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Surfboard Glassing Manual

Fiberglassing a Wood Surfboard with Epoxy Resin

by Brad Anderson

Chapter 2› Glassing & Finishing

This chapter covers all glassing steps, and fin-box, leash cup and vent installation and briefly addresses polishing.

IN THIS CHAPTER

ABOUT THIS PROCESS

Entire books are devoted to glassing, and though we've tried to keep it simple, your job is complicated somewhat by our choice of epoxy over polyester resin. Epoxy is more challenging to use than polyester, but it does not emit any volatile organic compounds (VOCs) which are greenhouse gasses, can be cleaned up with organic solvents, and it is stronger than polyester.

Be sure you are working in an area where epoxy drips won't damage anything. Glassing is always a messy process, and since epoxy is actually thinner than most glues, it can seem to get everywhere. Be prepared for that by protecting all surfaces that need to be protected - particularly the floor all around your glassing stand - even farther out than the board reaches because the epoxy will drip off of every edge.

We will also take some time to protect the board itself from drips throughout this chapter. Epoxy drips around the rails to the bottom of the board, and drips from the edge of the mixing cup no matter how careful you are. This is the reason for taping the rails, and masking off the bottom when installing fins. If you get a drip that cures where you don't want it to, it is not a disaster - it just takes time to sand it out. You can't chip these off, because they adhere so well that they just lift chips out of the epoxy or wood below them.

Also be sure to use all the required safety equipment and to thoroughly read the MSDS and other information that comes with the materials you'll be using.You do not want the epoxy on your skin - ever - and you never want to ingest or breathe in the sanding dust you generate from it. We will address some dust management considerations during this process.

Epoxy is exothermic: temperature matters, both room temperature and the heat that the epoxy itself generates when it is massed in the mixing cup. The room should be warm - 65 - 75 degrees Fahrenheit is probably ideal. Keep your epoxy jugs where they can stay warm too. If you have to glass in cooler temperatures, carry the warm epoxy out to the glassing areas, check the curing schedule if one came with your epoxy and plan for the appropriate curing time. Note that curing tables are usually for "thin film" application - refering to how fast the cure happens *when the epoxy is on the board*, not in the mixing cup where the heat of the chemical reaction is actually speeding the cure dramatically.

Your glassing stand will need to be narrower than the board, although you can adapt your shaping stand by masking off the top of the stand and adding some blocking or extensions that raise the board up so you can get to the edges.

When glassing and finishing, your board will be un-weighted on the stand most of the time (except when sanding). This makes it susceptible to being knocked off by others when you are not there, or by you as you work around the board. Be very careful when the board is not weighted and, unless it is curing, leave a weight on the board whenever you are not there with it.

The gloss-coat of epoxy requires requires cleanliness. You will want the finishing room to be as dust-free as possible. You should *not* sand the board in the same space in which you will varnish or glass it.

Sanding the board is a challenge to your patience. Our goal will be to get every single fish-eye, pimple and wave out of the board during sanding. Some irregularities can be filled by subsequent coats of epoxy, but every coat adds weight, and takes time. Close inspection, frequent wipe-downs toward the end, and side-lighting will help you be successful. When you are done, you want the board to look like it dripped out of a faucet.

BEFORE WE BEGIN

The following materials and supplies are required:

FIGURE 2-1. Table of Materials and Supplies

Item	Item
FCS fins for installation of FCS finboxes (not needed if you are using another fin system, or if you have FCS placement jigs)	Citrus cleaner
Board blank from the last chapter	Laquer thinner
Four-ounce and/or six-ounce fiberglass cloth, uncoated, 27 to 30 inches wide, six inches longer than the board.	Epoxy cups, graduated
Vent fitting	Fin-rope (glass-on only)
Leash cup (optional)	Five-minute epoxy (glass-on only)
Epoxy/hardener	Acetate or rice-paper logo
Wood dust or Cabosil	Disposable chip brush (for epoxy coats)
Masking tape	Foam brushes (for varnish)
80-grit, 120-grit, 220-grit, 400-grit (wet-dry) sandpaper	Cotton ball (for testing readiness of epoxy coat - optional)
320-grit, 600-grit (wet-dry) sandpaper (optional)	Rubber gloves (for clean-up - optional)
Automotive polish #7 and/or fiberglass polish	Tack cloth (optional)
#0000 Steel wool	Wax paper (for masking tail of board - optional)
Latex gloves	Rags - some absolutely clean

LAMINATE & HOT COAT

TASK 1: LAMINATE COAT

This coat is the application of the fiberglass cloth and logo. It is a very exciting part of the build, because this is the first time the true qualities of the coloration and figure of the grain in the planks will become evident. As these colors become more intense, you may also see bits of tape or glue that you missed. Some can be fixed during the lam-coat if you can be quick about it - some cannot.

Done well by an experienced glasser, the steps in this process take only minutes once the board is prepped. We will need to work briskly as the epoxy only has a certain amount of working time . Be organized to begin with, and have all things made ready before mixing the epoxy.

These two Tasks (Laminate Coat & Hot Coat) are particularly subject to outgassing which is when expanding air from the surface and/or interior is pushed through the coats that we are applying. This results in small bubbles that can show up virtually everywhere - though over-working the epoxy can cause bubbles as well. You might see it occur when the room that you are working in is heating up, rather than cooling down, or when the vent hole is plugged by the lam coat. Controlling the environment and making sure that the board can vent are ways to reduce outgassing. Another way is to seal the board with a thinned coat of epoxy before the lam coat is applied.

Step 1.1: Prep the Board

Epoxy reacts badly to any form of contamination - even from tack cloths and acetone. Don't use these at all during the glassing process. Parts of this prep process will be repeated when you do the opposite side of the board.

Goal: Remove all contamination and dust from all surfaces and tape the rails to prevent epoxy from dripping to the underside of the board.

Step	Action	Result
1.1.1	Before bringing the board to the glassing room, give it a thorough wipedown to remove loose dust. If you use a vacuum, make sure you don't dent the board with the attachment as the wood is very soft and will show marks easily. It's a good idea to give a cursory wipe with a rag dampened with denatured alcohol.	Loose dust is removed.
1.1.2	Bring the board to the glassing room, and set it upside down on the glassing stand.	The board is ready for prep.
1.1.3 	Decide where you want to mount logos on the board. In any case, select a spot that fits in with the grain and coloration. If there is a strong grain pattern that would be interrupted by the logo, try to find a better spot. Often, if there is a grain tear-out or other imperfection, the logo can be placed in such a way that it obscures the blemish.	The logo is placed on the the centerline of the board (dry) at a place that looks good.

Step	Action	Result
1.1.4	It is difficult to keep logos in place once the glassing starts as the squeegee tends to drag them around a little. This is complicated by the fact that glassing stands are usually tall, which makes it hard to see whether the logo is straight. We want to put on an alignment mark very lightly with pencil. Where the dry logo sits, make a light mark under the edge of the print where you will be able to register it - like at the lower right corner of the 'N' in "Grain". Remove the logo, and use a square to mark a light pencil line across the center line (at right angles to the centerline) that the logo can be aligned to.	You have a barely visible pencil line where the bottom of the word "Grain" should sit on that runs across the centerline.
1.1.5	Use a pair of sharp scissors to trim the graphic close to the lettering (like, less than 1/16") so that there is a minimum of acetate around the actual printing.	The logo is trimmed closely so that the effect of any "halo" is minimized.
1.1.6	Use colored masking tape to create a 'skirt" around the rail of the board. It is easiest to do this "upside down" so that you can ensure that the edge of the tape will hang free when you are done. Often, the tape will accidentally get wrapped to the underside of the board while glassing, which allows the epoxy to run down. To prevent this, a simple trick is to tuck bits of paper, or shavings behind the tape every 10" or so to keep it standing out. Attach the tape just below the tangent point on the rail. The glass will be doubled about 1/8" - 3/16" in the area where the top laminate laps the bottom laminate, and it is usually best it if that is not directly on the apex of the rail as it can create a discernable "pointy" feeling to the rail. One-inch 3M blue masking tape is best because of it's limited hold (won't usually lift grain when removed) and because it is easily visible to ensure complete removal.	There is a distict tape line tightly adhered to the board which will hang down and deflect epoxy drips.
1.1.7	Flip the board over deck-up. Check that you did not crush any of the tape to the rail or bottom. Run your thumb all around the tape to make sure it is well adhered.	The tape is still hanging down from the rail.
1.1.8	Wipe the board down with a rag dampened with alcohol. Give special attention to the top of the rails where you handled the board while taping it. Don't rub off the light pencil marks that indicate where you want to mount the logo. Let the alcohol evaporate for a while as you cut cloth.	There should be no remaining dust, and oils from your hands should be removed.

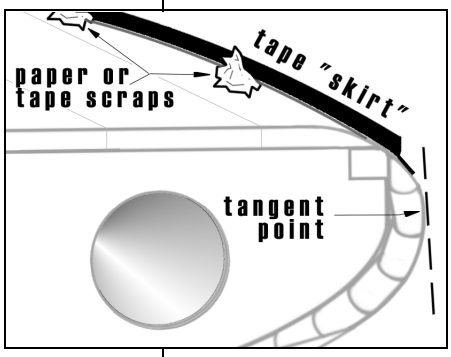


FIGURE 2-2. (right) Tape starts below tangent line, and can be held out with scraps of anything

Step	Action	Result
1.1.9	Look the surface of the board over carefully for grain tear-outs, knots and other recess-type imperfections, if any. You want to remember where these are because they will get special treatment in Step 1.3.	You make a mental note of areas that require special attention.
1.1.10	With clean hands, unroll cloth onto the board and cut it to length leaving just an inch or so hanging past the nose and tail and an inch hanging down one side of the board at its widest point (which should leave more cloth hanging off one side than the other). Very gently smooth it out by tugging at the edges in such a way that you straighten the threads in the cloth. You can see the weave moving around as you tug. Do everything you can not to catch threads and create runs by snagging the cloth on anything as you handle it. Don't fold it. Don't stress over little imperfection in the weave they will sort themselves out when wet.	The cloth is spread onto the board and is lying flat.
1.1.11	**Swallow-Tails Only:** As you trim the cloth around the swallow-tail in Step 1.1.12, you'll need to cut well up into the tail-crack so that the cloth can lay in without bubbling up. The geometry of this is a little hard to visualize until you actually doing it... but with the cloth very neatly cut almost to the top of the tail-crack, distort the now separated sides of the cloth toward each other gently stretching all of the cloth aft of the tail-crack toward the center. This allows the cloth to cover the tails more thoroughly on the inside of the swallow-tails. Keep neatly trimming as you do this until the cloth lays flat across all the curves in the tail. Make a mental note of areas that are still not quite covered - we will deal with that in Step 1.2. This needs to be done before trimming the sides of the cloth (see below).	Cloth is split where it has to cover swallow-tails, and lays smoothly over the inside of the tails without overlapping.

