STEP-BY-STEP

STEP 1: Peel or sandblast the bottom of the boat

STEP 2: Rinse the hull repeatedly with fresh water

STEP 3: Dry the peeled hull thoroughly.

STEP 4: Sand or plane out bumps and any ridges left by the peeling process, if the hull has large hollows, fill them after sanding and cleaning.

STEP 5: Wash and let dry.

STEP 6: Apply a coat of Epiglass to the entire hull.

CONTINUED →
Apply antifouling. Epiglass requires a tiecoat before antifouling can be applied. InterProtect 2000E and VC Performance Epoxy are both suitable for this. For more information visit www.yachtpaint.com.

**STEP 4:**

Bright clean colors there is Trilux®33®. Trilux 33 is ideal for use for boaters that want

**DIFFERENT TYPES OF ANTIFOULING PAINTS**

**MICRON® TECHNOLOGY**

Plants that use Micron Technology provide the longest lasting protection from fouling. The biocides are chemically bound to the paint film and are only active when in the water. This... which reduces drag and maximizes fuel savings. The longevity of these coatings is related to the thickness of the paint.

The first step in doing a great paint job is to make a full project plan that details the area to be painted. This plan should include surface preparation, priming, any filling, undercoating and finishing. Make sure that adequate time has been allowed for each job. You should also check with your local paint supplier to ensure that any special paint specs are met. In other words, if you decide that the second paint coat is to be applied a day after the first coat and the manufacturer’s specs say that it should be applied within six or eight hours, you might need to put in a long day to get the job done right. Getting a great paint job is in the details. Without a solid plan, good preparation, careful workmanship, and material compatibility, even the best painters can fail.

**HARD ANTIFOULINGS**

The technical term for these types of antifouling paints is ‘contact leaching’. The paint dries to a porous film that is packed with biocides, which leach out on contact with water to prevent fouling growth. Once the biocide is exhausted, the hard paint film remains on the boat. Hard antifoulings do not rely on antifouling ability out of the water and cannot be healed and relaunched without repairing. The main benefit of hard antifouling paints is their predictable antifouling performance in all waters.

They provide a hard, scuffable and abrasion resistant finish.

**BOTTOM PAINTS WITH TEFLON®**

DuPont® Teflon® is an extraordinary and versatile technology. EXCLUSIVE® available in yacht coatings from Interlux®. Teflon® has a coefficient of friction lower than ice, making it the most slippery material in existence. By featuring Teflon® in our antifouling products you get the benefit of smooth, low-friction surfaces that minimize drag and extremely hard coatings that resist damage and are exceptionally easy to clean. They are also easy to burnish to produce the smoothest, fastest antifouling surface.

**SPECIALTY ANTIFOULINGS**

**BRIGHT COLORS AND ALUMINUM** – For boats that want bright clean colors there is Titus® 33®. Titus 33 is ideal for use on aluminum and can also provide excellent antifouling protection on fiberglass, wood or steel. Titus 33 uses Biloxi Technology to control slime and has 2 biocides that work together to provide increased performance.
**OUTDRIVES** – Trilux® Prop & Drive is an aerosol antifouling developed specifically for use on lower units of outdrives and outboards.

**HARD RACING – MAXIMUM SPEED** – Baltoplate is a hard vinyl antifouling designed for the serious racers and has a long heritage of use by winning sailors.

**TRADITIONAL – WORK BOAT** – Bottomkote® is a traditional soft sloughing antifouling that provides good antifouling protection for most areas.

**MICRON® TECHNOLOGY**

Micron Technology formulations are second to none! Micron Technology was first introduced to the industry in the early 80’s and has evolved into class leading antifouling paint!

**MICRON® TECHNOLOGY vs OLD FASHIONED HARD ANTIFOULINGS**

- **OLD FASHIONED HARD ANTIFOULINGS**
  - Old fashioned hard antifoulings will eventually lose copper trapped within a rough, less polished paint film that will need to be removed by sanding or scraping.

- **MICRON TECHNOLOGY**
  - Micron Technology polishes to a smoother surface than old fashioned hard antifoulings maximizing fuel savings.
  - Unlike old fashion high copper bottom paints, Micron uses less copper more efficiently for longer lasting antifouling protection.