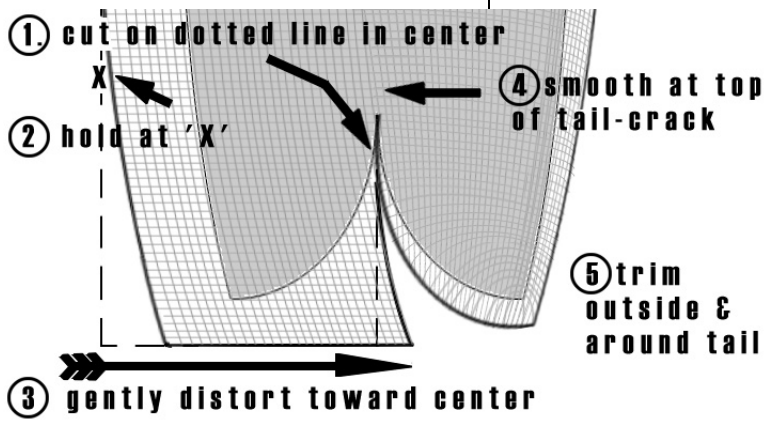


FIGURE 2-3. (right)
Trim center for swallow-tails.

Step	Action	Result
1.1.12	There should be more cloth on one side than the other. Use a good pair of scissors and carefully cut the cloth around the perimeter one to two inches below where it hangs clear of the board. As you are cutting, be sure the cloth isn't shifting across the board, leaving you short on the other side. The piece that is left over from one rail is larger than the other. Save this one for future glassing jobs (like fins or lap-laminations) and discard any that aren't large enough to keep.	The cloth covers the deck completely, and hangs down past the top edge of the tape at least. There are no snags or wrinkles, but it is possi-ible that the weave is not perfectly straight.

FIGURE 2-4. Cloth hangs below the tape - about an inch or two.

Step 1.2: Swallow-Tail Prep

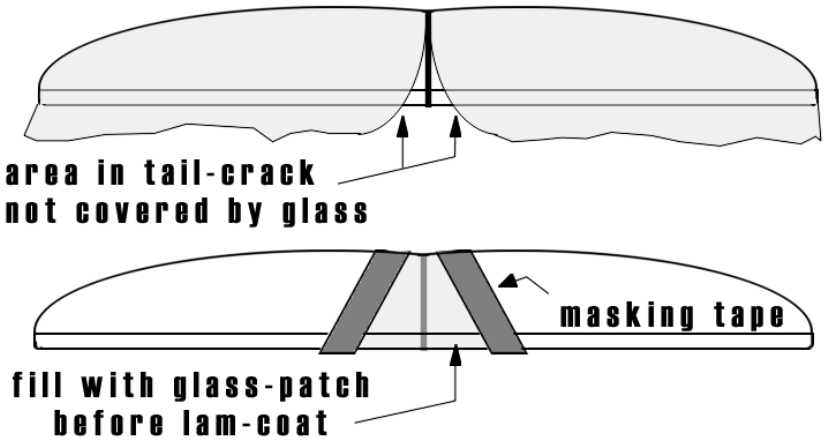
There is one final preparatory step for swallow-tails because the cloth you cut for the top will not adequately cover the tail-crack area. In this step, you will add a small patch of cloth in the tail-crack. It is safest to let this patch cure fully before applying the lam coat in Step 1.3, but you can also apply the lam coat as soon as the tail-crack patch has cured "green".

This is essentially a miniature lam-coat (in just the tail-crack) such as we are about to do for the rest of the board. Read through Step 1.3 before starting this step so that you understand the principles and methods behind laminate coats.

Goal: Epoxy a small patch of cloth in the tail-crack of the swallow tail that covers areas not covered by the cloth cut for the top.

Step	Action	Result
1.2.1	Note the areas that are not covered by the glass you cut for the top (see top of Figure 2-5)	Viewed from the rear, gaps are seen where cloth will not cover the tail-crack.

Step	Action	Result
1.2.2	Gently fold the glass away from the tail, and use masking tape to mark off the area that was not covered. The tape should form a closed loop over all the surfaces - the tailblocks, top and bottom - so that epoxy can't flow anywhere that we don't want it to. Tape flat onto the bottom so that the glass patch we are about to add will fold over a bit onto the bottom. It helps to form little dams with the masking tape all around as well so that there can be no chance of epoxy getting onto the board anywhere.	An area is masked off to protect the board while applying the glass patch.
1.2.3	Cut a patch of glass from the trimming scrap that extends onto the tape.	The patch is cut to overlap the tape, but not contact exposed portions of the board which are beyond the patch area.
1.2.4	Put on latex surgical gloves and mix up a small amount of epoxy. Pour some onto the area and spread it out with your finger. Lay the patch on, and with a finger, smooth it over until you have pressed most of the epoxy out through the weave. Use a putty knife or a wood shaving to set the glass well into the tail-crack.	There are no bubbles under the glass, and the weave is clearly visible.
1.2.5	Let the epoxy cure to at least a "green" state (see Step 1.3.21 for a description of "green" cure), then carefully cut along the tape line with a razor. Don't press too hard - you only need to score the glass fibers to peel the tape away and you don't want a knife-mark in the wood grain. Pull the tape sideways - not up - to keep from lifting the edge of the patch. Once the tape is off, use a gloved finger to press down the edges of the patch so that they don't create a hard edge under the overlapping lam coat. It is safest to wait until the patch is fully set before proceeding. In that case, cut the tape away, then sand down the edges of the glass a little to knock down any edge or fibers. Scratch up the rest of the surface of the patch so that the next layer of glass will stick.	The area cures enough so that the next steps can be performed.
1.2.6	Clean the area well with denatured alcohol before proceeding - including areas where masking tape adhesive residue may be on the board. If the glass patch is "green" cured only, keep the denatured alcohol off of it.	Epoxy will be able to adhere to the surfaces during the next steps.



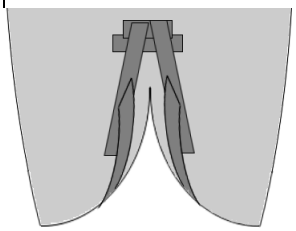


FIGURE 2-5.
(top) Glass draped over swallow-tail shows where patch is needed.
(bottom) Use masking tape to isolate the area where the patch will go.

Step 1.3: Laminate Coat: Applying the Fiberglass

Ideally, you will have everything prepared before mixing epoxy. Make sure that all your tools are at hand, your squeegee is perfectly clean, you have all your safety equipment on and the temperature of the glassing room up to the level you want it.

This entire Step will be repeated for the other side of the board later.

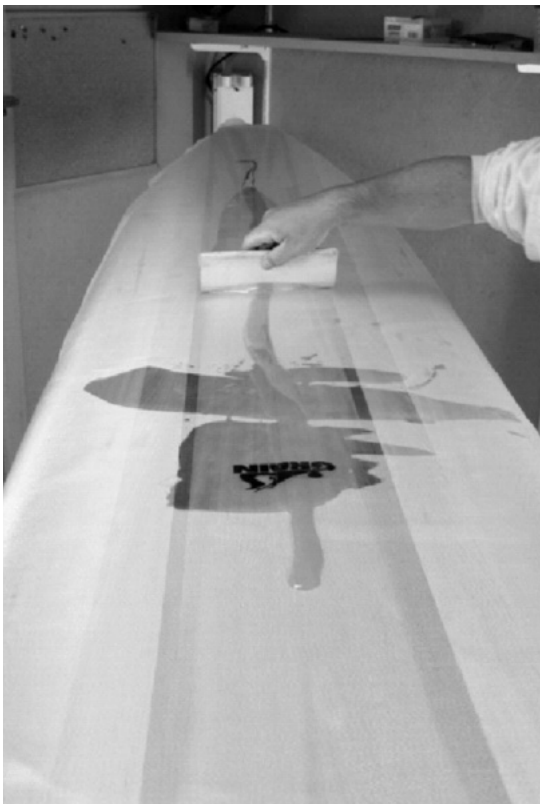
Goal: Adhere fiberglass without floating it, and without bubbles, dry (white) areas or pooling of epoxy.

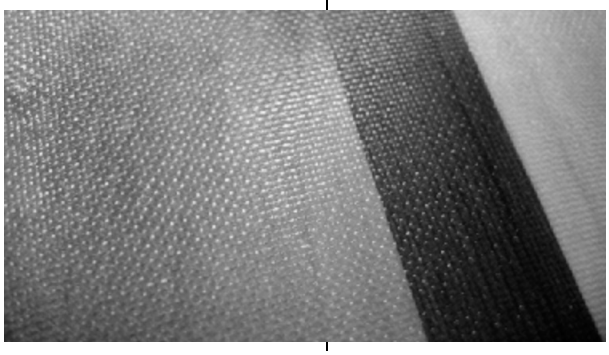
Step	Action	Result
1.3.1	Roll back the cloth from your board to expose the marks for the graphic and also any of the blemished or knotty areas of the board that require special attention.	The glass is laid in one or two loose folds away from the graphic.
1.3.2	Mix up a batch of epoxy. When applying 4-ounce fiberglass longboards, require between 11-16 ounces of epoxy, shortboards only about 8-9. If you mix too little, you will have to stop what you are doing and mix more which can be a bit of a problem if your first mix is already kicking off, but aside from that, it is better to mix up less than more because greater amounts generate more heat in the cup. Ideally, you will use every drop. After your first application, you will have a better idea of how much to mix.	You have enough epoxy well mixed (with no additives) to wet all the glass cloth on the board.
1.3.3	Drizzle a few drops of epoxy on any of the exposed blemish areas and knots. If it doesn't flow right down into the cavities of your knots, work the epoxy in a little with the tip of your mixing stick or corner of your squeegee.	Knots and chips are filled in, and the glass can lay over the fill without creating a dry spot later.
1.3.4	Pour a small patch of epoxy on the area where the graphic is going. Spread it thickly over the smallest area possible so that it is bigger than the graphic itself.	There is enough epoxy to reach all the edges of the graphic once it is placed.

FIGURE 2-6. (right) Too late now... once the cloth is on, mistakes in the graphic are hard to fix.

Step	Action	Result
1.3.5	Lay down the graphic on the marks you made, and holding one corner, lightly squeegee across the dry-ish surface of the top of the graphic lightly pushing the epoxy toward the other corners. Keep the graphic on your marks. Hold one of the other corners, and squeegee the other direction. Look closely for spots that seem to have air under them and squeeze the air to the edge and out. If you can't seem to squeeze all the bubbles out, pull up the graphic, put some more epoxy down, and try again.	There are absolutely no bubbles under the graphic and it is perfectly on your marks, and pretty much centered on the board.
1.3.6	Put the epoxy cup down for a minute - you need two hands. Lifting the cloth over wet areas, set it back into place - use care to center it as it was before and to keep from pulling the weave out of shape. If you set it onto wet epoxy in the wrong position, just carefully lift it, and re-set it. If there is a swallow-tail, be sure that the glass is back in place, and that the tail-crack patch is lapped everywhere.	The cloth is laid back in position with 1" - 2" hanging over everywhere.
1.3.7	Walk all the way around the board to make sure you didn't pull the cloth off of one edge... you don't want to discover this after the whole thing has been wetted out. Also, look for wrinkles - however slight - and try to get them out by standing at the end of the board that is closest and gently tensioning the cloth starting inboard of the wrinkle and working out and down the rail a foot or so. You will see the wrinkle magically correct itself as you flex the warp and woof of the cloth.	The dry cloth is positioned evenly on the board and is without wrinkles.
1.3.8	Check the graphic to see if it shifted. If it did, press the edge of the squeegee onto the graphic and shift it with even pressure in the needed direction.	The graphic is back on the marks.

FIGURE 2-7. (right) Pull air out from under the graphic.

Step	Action	Result
1.3.9	With your mixing cup in one hand and the squeegee in the other, pour about three-quarters of the cup down the centerline of the board. If you are bold, you can very lightly - very lightly - drag your squeegee along behind the pour to spread it down the board as you go.  **FIGURE 2-8.** (right) Pour most of the epoxy onto the centerline.	Most of the epoxy is on the board where it can be spread. The epoxy will cure in a time closer to its thin-set specification rather than heating and curing faster as a mass in the cup. No wrinkles are introduced by the squeegee.
1.3.10	Lightly spread the epoxy down the center from the graphic to one end of the board and then from the graphic to the other end. Lightly means no more than the weight of the squeegee - no pressure! Give the epoxy a chance to soak into the cloth a little - it takes a minute or so. As you work back and forth, find pools of epoxy and drag them along the board, forcing them to the outside with the squeegee.  **FIGURE 2-9.** (right) Lightly (lightly!) start spreading out the pooled epoxy.	The epoxy is pushed out from the center as you work along the centerline but the cloth is not wrinkled or lifted.

Step	Action	Result
	From this point on, the goal is simply to spread the epoxy everywhere on the cloth with the minimum number of strokes to the point that the blue tape is clearly visible and all of the cloth is definitely stuck to the board. You will increase pressure on the squeegee with every pass as the wet cloth-to-wood bond increasingly holds the cloth in place. Too much pressure on the squeegee too early, and you will pull bubbles and wrinkles into the cloth which take time to work out.  The main outcome is that the glass will stick tightly to the wood. Too much epoxy under the glass anywhere will "float it" in those spots, creating a high spot. Later, when you are sanding, you would sand right through those high spots and expose the glass - which we don't want. Additionally, you'll get greater strength by having the glass adhere tightly to the wood.	
1.3.11	Now start to work the pooled up epoxy from the centerline to the rail nearest you with continuous motions parallel to the centerline. Remember that you will need some of what is in the center for the opposite rail so don't move it all toward you. You will have alot of epoxy by the time you get to the nose (or tail), so whip the squeegee around without pushing the epoxy over the edge, and keep moving the epoxy down the board.  As you walk the board's length, you can apply more pressure on one side of the squeegee than the other to squeeze excess out of the wetted part and toward the dry part. You should see a little wave of epoxy peeling along the front of the squeegee toward the rail. Remember: too much pressure too early will drag wrinkles into the cloth.	The epoxy is spreading toward the nearest rail, without falling off the edge of the board.
	**If you get wrinkles:** You can try the same tensioning trick we used in Step 1.3.7, but if the cloth is too well adhered already, turn your squeegee and draw it along the wrinkle in the direction of its length. Usually, this means pulling perpendicular to the board centerline. The weave will compress in the area of the wrinkle - you can see it in the cloth, but as long as the wrinkle doesn't reform, it won't be visible when we are done.	
1.3.12	When you find that you are pulling epoxy onto areas of the cloth that are still dry and you need to let the freshly squeegee'd epoxy soak in a little, go around to the other side and repeat - pulling pooled epoxy toward the rail by drawing the squeegee up and down the board lengthwise. Leave the rails until last.	Epoxy soaks on one side while you spread on the other side.
1.3.13	The idea on this first laminating coat is to just saturate the glass, not make a mirror finish. Your goal is a surface where the texture of the weave (not the white color) is visible on the surface, yet the glass is completely clear. As you see that an area is fully wetted and without pools, move on. Try to drag excess onto any whitish areas or areas that are not completely transparent. Bear in mind that the more you work the epoxy, the greater the liklihood that you will work air bubbles into the cloth. Use the fewest strokes possible to get the job done.  **FIGURE 2-10.** (right) Correct appearance of wetted cloth.	You are removing pools and wetting dryspots as you encounter them.

Step	Action	Result
1.3.14	At some point, you will feel like there is not enough epoxy on the board to do the job. Wait *until* that point to start using the epoxy that remains in the cup, then drizzle it onto the driest areas. If you need more epoxy, wait until you have squeegee'd everything available before mixing it.	You make maximum use of the epoxy that is already on the board, and use your remainder where it is needed most.
1.3.15	Eventually, you will have epoxy approaching the rails, where it tries to run right off the board without soaking in. Try not to let that happen (a few small drips are fine). Make the little wave of epoxy stop just above the rails. When the bulk of the board is fully wetted, start pulling the squeegee away from the centerline at the rails to draw epoxy down in a controlled way that presses it into the glass. You can apply moderate pressure here - even on dry glass. It would be faster to just use twice as much epoxy and just let it run onto the floor, but wasting less is using less and environmentally, that is what we should all be doing.	Epoxy is drawn down around the rails until the cloth is wetted and blue tape begins to show.
1.3.16	Move along the rail briskly working the epoxy down and around as far as the tape. By the time you get all the way around the board, the cloth at the rails will have had time to soak up the epoxy and the tape should be showing brightly through the glass almost everywhere. Use the squeegee edge to press it as needed, and work epoxy over the rail where the glass is dry. Go around the board twice after you think you have it and look again closely.	At least the top 1/8" to 1/4" of tape shows clearly through the glass.

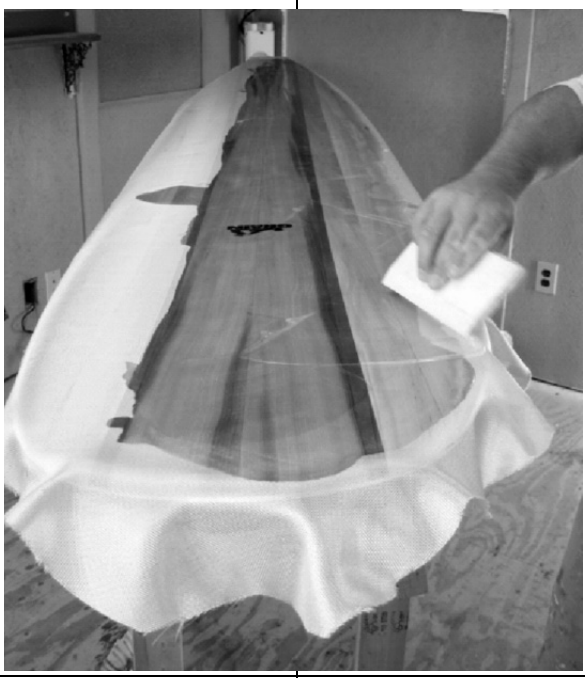


FIGURE 2-11. (right)
Epoxy will try to run off the glass at rails, nose and tail. Approach those areas slowly when pushing pools around.

Step	Action	Result
1.3.17	Some special attention is often required at the nose and tail. You may have noticed that the cloth, although wet, seems to want to lift off of some portions of the board. Press these areas tightly back to the board just at the top of the tape, and hold it there for a few seconds, moving around the rail to be sure there are no other similar spots.	There are no spots along the rail, or at the top or corners of the tail block where the glass is lifting away from the tape.
1.3.18	Check over the whole board one more time - this is your last chance to correct any problems with the graphic, but if you find any places that are still bubbled, or look too dry (these will appear whitish) then you can take care of them now with a little more epoxy. If you have some dregs in your mixing cup that are not setting, you can use them, but mix up a couple of ounces if you need to. Where you see shiny spots, there is still a bit too much epoxy, which you should spread a little more with moderate pressure on the sqeegee.	Things look pretty good, and you can take a minute to be psyched about how great this board is gonna look.
1.3.19	This whole operation is usually over so quickly that you think there must be more to do, but there usually isn't - until about a half-hour to an hour from now. Clean your sqeegee with citrus cleaner, isopropyl alcohol or vinegar (keep your gloves on) and when all the epoxy is off, give it a wipe with laquer thinner. Make sure it is **absolutely clean** - even the sides. Remove gloves and wash with the same cleaners (but NOT the lacquer thinner).	All your tools are cleaned. The glass will set until it is green.

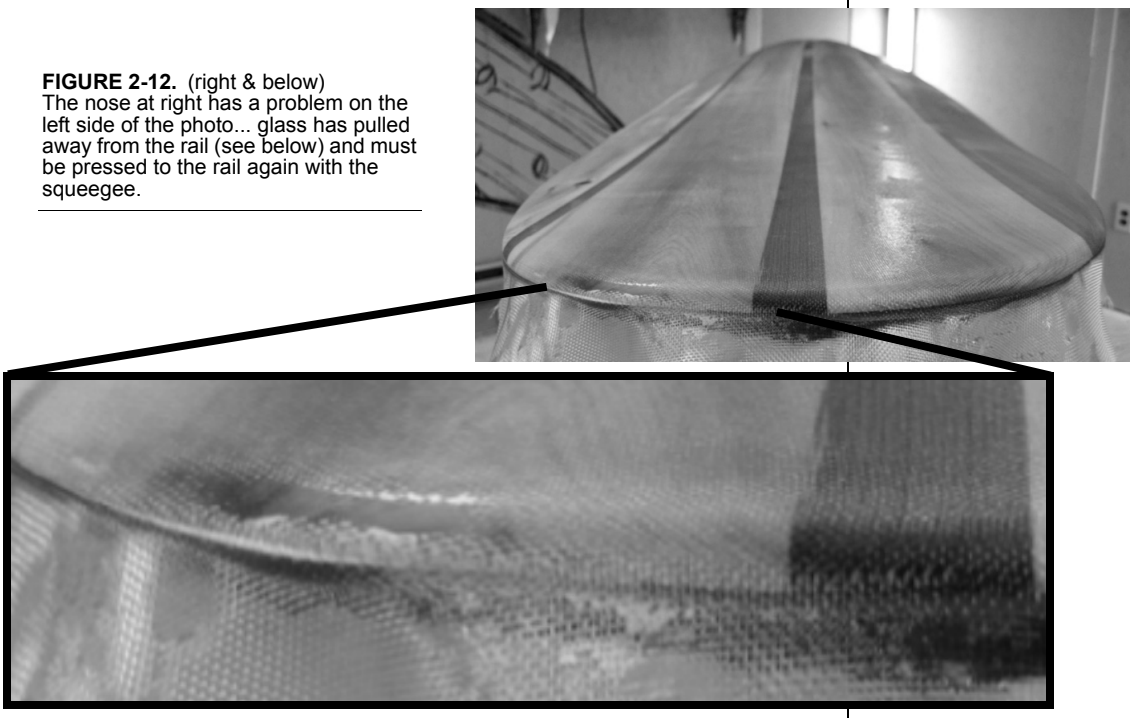


FIGURE 2-12. (right & below)
The nose at right has a problem on the left side of the photo... glass has pulled away from the rail (see below) and must be pressed to the rail again with the squeegee.