**BIOCIDE FREE** – VC Performance Epoxy and VC® Eco™ are Teflon®-containing coatings that can be used on boats that are permanently moored in the water but do not require antifouling protection. VC Performance Epoxy dries to a hard finish that is ideal for well sanding and buffing. The hard scoff resistant surface makes it the ideal coating for boats stored in racks and lifts as well as trailerd boats.

*VC Eco is only available in Canada*

**MICRON TECHNOLOGY AND FUEL SAVINGS**

After many years of using old fashioned hard high copper bottom paints, the paint film will continue to build up, become brittle, and start to crack and flake off. Micron Technology antifoulings polish at a controlled rate and therefore will never build up. It is this controlled polishing that enables Micron to be used on all boats, in all waters, and at all times. No paint build-up means that you will never have to remove old layers of Micron and spend precious hours or money each time you want to repaint.

**MICRON TECHNOLOGY AND FUEL SAVINGS**

There’s another added benefit to controlled polishing: Fuel Savings!!

- **Power or sail, with today’s fuel prices, a smooth bottom will deliver better fuel efficiency over the long term than old fashioned high copper bottom paints.**

**CONTINUED**
EPOXY TERMINOLOGIES: AN EXPLANATION

**PROPERTY DEFINITIONS**

**POT LIFE:**
The length of time before the liquid nature of a mix changes to a solidifying gel. Usually shorter than the working time.

**VISCOSITY:**
Property of a fluid which resists change in the shape of its elements during flow.

**TENSILE STRENGTH:**
The ability a material possesses of resisting deformation by the application of a tensile (stretching) force or load.

**TENSILE MODULUS:**
Measurement of the amount of stretch a material can take in relation to the ability to resist stress. eg: Rubber has a low modulus, steel has a high modulus.

**COMPRESSIVE STRENGTH:**
Maximum compressive load which a material is capable of resisting before breaking.

**COMPRESSIVE MODULUS:**
The measure of elasticity in a compressed state. A low modulus material would be more likely to deform before breaking.

**SHEAR:**
The tendency produced by loads to deform or fracture a member by sliding one section against another.

**FLEXURAL STRENGTH:**
The ability of a material to resist bending. A higher number denotes a stronger material.

**FLEXURAL MODULUS:**
Measurement of stress vs. strain. A high flexural modulus would equate to a stiffer material.

**SHORE D HARDNESS:**
Numerical measurement of cured epoxy hardness. A metal point is forced into the cured epoxy to measure resistance. A higher number denotes a harder surface.

**INTERLAMINAR SHEAR STRENGTH:**
The ability of the resin to hold two adjacent layers together under lateral loads.

**SPECIFIC GRAVITY:**
Comparison of density of material with that of water. eg: Water has a specific gravity of 1. Something with half the density of water = 0.5.

---

**WHY IS MICRON® A BETTER CHOICE FOR MY BOAT THAN OLD FASHIONED HARD BOTTOM PAINTS?**

<table>
<thead>
<tr>
<th></th>
<th>Hard Conventional</th>
<th>Micron Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long lasting</td>
<td>12-18 months</td>
<td>18-36 months*</td>
</tr>
<tr>
<td>Predictable performance</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Prevents fouling in all fouling conditions</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Multi-season</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can haul and relaunch without repainting</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Paint wears away with use – eliminating the need for sanding</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Becomes smoother as you use the boat</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Easy recoating – no sanding or labor to prepare</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Provides maximum fuel savings</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No need to scrub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unlike old technology bottom paints, Micron uses less copper more efficiently for longest lasting antifouling protection</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

* The length of service depends on the choice of Micron, water temperature, usage and number of coats applied.

There is no better choice for the boat owner than Micron Technology antifoulings.
- Least expensive can of bottom paint you can buy
  - You do not have to paint every year
  - No sanding to remove heavy build-up you get with hard antifoulings
  - Provides maximum fuel savings
- Proven performance since 1980
- Best selling range of antifoulings sold worldwide
- Suitable for all boats in all waters
- Use on power and sail boats up to 50 knots
- Highly engineered controlled polishing rate