Step	Action	Result
1.3.20	Go take a break or start getting ready for the next steps, but check back in after an hour or less. You will look for: 1). Areas that inexplicably look dry which looked perfect before. This sometimes happens where certain parts of the grain are more absorbant and have sucked up more than their share of epoxy. Some of those knots you pretreated may also have taken up more than you thought. Drizzle a little fresh epoxy on these areas, let it soak for a minute, then spread it so that it doesn't look shiny. 2). Areas along the rail where the glass may have popped up again. By this time, you will see that the glass is starting to get sticky. Often, just using a gloved finger to press the glass against the rail is enough to correct the problem, but if you do that, check back in ten minutes to see if everything is OK. The other alternative is to reposition the little clamps/pins to hold things in place.	After inspection, you are confident that the lam coat has no areas that are floating, no bubbles, and no dry, white areas. You are astounded at how gorgeous the grain looks.
1.3.21	Check back every so often - how often will depend on how warm it is in the glassing room. The glass needs to set up a bit so that when we come to the next step, we won't add epoxy when it can't penetrate the glass and float it. You want to catch it when it is still green, because the next coat must adhere to the lam coat with a chemical bond. If it cures too far, then the oppotunity to bond chemically will pass, and you will require a mechanical bond. A mechanical bond means that you need to scuff the surface of the glass with a Scotch-Brite pad to create scratches that will allow the next coat to "grab". Do not use sandpaper - that will expose fibers in the fabric. You will know that the lam coat is ready when you can touch it (on the tape!) without it feeling wet and sticking to your finger. You should be able to press your thumbnail into the glass and see a divit. You can try this trick as well: Brush a cotton ball against the tape area. If the epoxy holds the hair of the cotton ball, you can recoat without sanding.	When the glass reaches the green state, it is ready for the next task, which must be done immediately.

You will return to this Task once (if you haven't already) to do the other side after Steps 2.1 & 2.2 are complete.

END OF "TASK 1, LAMINATE COAT"

TASK 2: HOT COAT

This task must be done at the right time (as noted in the last step). Your window is about fifteen minutes on either side of zero-hour, so be ready on time. The hot coat is the foundation for making the board look perfect, so we will get as good a coat as we can, but plan for inevitable problems that need to be sanded out. The overall goal here is simply to fill the weave of the lam coat with epoxy using enough extra so that we can sand down any imperfections in the coat without reaching the glass fibers underneath.

There are areas of the board on which it will be difficult to keep the epoxy from flowing - particularly around the tightest curves at the nose and the tail. A critical concern is that the epoxy gets worked into the weave. If the epoxy is merely floated on, it may have a tendency to slough off the board and expose the texture of the weave - which is the exact opposite of our goal. Don't touch the surface of the board as much as you may want to - the oils from your hand can cause poor adhesion and disastrous migration of the hot coat.

As with the lam coat, it is important to have all your tools ready before beginning.

Step 2.1: Applying Hot Coat

The glassing room should be as dust-free as possible with minimized air movement. Any contamination in the air from fumes, dust, or forced-air heat can cause problems. If you are using a chip brush or any other type of bristle brush, have your tweezers handy for removing bristles from the coat. Every now and then, check the brush to see if there is a stray bristle about to fall out, and pull it out with your fingers.

We'll concentrate on one square foot at a time during this step. This entire Step will be repeated for the other side of the board later.

Goal: Fill the weave of the lam coat with a thick coat of epoxy that will act as a sanding base.

Step	Action	Result
2.1.1	If you are using a bristle brush, flex the dry bristles aggressively and comb through them with your fingernails to try to break out any loose bristles. We want as few to fall into the hot coat as possible.	The brush will not drop as many bristles.
2.1.2	Mix up another batch of epoxy. You will use about the same amount as was needed for the lam coat. Mixing a little more than you need here is no disaster... if you have an extra ounce, you can float it in with no problem. There is a minimum amount of epoxy that you will need to do a proper job, adding more than you need simply adds weight to the board. If you are not concerned about weight, lay 'er on - it increases the possibility of a coat thick enough that you know sanding will go well.	You have thoroughly mixed at least as much epoxy as you used in the lam coat.

Step	Action	Result
2.1.3	You should be wearing all the appropriate protective equipment. Start at one end of the board and pour on a few ounces of epoxy about a foot from the end. Careful here. Too much, and it will try to run right off the board, and have you scrambling. Brush the epoxy *across* the board in short strokes using some pressure - you are actually working the epoxy into the weave. Keep track of where you are brushing, because you want to work the epoxy in everywhere.	The epoxy is not spread cleanly, there are places where there is too much, but the weave is filled everywhere that you have brushed.
	If you see a "wave" of epoxy that looks like mercury rolling in front of your brush, you may not be working the epoxy into the weave with enough authority. Slow down and brush with forceful strokes across the board. If the epoxy you are pushing in front of the brush starts to look foamy, then you may be entraining air into the coat which can cause a grid of very small bubbles to appear.	
2.1.4	Don't worry about getting things to look smooth and glassy yet - we will brush this coat out in a couple of minutes. Work epoxy down over the rails in the limited area in which you are working. Go heavy on the rails - this is where epoxy tends to slough off...	Some epoxy will drip off the cloth that hangs down, but not so much that you aren't keeping control of it.
2.1.5	Look across the one square foot you just coated and down the rails with light shining from the sides. Brush some epoxy to areas where you see weave showing through, or add more epoxy. If you see any really heavy areas that will run down off the board too rapidly, brush them out so that they are more evenly spread.  **FIGURE 2-13.** (right) Work the epoxy into the weave. You can move quickly through this stage.	There is no weave showing through and epoxy flow off the rails is controlled.
2.1.6	Move up to the next area of the board. You should be working areas of just about one square-foot at a time. Repeat Steps 2.1.3 through 2.1.5.	The weave is being filled one square foot at a time.

Step	Action	Result
2.1.7	Now stroke lengthwise (parallel to the centerline) through the areas you have worked. Brush from where you started up to the dry parts of the board, pulling the excess of epoxy to the wet-edge. If you want a heavy coat, don't press very hard on your brush - if you are trying to go light, use some pressure to move excess - almost as you did with the squeegee in the lam coat. Again, don't worry too much if you have some brush strokes showing - even if they look significant... we will come back to this area later.	The epoxy coat is stroked out more uniformly over the surface of the board - except the rails, where it may be a little heavy in anticipation of it running down.
2.1.8	Repeat Steps 2.1.5 through 2.1.7 until the board is totally coated. Try to have a little epoxy left in your mixing cup at the end.	There is an uneven coat of epoxy over the whole board.
2.1.9	Take a look at all the rails. Find areas where the weave is not completely covered, and use what is left in your cup to fill them if you need to. There should be smooth epoxy (not weave) all down the rail, overlapping the tape edge. The tape edge is a commonly missed area. Look closely.	The tape edge looks wet and bright everywhere.
2.1.10	By this time, the epoxy should be pretty evenly spread over the board with some lengthwise brushstrokes showing. Starting at one end, walk the full length of the board and use the brush in one, long, light stroke all the way to the other end. Go back the other way, overlapping your last stroke. Repeat until the board has been fully stroked out.	Ideally, the remaining brush strokes will level out, but don't worry if there are a few remaining - they are likely to "float" out, leaving a glassy finish.
2.1.11	Now lightly brush all the way around the rails in long, continous strokes. Try not to pick up any fibers from the rough edge of the glass that is hanging down, and stroke *lightly* so that you only even out what is there, without removing any. Remember, this is where the coat will tend to be thinnest.	The coat is evened out along the rails.
2.1.12	Walk all around the board twice, closely inspecting the tape line and the rails. Fix any problems and then stroke them out.	The rails look good - bright tape, wet everywhere.
2.1.13	Take a good look at the surface of the board with light cast from the side before you walk away. If you see any areas where the epoxy has drawn away in a circle from the glass underneath (you will actually be able to see the weave) drip a dollop of epoxy on, but don't bother brushing it out. It will be a little hump when it cures, but it will be easy to sand out - left as a crater, it would mean patching it before sanding. You can even do the same for any little "fish-eyes" that look like miniature craters, only use just enough of a drip to turn them into a pimple.	The board's surface looks mostly glassy and wet and brush-strokes are floating themselves level. There may be some isolated humps and pimples from your fixes, and dust-motes sticking up.
2.1.14	That's it. Toss your brush, dispose of the mixing bucket safely, and leave the area clean. Clean any epoxy off yourself and your tools with citrus cleaner, isopropyl alcohol or vinegar.	Everything is put away and clean. You are pretty psyched at what a good job you are doing.

You will return to this Task once (if you haven't already) to do the other side after Steps 2.2 & 1.3 are complete.

Step 2.2: Trim Tape & Re-prep

All we are doing in this step is getting the board ready for the next step. If you have just finished lam & hot coat on one side, you are prepping to do the other side. If you have completed one-side gloss coat in Step 6.2, you are prepping for the next gloss coat. This step is best done as soon as the glass is set up. It will be very soft and easy to cut through. If you wait a few days, the epoxy is much harder, and this step is more difficult.

This entire Step will be repeated a number of times as you are directed here by the instructions.

Goal: Remove tape from the rails in a nice, straight line, leaving a taper of about 1/8" to 3/16".

Step	Action	Result
2.2.1	If the top of the board has been freshly glassed by the time you reach this step, re-drill the 1/8" vent hole that you put into the board in Step 9.1.15.	The board can vent as it heats and cools through the 1/8" vent hole drilled earlier.
2.2.2	Take the board out of your dust-free glassing room and slot it into a shaping stand with one rail up. If there is glass hanging down from lam & hot coat, be careful not to catch it on anything while moving the board around.	The rail is face up where you can see it, and no glass has been torn from the rail.
2.2.3	With a razor knife, very carefully cut a line around the perimeter of the board right at the upper edge of the tape. Don't cut deeply - you don't want to cut into the wood beneath the glass. As you cut, you can pull gently on a loose end of the part you are cutting off which allows the knife to cut under pressure and makes the job go more quickly. It takes less pressure then you think as you really only need to nick the glass strands and they will tear off like perforation. You really want to pull the tape and the excess glass in one long strip together. Use care around the hard corners of the tail and the nose... it will be easy to slip there, and don't want to accidentally scar the board with the knife blade. If there are bits of tape still under the very lip of the glass, don't worry. You will get them out in another way. If you are installing a standard fin-box with drill bits and chisels (as opposed to using a router) and you have just hot-coated the board's bottom, then this is a good time to also do Steps 3.1.1 through 3.1.5 because the glass is nice and soft and easy to cut right now.	A clean line is cut at the tape line, with no stray knife marks. There may be tiny slivers of tape here and there under the edge of the glass.

FIGURE 2-14. Trim the tape (and glass if any) carefully. Don't cut into the board beneath.

Step	Action	Result
2.2.4  	It is useful to taper off this slight edge - especially if you are doing this step after lam & hot coat. You can use a hard (hard!) block with some 120-grit sandpaper on it to sand just the edge. If you had slivers of tape under, you want to sand until these are gone. One other great tool to use is a scraper. With it you can quickly move around the board and scrape the taper right into the edge, removing all the stray tape at the same time. Greater control may be had by using a fine-cutting file or rasp. Don't contact any soft wood that may be showing below the taper. This is where blue-colored tape really helps - it sticks out like a sore thumb and is easier to see. Green and manila colored tapes are harder to see and it is easy to miss them - which is no good because you will be glassing over this edge in the following steps, and then it's permanent! **FIGURE 2-15.** Taper the glass at the edge.	A taper at the edge of the glass will be about 1/8" wide, and will allow the next layer of glass and/or epoxy to lay over without creating a hump.
2.2.5	Check over the whole tape line looking for slivers of tape, and to be sure that you have tapered it everywhere.	The tape is entirely gone and the line is tapered.
2.2.6	If you have reached this point after your SECOND HOT COAT, go on to Step 2.3.	
2.2.7	If you have reached this point after your SECOND GLOSS COAT, go to Step 6.4	
2.2.8	If you have reached this point after your FIRST HOT COAT or FIRST GLOSS COAT, complete this Step (Step 2.2).	
2.2.9	Now we need to protect the glassed side of the board (the top) with masking tape. Instead of applying the tape at the tangent point of the rail, this time put the edge of the tape right at the edge of the taper you made in Step 2.2.4 **FIGURE 2-16.** Tape so that the taper is exposed.	Reapplied tape allows the next lam coat to overlap the first lam coat, but protects the existing glass from drips.
2.2.10	If you have reached this point after your FIRST HOT COAT, go to Step 1.1.7.	
2.2.11	If you have reached this point after your FIRST GLOSS COAT, return to Step 6.2	

Step 2.3: Hot Coat Sanding

This step is in preparation for the gloss coat. The gloss coat will fill in all the scratches from the sanding we do here. What we need to do now is take all the blemishes out of the surface of the board. Anything we miss here would have to be filled in the gloss coat - which is do-able, but there is no guarantee that the gloss coat will fill in what you miss. Be thorough.

The set-time for the hot coat will make a big difference in how well it sands. The sooner you do it, the "greener" and softer the coat is. That's bad - soft epoxy makes the paper gum up easier, and allows deeper scratches to be put into the board. An extra day makes a really big difference. Green epoxy is also more dangerous to inhale and even the dust that is left on the floor becomes airborne when you shuffle your feet around in it. ALWAYS wear a respirator in any room that epoxy has been sanded in until the entire room - walls, floors, stands and tools - has been thoroughly vacuumed and cleaned up.

You may also feel it is worth the investment to get more expensive sand paper. The 3X series of papers made by Norton is excellent - it lasts longer and does not gum up as quickly.

Goal: Fully sand the board without exposing any glass fibers, removing all irregularities in the surface, including waves, dips, and craters.

Step	Action	Result
	The board should have no tape on it, and the last hot coat should be tapered off at the rails (see Step 2.2). This means that we don't really need to sand at the lap line. In fact, the rails altogether must be approached carefully, because it is very easy to sand through the epoxy to the cloth underneath where the sanding pad connects with only a small part of the rail at a time (because of the curve of the rail - which is the same idea that worked in our favor when tapering the edge of the glass - see Figure 2-15).	
2.3.1	Inspect your hot coat with light cast from the side of the board. You will probably see many imperfections in the coat. This is normal. If you had a rare bonus hot coat which looks glassy and perfect, you may be able to get away with very little sanding and can use only 220-grit sand paper for this step. If that is the case, all you need to do is scratch up the surface everywhere, dulling the entire board so that the gloss coat (Step 6.2) can grip. Use an 8" hand-sanding pad, and start with the surfaces, staying away from the rails.	
	As you are sanding, be vigilent in looking for the tell-tale cross-hatch pattern of the glass cloth. It will become barely visible before the cloth actually becomes exposed, but any more sanding at all will go through to it. Once you are through, the glass often won't easily go transparent with subsequent coats as it is supposed to because it doesn't soak up the epoxy as readily now that it has set. If you post-cured the board then there is likely to be weave print-through all over the surfaces. You will be sanding the *tops* of that print-through pattern off in an attempt to make the surface level and smooth. There is additional danger in exposing weave in these instances... use care.	

Step	Action	Result
2.3.2	More than likely, you will need to use 120-grit paper to get the worst problems evened out. It is possible to use a random-orbital sander to get the worst of this taken care of, but be aware that it is extremely easy to accidentally sand through to the glass cloth with power sanders and a light touch is required. If you use a power sander, also be careful not to create more problems by over-using the edge of the pad. This creates "waves" in the board that will show up when the gloss coat is put on. The safest plan is to go over the whole board with a fairing board or an 8" hand-sanding pad. Sand in lengthwise strokes with the intent of making a smooth surface with no waves, with all the little craters and fish-eyes removed. Some Grain builders go right at it with a light hand and 80-grit paper when there is alot to do, but starting with 120-grit is typical to better identify where all the problems are, then return to bad problem areas to sand them level with 80-grit (or for a bit longer with 120 grit). Stay away from the rails for now.	The surfaces (i.e. not the rails) of the board are sanded level, clear of fish-eyes and without waves. When wiped, you can see no shiny spots where you have sanded.
	The trade-off in using coarser grit papers is that, although you can progress more quickly, you may generate deep scratches in the finish that have to be taken out later, and can more easily expose cloth. If you choose to use 80 grit, don't bear down so hard that you create deep scratches anywhere. The gloss coat should fill the finer sanding scratches, but depending on how heavy you put it on, it may not fill everything reliably.	
2.3.3	Now inspect the rails - you may want to slot the board with the rail up to be able to see better. Drips are more likely to have happened in this area, but they can usually be whipped down pretty quickly. Using 80-grit anywhere on the rails is dangerous work, and is not recommended. If you have a few spots where there are drips or runs, use a hard block and 120-grit or 220-grit paper to focus tightly on them until they are levelled out. Don't concentrate on one area too long, because the rails usually have the thinnest amount of epoxy over the weave, and you will expose cloth very quickly.	You have completely removed whatever drips or runs that you can see.
2.3.4	Sand the remainder of the rails with a sponge-sanding pad - you can wrap fresh sandpaper around them, and keep them forever. The sponge-pad is so soft that it will wrap around the rail and not focus the sanding on only the tangent point of the rail. If any problem spots show up as you sand, consider switching to a hard block that can focus on drips, dips or waves.	The rail is a uniformly curving surface sanded out with no drips or fish-eyes remaining.
2.3.5	Once the rails look uniformly curved, with no waves or drips, you are done. If you haven't done it already, sand out all the heaviest scratches with 120-grit or 220-grit with paper used in your hand (no pads, blocks or sponges). You will feel any subtle problems with your palm that you may not have detected otherwise. Wipe the board down and look for anything shiny, then sand out those shiny spots. Remember not to oversand.	The entire board has been sanded to at least 120-grit.

END OF "TASK 2, HOT COAT"

FINS & HARDWARE

Before applying the gloss coat, we will install all the fins and hardware. The gloss coat will in part help to finish off the areas with hardware, filling gaps in the epoxy we use to mount the hardware, and blending in additional glass used to mount glass-ons (if any) etc.

Throughout all of the tasks in the Fins & Hardware section, the board should be well-weighted on the shaping stand. This is a standard for protecting the board from accidents, but also is required to ensure that you have a steady work surface.

Hardware includes fin-boxes which can be of almost any type. Grain uses standard longboard fin-boxes and FCS fin-boxes. Fins can also be glassed on.

Leash cups are hardware used for attaching a small cord that a leash can be attached to. There is also the option of creating a glassed-on leash loop, or drilling a hole through the bottom of standard fin-box slots and up through the deck (requires an oversized hole filled with epoxy first to seal the hole). That treatment is no longer used at Grain. Purists sometimes do not bother with a leash attachment of any kind.

Vent hardware is needed for all hollow boards because the air inside expands and contracts with temperature. For instance, if the board sits in the sun for more than a couple of minutes, the air will heat up and expand. If it expands too much, the pressure generated will try to blow the board up like a balloon, potentially causing the planks to actually pop free of the frames. There is no easy way to fix this, so the vent screw should be left out of the board any time it is not in use.

TASK 3: STANDARD FIN-BOX

The standard fin-box is included with all long board kits and the Paipo kit. It is not mandatory that these boards receive standard fin-boxes though - they may get glass-ons or other types of removeable fin systems.

The standard fin-box is designed to sit in a slot in the board that is slightly longer, deeper, and wider than the fin-box - but not quite as wide as the little tabs that stick out the side. The tabs rest on the bottom surface of the inverted board to ensure that the fin-box is level with the bottom. Once the epoxy that sets the fin-box is set, they - and the “curb” that prevents epoxy getting into the slot - gets ground off.

The epoxy that we will use to set the fin-box needs to have space to be effective. In other words, the fin-box should not fit tightly into the mortise or the epoxy will not be strong enough.

Don’t worry if there are some tabs missing from the fin-box - as long as it can be supported in the board or you can devise a way to support it.

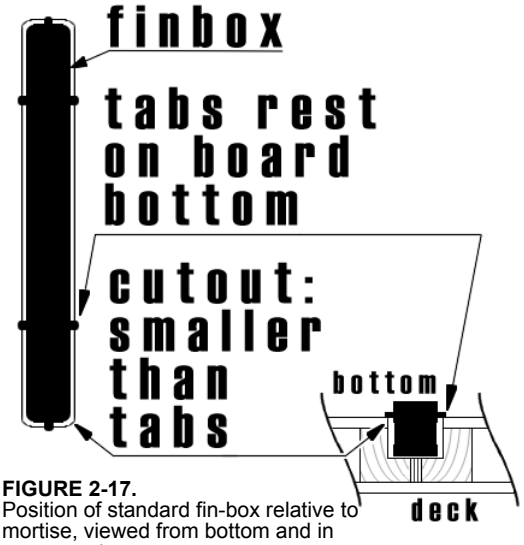


FIGURE 2-17.
Position of standard fin-box relative to mortise, viewed from bottom and in cross-section.

Step 3.1: Position fin-box

If you are installing a center-line fin-box, you would have placed blocking back in Step 7.1. If you have not installed that blocking, your options are limited, and you should probably consider a glass-on. You should also have thought some about where you want to locate the fin already, so refer to your notes or your photograph of the board's interior before continuing with this step.

Goal: Place the fin-box in the proper location for the board.

Step	Action	Result
3.1.1	Locate the centerline of the board in the area in which the fin-box will be installed. If your frame was well centered on the bottom planks, then the center will be the center seam, or the middle of the center plank (if there is no center seam). Mark the centerline (or use the seam if there is one).	The centerline is clear on the board in the area in which the fin-box will be installed.
3.1.2	Mark the distance from the tail, and from that mark, the length of the mortise you will be cutting. Then mark the width of the mortise, and draw two lines at that width parallel to - and centered on - the centerline. See Figure 2-17 for details on the size and relationship of the mortise to the actual size and position of the fin-box. Remember that the mortise will be both longer and wider than the fin-box itself - but not wider than the tabs that need to hold the box in place. For a standard fin-box (1" x 1") the mortise will never be greater than 1-1/8" wide.	Pencil lines indicate the exact outlines of the mortise.
3.1.3	Refer to the notes or photos you made in Step 8.5.1. Will your marks correspond to the location of the blocking you installed? You are limited by that blocking and must install the fin-box entirely within it. Alter your marks if there is a problem.	The fin-box mortise will land entirely within the previously installed blocking.
3.1.4	Place the fin-box inside your marks to be sure everything looks right. Correct the lines if the marks are not correct.	You have confirmed your measurements.
3.1.5	If you will be using a drill and chisels to make the mortise, then use a metal straight-edge (clamped or held by a friend) and score the glass along the parallel lines. If you are using a router, then the pencil marks are adequate.	The glass fibers have been scored through so that the drill bit and chisel will not tear them and make a nasty edge.

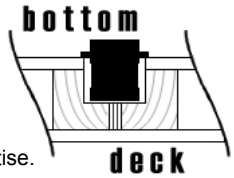
Step 3.2: Plow Fin-box Mortise

How this step is accomplished depends entirely on your choice of tools. The preferred methods are with a router (requires guides or a template), or with a drill and chisels.