If it’s not Micron Technology it’s old technology!
## TECHNICAL DATA

### COMPONENT PROPERTIES

<table>
<thead>
<tr>
<th>Component</th>
<th>HT9000</th>
<th>HT9001 - Fast</th>
<th>HT9002 - Std</th>
<th>HT9003 - Slow</th>
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</thead>
<tbody>
<tr>
<td>Mix ratio (by weight)</td>
<td>100</td>
<td>22</td>
<td>21</td>
<td>21</td>
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<tr>
<td>Mix ratio (by volume)</td>
<td>100</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Color (Gardner)</td>
<td>1 – water white</td>
<td>5 – light amber</td>
<td>5 – light amber</td>
<td>5 – light amber</td>
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<tr>
<td>Mixed color (Gardner)</td>
<td>2 – pale straw</td>
<td>2 – pale straw</td>
<td>2 – pale straw</td>
<td></td>
</tr>
<tr>
<td>Component density (g/cm³)</td>
<td>1.14</td>
<td>1.07</td>
<td>0.98</td>
<td>0.98</td>
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<tr>
<td>Mixed density (g/cm³)</td>
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<td>1.11</td>
<td>1.11</td>
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<tr>
<td>Viscosity @ 25°C (cP)</td>
<td>850</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Shelf life (months)</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Hazard definition</td>
<td>Xi, N</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Cure to max strength (days)</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Minimum usage temp (˚C)</td>
<td>10</td>
<td>15</td>
<td>25</td>
<td></td>
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</table>

### CURED SYSTEMS PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>HT9001</th>
<th>HT9002</th>
<th>HT9003</th>
<th>HT9000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tg DMTA (Peak Tan) (˚C)</td>
<td>59</td>
<td>52</td>
<td>52</td>
<td>63</td>
</tr>
<tr>
<td>Ext. HDT (˚C)</td>
<td>54</td>
<td>49</td>
<td>49</td>
<td>56</td>
</tr>
<tr>
<td>Shore D Hardness</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Barcol Hardness</td>
<td>26˚</td>
<td>25.8˚</td>
<td>23˚</td>
<td></td>
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<tr>
<td>Moisture Absorption (mg)</td>
<td>31.5˚</td>
<td>27.1˚</td>
<td>22.9˚</td>
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</tr>
<tr>
<td>Cast Compressive Str. (MPa)</td>
<td>109</td>
<td>104</td>
<td>108</td>
<td>104</td>
</tr>
<tr>
<td>Cured Density (g/cm³)</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
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<tr>
<td>Wood Bond Strength (MPa)</td>
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<td>4.65</td>
<td>4.34</td>
<td></td>
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<tr>
<td>Cast Flexural Strength (MPa)</td>
<td>109</td>
<td>102</td>
<td>103</td>
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<tr>
<td>Cast Flexural Modulus (GPa)</td>
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<td>2.7</td>
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<tr>
<td>Cast Tensile Strength (MPa)</td>
<td>53.2˚</td>
<td>71.0˚</td>
<td>69.2˚</td>
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<tr>
<td>Cast Tensile Modulus (GPa)</td>
<td>3.5˚</td>
<td>3.5˚</td>
<td>3.6˚</td>
<td></td>
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<tr>
<td>Laminate Compressive Strength (MPa)</td>
<td>190˚</td>
<td>216˚</td>
<td>212˚</td>
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<tr>
<td>Laminate Compressive Modulus (GPa)</td>
<td>16.6˚</td>
<td>17.3˚</td>
<td>18.6˚</td>
<td></td>
</tr>
<tr>
<td>Laminate ILSS (MPa)</td>
<td>25.9˚</td>
<td>30.1˚</td>
<td>27.1˚</td>
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</tr>
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### WORKING PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>HT9001</th>
<th>HT9002</th>
<th>HT9003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot Life @ 77°F (25°C)</td>
<td>14 minutes</td>
<td>30 minutes</td>
<td>55 minutes</td>
</tr>
<tr>
<td>Application Temp.</td>
<td>50°F (10°C)</td>
<td>59°F (15°C)</td>
<td>75°F (25°C)</td>
</tr>
</tbody>
</table>

### CURING PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>HT9001</th>
<th>HT9002</th>
<th>HT9003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gel time – 100g mix in water (mins)</td>
<td>34</td>
<td>34</td>
<td>33</td>
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<tr>
<td>Thin film working time – initial gel – tack-off (hrs)</td>
<td>14</td>
<td>14</td>
<td>14</td>
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<tr>
<td>Thin film working time – final gel – overcoat (hrs)</td>
<td>56</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Sandable time (hrs)**</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>De-mold/clamp time (minutes)</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