During the actual cutting, confirm that you are not opening up any holes all the way through the internal blocking to the inside of the board. If you do, you may have the mortise laid out in the wrong place. If this happens, confirm your location marks. On boards with thinner tails, you have to be extra careful that you don't cut the mortise all the way into the top planks.

Goal: Plow a mortise in the bottom of the board that is entirely within the blocking installed in Step 7.1 and on the marks made in Step 3.1.

Step	Action	Result
3.2.1	Determine which method you plan to use for installing the fin-box. Using a drill and chisels involves drilling a series of holes the depth of the fin-box - overlapping as much as the bit will allow you to, then cleaning out the remaining waste with chisels. If you are planning to use a drill and chisels, obtain a 3/4" or 1" forstner bit. Complete Steps 3.2.2 through 3.2.8.  Spade bits are dangerous because their center points can drill through to the top of thinner boards - they are for rough boring, and **are not recommended**. They are also harder to control when drilling overlapping wasting holes such as we will be doing.	You understand the methods outlined in this step, and have selected one that is consistent with your skills.
3.2.2	Set the board on the shaping stand bottom up and shim it with something so that the tail of the board is as level in both horizontal dimensions as you can get it. Weight the board well.	The board is secure and oriented so that it is easy to see if the bit is perpendicular.
3.2.3	Chuck your bit into the drill. You can mark the drill shank with a piece of masking tape at the correct depth - usually just a hair over 1".	There is a guide that will help keep you from drilling too deeply.
3.2.4	You will be trying to drill into the bottom of the board at a perfect right angle. It helps to have a friend eyeballing the shaft of the bit to keep you at the correct orientation as you drill. Start drilling at the front of the mortise. Make sure that the edge of the bit doesn't cross your forward line or either of the side lines. You can use a bit as large as 1-1/8" (gutsy), but that means that you need to drill dead-on the center line. If you are using a smaller bit, you can align the side of the bit so that it will cut just inside of one of the side-lines you scribed. Don't hurry.	The bit is perpendicular to the board's bottom, and within the lines marked.

Step	Action	Result
3.2.5	Stop drilling at the right depth. Withdraw the bit and move it down the mortise - align it closer to the opposite side if your bit is less than 1-1/8". Overlap with the previous hole as much or as little as you want as long as the centering point is inside the new hole, not the last hole. Overlapping holes more makes less waste for the chisel to remove, but it is harder to control the bit the more the holes overlap - which can cause you dig into the sides of the mortise a bit.	You have a hole that is about 1" deep, and within the lines marked.
3.2.6	Continue to drill holes until you are at the rear of the mortise.	A series of overlapping holes is drilled within the lines of the mortise, all approximately the same depth.
3.2.7	You may find it easier to slot the board into the stand with one rail up during parts of this step. Use a chisel to cut drill-waste from the sides of the mortise. Stay just inside the line - we will trim to it last. You may find it easiest to remove material from the center first and work your way to the sides. Save the top edge along the scribed line till the very end, as your chisel is sure to bump against it as you work and you want it to end up clean and beautiful. Don't worry if you undercut the mortise a little - in other words, the sides can slope away from each other as they go down - this will actually help hold the fin-box in place.	The bulk of the boring-waste is removed, and the sides are nearly trimmed approximately square to the bottom.
3.2.8	Finally, sharpen your chisel, and slice carefully along the top edge of the mortise to clean to the line itself.	The line is clean, straight and there are few glass fibers showing white at the edge.
3.2.9	Now dry-fit the fin-box itself into the new mortise. If it doesn't fit as it is supposed to, make necessary adjustments.  **FIGURE 2-18.** (right) fin-box fits loosely, with tabs suspending it off of the bottom of the mortise.	The fin-box should rest positively on the six tabs that stick out when centered in the mortise, and the bottom of the fin-box should not touch the bottom of the mortise.
3.2.10	Remove the fin-box and examine the mortise interior. If there are any gaps that look like they could be open to the board interior, fill them with something that will prevent epoxy from running into them - super-thick epoxy putty, or some fast-acting thick filler. Be careful not to get any foreign matter smeared onto the surfaces inside the rest of the mortise - it will prevent the epoxy from adhering.	There is no avenue for the epoxy that will hold the fin-box in place to drain into the board interior.

Step 3.3: Install fin-box

If you have FCS fins to install along with your standard fin-box, you may want to skip up to Step 4.1 now to drill the holes, then return here to complete this step and "Step 4.2: Install FCS Fin-box" at the same time so that you can both prep the board, *and* mix all the eoxy for both jobs at once.

Goal: Install the fin-box with a slight overflow of thickened epoxy with no drips on the surface of the board.

Step	Action	Result
3.3.1	Take one more look at the bottom of the board and erase all marks on fiberglass or wash it with denatured alcohol.	There are no marks that will get trapped under coatings of epoxy.
3.3.2	Tape off the board so there's no chance of dripping epoxy on the completed hot coat. Tape close to the edge of the mortise you just created, and tape a layer of wax paper, multiple layers of newsprint, or some other sheeting over the rest of the tail to catch the inevitable drips. If you want to be extra safe, you can tape the slot in the fin-box where the fin will go so that no epoxy can drip in.	The tail of the board is protected, and you have a place to set down your glue pot.
3.3.3	Don your safety gear, and mix up a small batch of epoxy. After it is mixed, fold in some wood flour (such as you might get from a sander) or cabosil until the mix is like a thin applesauce.	The mix has aggregate that makes the epoxy stronger.
3.3.4	Dump the epoxy into the mortise until it is about half filled, then set the fin-box into the mortise, centering it until it rests on the tabs at the sides and ends. There should be some squeeze-out, but if there isn't and you can see epoxy all around the sides of the fin-box part way up, then you are still fine - the rest will fill with the gloss coat.	The epoxy should rise up the outsides of the fin-box, with no appreciable air cavities within it. It may or may not reach the board bottom.
3.3.5	Using some masking tape, tape across the fin-box - near both its ends - with the tape extending to the rails to hold the fin-box in place. If you see any bubbles or voids, use a toothpick or a pin or anything that is totally uncontaminated to stir around a little in the epoxy as long as you can do it without messing up any of the alignment. You want to see if you can work out any bubbles or voids so that they don't become a problem later. Let the fin-box set until the epoxy is firm and holding.	A small amount of pressure is required to hold the fin-box down, and to prevent it shifting from side to side as it cures.

END OF "TASK 3, STANDARD FIN-BOX"

TASK 4: FCS FIN-BOXES

This task is typical for multi-fin boards with removable fins. A prime concern is that the FCS fin slots align, and that they are exactly the correct distance apart. FCS fin-boxes are often used on twins, thrusters, and 2+1 setups.

Before beginning, you should have in hand an FCS fin - preferably the size you will be using - or an FCS fin-box placement jig.

Step 4.1: Drill FCS fin-box Holes

You may be installing FCS fin-boxes on the centerline or near the rails, or both. In either case, there should be adequate blocking in place to support the boxes, and marks on the bottom of the board indicating their location. If there are no marks signifying the center of the fin-box blocking, then consult with the notes that you made in Step 8.5.1.

Goal: Drill loose holes sized so that fin-box tabs suspend fin-boxes, and fin-boxes do not bottom out.

Step	Action	Result
4.1.1	If you already made marks on the bottom of the board indicating where the center of the fin-boxes should go, then confirm their location with an FCS installation jig, or the fin itself. For side-fins, ensure that the marks are symmetrical with those on the other side of the board and make any necessary adjustments. If there are no marks, refer to the notes or photos you made in Step 8.5.1. to locate the blocking you installed in "Step 5.2: Installing FCS (side-fin) Blocking" or "Step 7.1: Centerline Fin-boxes". You are limited by that blocking and must install the fin-box entirely within it. Alter your marks if there is a problem. When the locations are confirmed, use an awl to create a dimple in the board at the exact center-point of every FCS fin-box location.	There are small pimples in the glass that the Forstner bit center points can register on which represent the exact center of the fin-boxes and the approximate center of each fin-box blocking.
4.1.2	Take one more look at the bottom of the board and erase all marks on fiberglass or wash it with denatured alcohol.	There are no marks that will get trapped under coatings of epoxy.
4.1.3	Before drilling the holes, put masking tape right over the center-points that you marked with the awl or with a pilot hole. Locate the center-points through the tape and poke the spot. Continue taping all around the area - 2" tape works well, but you can use any masking tape and just overlap it a bit. You should have tape covering at least an inch on either side of your marks. It also helps to tape wax paper down over the area between the fins and even as far as the tail and hanging over the rails. It is easy to drip epoxy unintentionally, and cleaning up the cured drops takes time and can be damaging to your hot-coat.	The hot coat is protected from epoxy drips.
4.1.4	Lay a ruler over the tape so that you can draw a line with a fine point pen right through the centers of the points you marked onto the tape. Let the line extend for an inch in front of the forward mark, and an inch behind the rear mark. Do all your FCS marked pairs the same way. This is important.	You have struck a line that represents the center-line of the fin-tabs.

Step	Action	Result
4.1.5	**This is it. All the care in measuring and marking comes down to this moment. Take your time and get this right.** Chuck a 1-1/8" forstner bit into a drill and carefully place the center of the bit onto one of your marks. Drilling slowly and with the shaft of the drill perpendicular to the board's bottom, drill through the tape and into the board. Use a firm hand and don't let the bit wander at all - you need this hole to be very clean at the edges. Until you have broken through the glass, this isn't about pressure on the bit, it is about keeping it steady and turning without wobble. Once the hole is well along you can stop and test the depth as often as you need to in order to drill to the depth of the FCS fin-box as shown in Figure 2-19.  **FIGURE 2-19.** FCS Fin-box positioning guides - relation to hole, blocking and bottom.	The FCS fin-box fits in the hole with its positioning guides setting on the board bottom, and the base of the fin-box suspended above the bottom of the hole. Masking tape goes right up to the edge of the hole. When you look down into the hole, you should see only solid blocking - not the interior of the board.
4.1.6	Complete the drilling of all your holes. Be careful and do it right. If you found that first one too scary, you can hedge your bets by pre-drilling a 1-1/8" hole in one of your planking offcuts, and clamping that offcut onto the board bottom with the awl-mark EXACTLY in the center. If it is clamped really well, and can't shift about, it will keep your bit from wobbling when you are getting the hole started. This doesn't work well with spade bits, but works great with Forstners.	You will have four (4) 1-1/8" holes (eight for a quad set up of FCS fins, six for a thruster, etc)
4.1.7	Dry-fit all your fin-boxes into the resulting holes. The holes will be a little sloppy (that is good) and you will be able to shift the fin-boxes around a bit. Make sure that you can line all the fin-box slots up with the centerline you drew on the tape with your pen. The positioning guides should land right on the lines. To be extra sure, lock the fin-boxes onto your installation guide or the fin you are using by slightly tightening the set screws, and set the whole assembly in place with all the guides on the lines. If it looks good, go on. If not, you have to decide whether to live with it, or wheather to out-size one or more of your holes to get things to line up.  **FIGURE 2-20.** It is critical to line up positioning guides with line on tape. Fin-boxes don't have to be centered in the holes.	Using a fin or positioning guide helps to ensure that everything lines up beautifully without having to tip or twist hardware.

Step 4.2: Install FCS Fin-box

Even now, after all the measuring and checking, care needs to be exercised when setting the fin-boxes. The fin-boxes will be loose in the holes that you drilled for them, and if they didn't quite line up with your marks as expected in Step 4.1.7, you may have oversized one of the holes to as much as 1-1/4". When actually setting the fin-boxes in for good, you will need to be sure that they are shifted to the proper position within their holes.

Goal: Epoxy the fin-boxes into the loose holes made for them so that they are perfectly aligned, and the correct distance apart with minimal glue squeeze-out.

Step	Action	Result
4.2.1	Examine the interior of the holes. If there are any gaps that look like they could be open to the board interior, fill them with something that will prevent epoxy from running into them - super-thick epoxy putty, or some fast-acting thick filler. Be careful not to get any foreign matter smeared onto the surfaces inside the rest of the mortise - it will prevent the epoxy from adhering. Let cure.	There is no avenue for the epoxy that will hold the fin-box in place to drain into the board interior.
4.2.2	If you haven't already, fit the FCS fin-boxes onto the FCS template guides or onto your fins and lightly tighten the set screws. Look at the surface of the fin-box. You want the side-fins to use fin-boxes with an "R" (for "rail") stamped on them and fin-boxes that will go on the centerline to have a "C". Center-fin fin-boxes will be set with one set screw on each side of the fin. Rail fin-boxes have arrows that point to the rails. Bummer if you get this wrong, because your fins won't fit right. **FIGURE2-21.** R or C? 	Fin-boxes are locked onto positioning templates or actual fins, with set screws of rail-boxes inboard (flat side of fin) and center boxes on alternate sides.
4.2.3	Mix some epoxy with hardener. You will need less than four ounces. AFTER it is mixed, add cabosil or very fine wood dust until the mix has the consistency of a thin paste. Cabosil is dangerous - use a respirator and mix it in a well-ventilated space. Have a a few 18" strips of 1" masking tape ready, and hanging off the side of the board.	You have a thickened adhesive with gap filling properties.
4.2.4	Pour some of the epoxy into the holes - about a third full.	You don't want a ton of epoxy to gush out when you set the fin-boxes.

Step	Action	Result
4.2.5	Start with one set and slowly press it down into the hole so that the positioning guides make contact with the tape on the bottom of the board, and are exactly on the lines you penned onto the tape. You want the fin-boxes to sit so that their up-sides (with the slot and set screw) are *parallel* to the surface of the board. Your fins should have all the cant built into the tabs, so there's no need to angle the fin-boxes in any way. Use long strips of masking tape to secure the fins at the correct angle. Don't worry if the epoxy does not spill out of the hole onto the board's bottom. We can fill the remaining bit with epoxy from the gloss coat.	Two fin-boxes are installed with one of the fins. No epoxy has spilled into the "well" that contains the slot and set-screw. A small amount of epoxy may have pushed out onto the tape covering the board's bottom.
4.2.6	Do the other fins. Use a toothpick or a pin or anything that is totally uncontaminated to stir around a little in the epoxy as long as you can do it without messing up any of the alignment. You want to see if you can work out any bubbles or voids so that they don't become a problem later.	The positioning guides are on the tape and on the penned line. The up-side faces are parallel to the board bottom. The epoxy is free of bubbles and voids.
4.2.7	Check everything to be sure it all lines up as intended. If it all looks good, wipe up any spills or minor drips that are on the board, and check to see if your hands touched the deck of the board and smeared epoxy on it. Cleaning that stuff now will prevent damage and save time later.	The positioning guides or fins slotted into the curing fin-boxes are held securely in place. The board is clean.
4.2.8	Return all tools and make sure there is no epoxy on them.	Tools are where the next guy can find them.

FIGURE 2-22.
FCS placement jigs holding new finboxes in place. Longboard finbox also shown clamped in place.

END OF "TASK 4, FCS FIN-BOXES"

TASK 5: VENT & LEASH CUP

These fittings are easy to install. There should already be blocking inside the board to support them, but in the event that it was forgotten or can't be located, there are alternatives in how these features are installed.

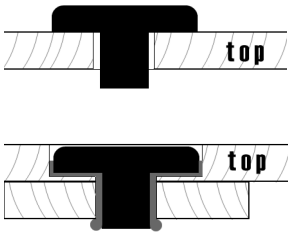


FIGURE 2-23.
Vents: surface mount (top) and flush mount (bottom).

The vent can be surface or flush-mounted. If there is no blocking, it must be surface mounted which can happen anywhere there isn't a frame or other obstruction (see Figure 2-23.) Though some instruction is included here, surface mounted vents don't get drilled or installed until after the board is nearly complete.

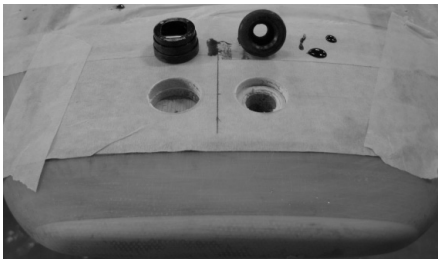


FIGURE 2-24.
Leashcup & flush mount vent ready to be installed.

This task will cause the vent to be either flush- or surface-mounted, and a leash cup will be installed. These are visually strong elements, so we will want them symmetrically installed, a decision which was made in Step 7.2 when the blocking was installed.

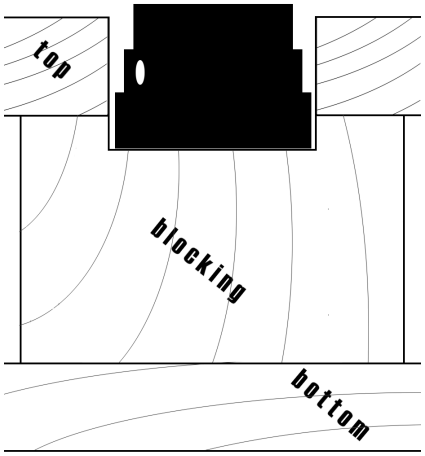
Step 5.1: Drilling for the Vent and Leash Cup

You should already have a small hole where the vent is to be located so that the board can breathe. This hole is your center mark for drilling, and should be pretty near the center of the blocking. If you need to correct the location of the vent at all - for symmetry with the leash cup for instance - you may shift it as much as 1/4" in any direction without any problem because the vent hole we will drill in this step will be only 5/8" in diameter.

The leash cup on the other hand, must have blocking and your hole must end up completely on the blocking so that you don't open a path to the board's interior.

Goal: Prepare for installation of leash cup and vent.

Step	Action	Result
5.1.1	Locate the vent hole that you already drilled into the board. Measure out and mark in pencil a symmetrical location for the leash cup. You are limited to those locations where you know that there is blocking. Refer to your notes or to photos of the interior which you may have taken (back in Step 8.5.1). Confirm that the location that you have marked has blocking behind it. Shift the mark (no more than 1/4" in any direction) if you need to in order to be sure that it is on the blocking.	There is a pencil mark that is near the center of the leash cup blocking.
5.1.2	Back to the vent mark: Make sure that its location is symmetrical in some way with the leash cup mark (see Step 7.2 for a discussion of hardware location.) If it is not aligned properly, make a new mark that is aligned.	The leash cup and vent mark are evenly aligned.
5.1.3	Use an awl to create dents on the two marks.	You have a point that will help to register the drill bit.

Step	Action	Result
5.1.4	Before drilling, put masking tape right over the points that you marked with the awl. Locate the holes through the tape and poke the spots. Continue taping all around the area - 2" tape works well, but you can use any masking tape and just overlap it a bit. You should have tape covering at least an inch on either side of your marks. Rub the tape down well to make sure it is sticking. It also helps to tape wax paper down over the general area and even as far as the tail and hanging over the rails. It is easy to drip epoxy unintentionally, and cleaning up the cured drops takes time and can be damaging to your hot-coat.	The board is protected from drips and epoxy squeeze-out, with the centers of the holes we plan to drill marked through the tape with awl-marks.
5.1.5	Chuck a 1" Forstner bit into a drill and carefully place the center of the bit onto the leash cup mark. Drilling slowly and with the shaft of the drill perpendicular to the board's bottom, drill through the tape and into the board. Use a firm hand and don't let the bit wander at all - you need this hole to be very clean at the edges. Until you have broken through the glass, this isn't about pressure on the bit, it is about keeping it steady and turning without wobble. Once the hole is well along you can stop and test the depth as often as you need to in order to drill almost to the depth of the leash cup. You will want the leash cup to extend above the surface of the board about 1/16" - we will grind it off later.  **FIGURE 2-25.** Leash cup should stick up about 1/16". If you bore too deep, you will need to fill the bottom with thickened epoxy - which is fine, but takes a little more time.	Tape protects the board from the epoxy we will use to install the leash cup, and the hole is deep enough that the leash cup, dry-fit, will stick up just a little.
5.1.6	Now we will drill out for the vent. **If you are surface-mounting the vent (see Figure 2-23) then skip to Step 5.1.7.** Flush mounting requires blocking (already in place) and the 1" Forstner bit. Centering the bit in the awl-dent, again drill through the tape with care - we still want a clean hole. Drill only to the depth of the vent fitting flange - or a hair more. Three-sixteenths inches (3/16") is bordering on too much. With the plug removed, you can use the vent fitting inverted to check the depth - when the flange is just below the surface of the glass, you have drilled far enough.	There is a 1" hole less than 3/16" deep symmetrical with the leash cup hole.

Step	Action	Result
5.1.7	Switch to a 5/8” bit - any type will do, but you will find that a bit with a center-point is best - i.e. a Forstner, spade, or brad-point bit. This is because the next hole needs to be almost exactly centered on the 1” hole we just made. Center the bit in the bottom of the flange (or on the awl-mark if you are surface mounting) and drill the hole carefully all the way to the interior of the board. You will be dropping chips into the board in this step which is not great because they will knock around in there pretty much forever unless you get them out. Two things can save you a little time: 1.) Go slow at the end, and try to leave the last chip(s) stuck to the inside of the planks as the chip(s) start to splinter away inside. Any chips hanging right at the inside of the hole, can often be pulled out with some tweezers or a needle-nose plier. 2.) Have a vacuum running with the nozzle pointed at the hole as you drill so that almost all the chips are sucked up instead of falling down into the board.	A 5/8” hole is drilled through the planks from the top to the interior.
5.1.8	After the hole is complete, set a vacuum nozzle right on top of the new hole to suck out any chips that got into the board. Take a careful look to see if you missed any, and picking up the board move it around a little to see if you can hear a loose chip. Now is the time to get it out. Good luck - it’s a pain.	The interior of the board is clean with no chips knocking around as a result of drilling.

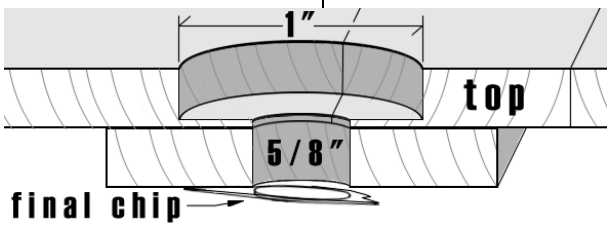


FIGURE 2-26. Holes for the vent that will allow flush-mounting. Surface-mount would have only a 5/8” hole and no backing pad

Step 5.2: Install Vent & Leash Cup

Optimally, the epoxy bonding the leash cup cures with the leash cup hole facing up, so that the epoxy can float bubbles to the top, and all the epoxy stays in the hole. Conversely, the epoxy bonding the vent cures with the vent hole facing down because the flange holds epoxy in, and with the board inverted, the epoxy pools around the inside of the vent instead of dripping uselessly into the interior. If the vent is mounted on the bottom, do it first, then immediately invert the board and do the leash cup. In all cases, begin at Step 5.2.1.