### EPIGLASS® POT LIFE

<table>
<thead>
<tr>
<th>Hardener</th>
<th>Foot Hardener</th>
<th>Standard Hardener</th>
<th>Slow Hardener</th>
</tr>
</thead>
<tbody>
<tr>
<td>HT9001</td>
<td>14 minutes</td>
<td>30 minutes</td>
<td>55 minutes</td>
</tr>
<tr>
<td>HT9002</td>
<td>14 minutes</td>
<td>30 minutes</td>
<td>55 minutes</td>
</tr>
<tr>
<td>HT9003</td>
<td>14 minutes</td>
<td>30 minutes</td>
<td>55 minutes</td>
</tr>
</tbody>
</table>

**After removal of any surface by-product

### DISCLAIMER

- Will cure down to 41°F/5°C but best applied at temperatures of 50°F/10°C and up.
- Best applied at temperatures of 59°F/15°C and up.
- Best applied at temperatures of 75°F/25°C and up. **After removal of any surface by-product

---

* Lloyds Test Data after 16 hrs @ 40˚C (104˚F)
HEALTH & SAFETY

BEFORE YOU START

Any epoxy is a fairly nasty stuff if you get it on your skin. In extreme cases it can sensitise your skin to such an extent that you may break out in a rash as soon as somebody opens a can and absorb more chemicals. Change gloves frequently during the day’s work, again to avoid any chemicals being absorbed.

Even though many professionals may do it, Interlux does not recommend washing your skin with a solvent. Solvents strip the skin of its natural protective oils increasing the chance that you will get any epoxy in your eyes. Interlux recommends flushing them for at least 15 minutes with running water.

GING GOGGLES DUST MASK

PERSONAL PROTECTION EQUIPMENT

When mixing fillers and powders with epoxy resin, wear a dust mask or respirator. Fillers such as microballoons or filler powders easily become airborne and may be inhaled. A respirator will give you the best protection, but failing that use a dust mask.

WORKING WITH EPOXIES

Like many boat building materials working with epoxies can be hazardous to your health. Epoxies are a blend of chemicals and as with any chemical, poor handling, misuse, and poor disposal can cause problems. There are some strong chemicals present that should be respected by the user. Always read the health and safety information displayed on the labels and safety data sheets. Always use the recommended personal protection equipment (PPE).

CUT UP

Wash tools with 202 Solvent. Don’t leave unused mixtures in pots or cups. Heat is given off when epoxy sets up and if you try to accelerate a cure using an electric heater, make sure the heater has the appropriate safety controls, cannot get too hot, is not placed too near flammable materials, and there is adequate ventilation available. Exhaust systems should vent outside the workshop or weared. Ensure also that the heater is not a combustion type such as a propane space heater. Not only will there be an increased fire risk, but the heat will contain extra moisture that may cause a surface by-product to form.

CLEAN UP

Wash tools with 202 Solvent. Don’t leave unused mixtures in pots or cups. Heat is given off when epoxy sets up and if the mixture sets up in a cap it can emit a lot of smoke. There have also been occasions where a curing mixture has been tossed into a fresh can and ignited the can’s contents, burning down the workshop. Put pots of un-hardened mixtures on the ground outside the workshop until they are completely cooled and set hard, then throw away with normal rubbish.

ESTIMATING QUANTITIES REQUIRED

1. LAMINATING RESINS

Resin/Hardener Mix required (ml) = A x n x WF x R.C. x 1.5

A = Area of laminate (sq m)

n = Number of plies

WF = Resin content by weight

R.C. = Resin content by weight

2. GELCOATS AND COATINGS

SOLVENT FREE: Resin/Hardener Mix required (ml) = A x n x S.C. x 1.05

SOLVENT BASED: Resin/Hardener Mix required (ml) = A x n x 1.15

10 x S.C. x 1.15

3. FIBER WEIGHT FRACTION

FWF = \( \frac{\rho_F}{\rho_{C}} \)

FWF = \( \frac{\rho_F}{\rho_{C}} \) x FVF

FWF = \( \frac{\rho_F}{\rho_{C}} \) x FVF

4. CURED PLY THICKNESS FROM PLY WEIGHT

CPT (mm) = \( \frac{W_{F}}{\rho_{C}} \)

CPT (mm) = \( \frac{W_{F}}{\rho_{C}} \) x FVF

CPT (mm) = \( \frac{W_{F}}{\rho_{C}} \) x FVF

LAMINATE FORMULAE

1. FIBER VOLUME FRACTION FROM DENSITIES

FVF = \( \frac{(\rho_C - \rho_m)}{(\rho_C - \rho_m)} \) (assuming zero void content)

FVF = \( \frac{(\rho_C - \rho_m)}{(\rho_C - \rho_m)} \) x FVF

FVF = \( \frac{(\rho_C - \rho_m)}{(\rho_C - \rho_m)} \) x FVF

2. FIBER VOLUME FRACTION FROM FIBER WEIGHT FRACTION

FVF = \( \frac{\rho_C - \rho_m}{\rho_C - \rho_m} \times \frac{\rho_{FWF}}{\rho_{C}} \)

FVF = \( \frac{\rho_C - \rho_m}{\rho_C - \rho_m} \times \frac{\rho_{FWF}}{\rho_{C}} \)

FVF = \( \frac{\rho_C - \rho_m}{\rho_C - \rho_m} \times \frac{\rho_{FWF}}{\rho_{C}} \)

3. FIBER WEIGHT FRACTION FROM FIBER VOLUME FRACTION

FWF = \( \frac{\rho_{FWF}}{\rho_{C}} \)

FWF = \( \frac{\rho_{FWF}}{\rho_{C}} \)

FWF = \( \frac{\rho_{FWF}}{\rho_{C}} \)

4. CURED PLY THICKNESS FROM PLY WEIGHT

CPT (mm) = \( \frac{W_{F}}{\rho_{C}} \)

CPT (mm) = \( \frac{W_{F}}{\rho_{C}} \)

CPT (mm) = \( \frac{W_{F}}{\rho_{C}} \)

POST-CURE CYCLE

PRE-CURE CYCLE

LAMINATING RESINS

GLOVES GOGGLES DUST MASK

PERSONAL PROTECTION EQUIPMENT

WORKING WITH EPOXIES

Like many boat building materials working with epoxies can be hazardous to your health. Epoxies are a blend of chemicals and as with any chemical, poor handling, misuse, and poor disposal can cause problems. There are some strong chemicals present that should be respected by the user. Always read the health and safety information displayed on the labels and safety data sheets. Always use the recommended personal protection equipment (PPE).

CUT UP

Wash tools with 202 Solvent. Don’t leave unused mixtures in pots or cups. Heat is given off when epoxy sets up and if the mixture sets up in a cap it can emit a lot of smoke. There have also been occasions where a curing mixture has been tossed into a fresh can and ignited the can’s contents, burning down the workshop. Put pots of un-hardened mixtures on the ground outside the workshop until they are completely cooled and set hard, then throw away with normal rubbish.
FREQUENTLY ASKED QUESTIONS

1. How can I tell the difference between arvake brush and unsanded resin? Do to the chemical make-up of Epiglass® or BY800 hardeners, an arvake brush may be seen after curing, which many people often mistake as uncured resin. To tell the difference between arvake brush and uncured resin check the cure after a day or so with a fingernail. It should be difficult and/or impossible to do so. Arvake brush can be removed with fresh water, or water with a drop of detergent added. Sand the surface, and then continue with the system.

2. How do I avoid a ‘soft cure’ of my Epiglass mix? Ensure that the hardener you choose is best suited to the climatic conditions. For warm environments select a slow hardener, in cooler climates make sure you use a faster hardener.

3. How do I decide which hardener best suits my needs? Only use the specially calibrated dispensing pumps available from Interlux – don’t use other manufacturers dispensing aids as they may be calibrated to dispense a different mix ratio. In the unlikely event of your Epiglass mix starting to bubble and smoke, and within a minute you couldn’t use it. How do I avoid this? Re-assess the hardener you are using – is it suitable for the climatic conditions? You are probably using a fast hardener in a warm room, by using a slower hardener, mixing smaller quantities or working in a cooler environment you can avoid the problem.

4. How can I be sure I’ve used the correct amount of base and hardener? If you have any doubts about the toxicity of the materials that you are working with, you can obtain a Material Safety Data Sheet from the manufacturer. MSDSs are required for all epoxies and tell you what toxic materials are in the resin and hardener.

5. How can I avoid, or can I add a tint to Epiglass? Universal type tinters are formulated for use in both solvent and water-based products, and contain a type of solvent that will act as a plasticizer, heavily retard the cure and may stay trapped in the film. As this may lead to soft cures, it is not advisable to add tints to Epiglass.

6. How do I tell the difference between amine blush and uncured resin? An amine blush may be seen after curing, which many people often mistake as uncured resin. To tell the difference between amine blush and uncured resin check the cure after a day or so with a fingernail. It should be difficult and/or impossible to do so. Arvake brush can be removed with fresh water, or water with a drop of detergent added. Sand the surface, and then continue with the system.

7. How can I avoid a ‘soft cure’ of my Epiglass mix? Follow the mixing instructions carefully. If there is an amine blush, wash the area thoroughly with soap and water. If you get chemicals in your eyes, wash with a mild alkaline solution. Brush with running water for at least fifteen minutes, and seek medical help immediately. If you swallow resin or hardener, drink plenty of water and get medical help immediately.

8. How can I be sure I’ve used the correct amount of base and hardener? Use the specially calibrated dispensing pumps available from Interlux – don’t use other manufacturers dispensing aids as they may be calibrated to dispense a different mix ratio.

9. How do I avoid a ‘soft cure’ of my Epiglass mix? In the unlikely event of your Epiglass mix starting to bubble and smoke, and within a minute you couldn’t use it. How do I avoid this? Re-assess the hardener you are using – is it suitable for the climatic conditions? You are probably using a fast hardener in a warm room, by using a slower hardener, mixing smaller quantities or working in a cooler environment you can avoid the problem.

10. How can I avoid, or can I add a tint to Epiglass? Universal type tinters are formulated for use in both solvent and water-based products, and contain a type of solvent that will act as a plasticizer, heavily retard the cure and may stay trapped in the film. As this may lead to soft cures, it is not advisable to add tints to Epiglass.

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Outside the boatyard, Epiglass can be used for a myriad of projects. It has been used for home and office repairs, for example, the repair of rotted sills and walls in older homes. Because it protects against many boring insects it can be used to protect vulnerable materials with none of the chemical based often found with preservative coated wood. Epiglass can also be used to protect wood that will be exposed to water. By fully encapsulating the wood, it will be protected from water absorption.

Epiglass can be used to glue furniture joints together on both new and older furniture with damaged joints. It can be used to preserve and protect furniture or larger projects when used like a varnish and top coated with Schooner or Perfection. Epiglass is also suitable for a wide variety of modelling and craft uses.

In short, Epiglass can be used around the interior of the home and workshop because it does not contain VOCs, and is relatively benign. It can be sanded, although protection should be worn against sanding dust, and it can be applied by brush or roller.

If you use Epiglass for an unusual purpose we’d love to hear about it. Contact your local Interlux office to tell us about it.

**EPIGLASS RANGE LIST**

**EPOXY RESIN**
- HT9000QT/QT Resin & Fast Cure Kit
- HT90001 Resin Gallon
- HT90005 Resin 4 Gallon
- HT900055 Resin 5.2 Gallon

**FAST HARDENER**
Formulated for use in colder climates or where users require a faster curing system.
- HT9001QT Fast Cure Quart
- HT90011 Fast Cure Gallon
- HT90015 Fast Cure 4.5 Gallon

**STANDARD HARDENER**
The most widely used hardener, formulated for most conditions.
- HT9002QT STD Cure Quart
- HT90021 STD Cure Gallon
- HT90025 STD Cure 4.3 Gallon

**SLOW HARDENER**
Formulated for use in warmer climates or where users require a longer curing system.
- HT90031 Slow Cure Gallon
- HT90035 Slow Cure 4.3 Gallon

**GLUE POWDER**
The extender produces a high strength epoxy glue when mixed with the Epiglass epoxy resin.
- HT720QT Glue Powder Quart

**FILLER POWDER**
Used to produce a filling compound that can be used above and below the waterline.
- HT450QT Filler Powder Quart

**PUMPS**
Used for dispensing Epiglass at a 4:1 ratio.
- HT55 For Gallon Kits
- HT80 5-Gallon Kit - Dispensing Unit
- HT30 Trolley Pump
- HT100 Table Pump - Dispensing Unit

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