The instructions below assume that the vent and leash cup are both being mounted on the same side of the board and that you want to do them both at the same time. But if you have the time, do these separately letting each cure independently so that you can let them cure in their best orientation.

Through this step and during the gloss coat, it will be *really important* not to let any epoxy get into the openings of the vent or the leash cup.

Goal: Both the vent and leash cup get installed with epoxy, with marginal amounts of squeeze-out that do not get inside the pieces of hardware.

Step	Action	Result
5.2.1	Remove the vent plug from the vent, and set the plug aside with its O-ring. Using some 120-grit sandpaper, rough up the surfaces of the vent and leash cup that will come in contact with epoxy. This means the sides and bottom of the leash cup, and every outisde surface of the vent - including the top, sides and underside of the flange. Wipe them down with de-natured alcohol.	Release oils and waxes from the molding process get sanded off and the epoxy will have scratches to bind to.
5.2.2	Mix a batch of epoxy, and thicken it with wood flour or cabosil to the consistency of a wet putty. You need a small amount - only a few ounces.	The epoxy is ready for use.
	There should still be tape and paper protecting the surfaces of the board you are working on. We will start with the leash plug (Step 5.2.3) because installing the vent second allows us to invert the board as soon as the vent is installed so that epoxy will not drip out of the hole into the board. This makes a more reliable bond. Again, it is preferable to let the leach cup cure face-up *before* installing the vent. If the vent is going on the bottom, do the vent now (Step 5.2.6) and once the board is inverted, come back to Step 5.2.3 to install the leash cup.	
5.2.3	Dry-fit the leash cup one more time... if the hole is too deep, remove the leash cup and get a little chip of wood that is tall enough to shim the leash cup so that it is is sticking up above the top planks about 1/16”. Pour or scoop thickened epoxy into the leash cup hole until it is about half full. Press the leash cup down into the epoxy slowly. You will see epoxy squeezing up the sides. It needs to make it to the surface of the board and to spill out a little. If not, pull the cup, and put a little more epoxy.	The leash cup is installed, its top edge about 1/16” above the deck of the board.
5.2.4	Once it is in, orient the cup to your preference - the metal bar should be perpendicular to (preferred) or parallel to the centerline. Keep the top of the leash cup clear of epoxy.	The cup is properly oriented and tape can still stick to the top of the leash cup.
5.2.5	**This step is necessary only if you are doing vent and leash on the same side of the board at the same time.** Carefully tape across the top of the leash cup with several 6” strips of masking tape pulled tight. It needs to be well stuck to the top of the leash cup and to the board where there is no epoxy. Keep applying tape until you have a membrane that will prevent epoxy from dripping onto the floor when we flip the board.	The leash cup stays in its orientation, no epoxy gets into the leash cup, and the epoxy is held in place.

Step	Action	Result
5.2.6	Now the vent. Remove your board weights and clear the top of the board of all tools. Put some epoxy onto the shelf formed for the vent flange, and butter the vertical part of the vent with epoxy. Press the vent into place and quickly clean out any squeeze-out that you can see. If the vent didn't fit tightly, you can put another piece of masking tape over the vent to keep it from sliding out when we invert the board. A little wood-chip shim between the tape and the vent can apply a little pressure since the vent is recessed a bit already, and you would like it to stay that way.	The vent fits tightly in the hole you made for the flange (or is taped) and has little or no epoxy visible.
5.2.7	Immediately flip the board over vent-side down on the stand. Weight the board.	Inverting the board with the vent installed lets epoxy that would have dripped into the board settle against the installed vent on the inside.
5.2.8	Gore-tex vents and vent fittings are <u>not included</u> in Home Grown Kits, but for those that procure them separately, understand that they are tricky to install, and <u>we don't recommend them for first-time board builders nor is their installation supported by Grain Surfboards</u>. The blocking has to be a minimum of 7/8" deep, is *not* pre-bored prior to installation and may be installed anywhere there is 1/4" of clear-space below. Fittings are installed similarly to a leash-cup and, after curing, a 1/4" drill bit is carefully driven down past the fitting's threads to open the vent-hole through the bottom of the blocking into the board.	
	1. Mount the fitting nearly flush with the surface of the board. **2.** Prevent ANY epoxy from getting into the fitting during installation and gloss-coating. **3.** DO NOT damage the delicate threads when drilling the hole in the bottom of the blocking after installation of the fitting. **4.** DO NOT rip the cap off the actual membrane plug when installing after gloss coat. We <u>hand-tighten only</u> using a 16mm deep socket with the end ground flat (to remove the interior bevel).	

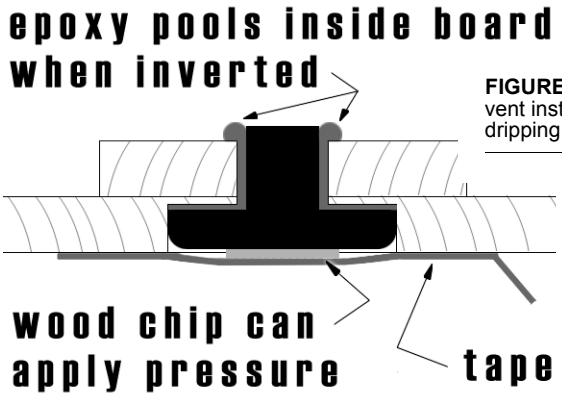


FIGURE 2-27. Inverting the board after vent installation keeps epoxy from dripping out into the board's interior.

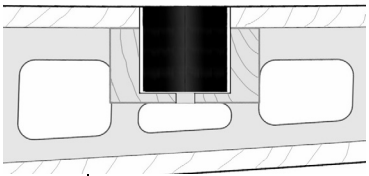


FIGURE 2-28. Gore-tex vent shown mounted on keel centerlinewith blocking split around reserved keel location (not on all boards),

END OF "TASK 5, VENT & LEASH CUP"

GLOSS COAT

TASK 6: GLOSS COAT

Finally. The gravy. This step will essentially complete the construction of the board. The job of the gloss coat is to fill all the sanding scratches in the hot coat, to fair any blending of epoxy that was necessary from installing external leash loops or glass-on fins, and to provide a base for final wetsanding and polishing.

We want this to come out glass-smooth if we can which is more difficult with epoxy than it is with polyester resin. If you are not overly concerned with board weight, you can usually improve your odds of getting a good gloss coat by applying the epoxy more heavily.

Step 6.1: Prep the Board

Prepping the board for gloss can take some time depending on the number of other installations that were made since the hot coat was finished. There are a number of fittings that need to be ground and sanded flush to the board's surfaces, and there may be glass and epoxy that still needs to be blended into the hot coat (such as for surface mounted leash loops or glass-on fins. This blending should have been completed when those were installed, but we will take a last look before gloss.

The grinding and sanding of hardware is not difficult, but you must use an especially light hand with power tools and know when to stop. This is probably the last chance you will have to significantly mess up the board, so don't blow it now.

Goal: Level the epoxy around hardware.

Step	Action	Result
6.1.1	First, we'll grind down the *leash cup* and *any fin-boxes* until they are about flush with the tape that is masking the board around them. No matter what the fitting, the procedure is the same: remove the bulk of the fitting that is above the tape with the most expeditious means possible. Take a look at all the fittings that you will need to work on, and confirm that there is tape around each, and that the set-screws on FCS fin-boxes are wound down into their threaded recesses so you don't grind into them.	The fittings are ready for machining.
	The tape that we left on protects the surface of the board and acts as a "warning strip" to let us know when to switch to hand-sanding. Once power tools start to lift the tape in any area, move on to another area until all the tape shows marks from the power tool you are using.	
	In the shop, we use a 4" grinder with a coarse 2" grinding disk to carefully grind away most of the material. A belt sander can also be used, but it is difficult to ensure that it is oriented flat to the board, so it is easy to accidentally tip it and gouge the board - even a disk sander is a better choice. If you are at all uneasy about using an aggressive power tool at this late stage of the game, you can use a small sure-form, or just get the coarsest sand paper you can find, and wrap it around a small, hard block.	

Step	Action	Result
6.1.2	Begin machining the fittings down to the tape. You will be grinding out the plastic that is sticking up, as well as the epoxy that squeezed out when you installed the fitting. As you get closer to the tape, take it slow - if you are using a grinder or disk sander, brush it lightly over the surface you are machining. The tape should start to show scarring and even lift away in some spots. Move right on when you see that, and keep going until all the tape is scarred or lifting right at the edge of the fitting. Move to the next fitting until they are all done.	All fin-boxes, and the leash cup are ground to the tape and the tape is scarred right at the edge of the fitting.
6.1.3	Now wrap some 80-grit or 120-grit paper around a hard block and use the block to continue leveling the fittings. As soon as the tape becomes more of a hindrance than a help, stop and peel some off. No more 80-grit after that point. Keep moving from fitting to fitting until they are all done.	Tape is all removed from around fittings, and finer grit paper is being used used once the board's surface is exposed.
6.1.4	Take one last look around the board to make sure that everything looks right. In particular, be critical of any surface-mounted fittings such as fins and surface-mounted leash loops. The epoxy that you have added since the hot coat should have no distinct edges and should slope gradually into the hot coat. A little finger-sanding with 120-grit, or sanding right along the edge of the new epoxy with the edge of a slightly tipped block - being careful not to get onto the hot coat - will often be a good investment at this time. Keep an eye out for any glass weave you may start accidentally exposing.	All "new" epoxy is blended with no glass weave showing, and with no clear "edges" where it meets the hot coat.
6.1.5	This is a good time to clean up the board, but take the time now to make sure that every single sliver of tape has been removed, and that all the dust is off the board. Look for any deep scratches that you may have missed and figure out if you can risk sanding them out or not. Look for any stray pencil marks that you may have missed and wipe the whole board down with denatured alcohol - just for dust and pencil marks - you will give it one last go-over just before gloss coat.	The board is clean, clear of pencil marks and deep scratches.
6.1.6 	Now tape over any openings that you don't want epoxy to run into. Trim the tape as close to the edge of the hole as you dare - you shouldn't need more than 1/16" of tape sticking to do the job. Tiny balls of masking tape can be forced into FCS set screw holes (sticking up a bit is fine) to protect the threads. An ideal way to protect the fittings is to make up plugs that fit into each fin-box cavity, the vent, and the leash cup. If the plugs are sized so that masking tape can fit around them for a seal, they can be inserted where ever you need to exclude the epoxy, yet the epoxy can run over the top of the fittings that we sanded flush in Step 6.1.3 to seal them perfectly. For example, a foam brush handle is the perfect diameter for the vent. Tightly wrap tape around the end of a cut-off handle with the sticky-side out, and work it down into the vent. The tape will stick to the inside of the vent, and the handle will keep the shape.	The openings are blocked or taped so that epoxy from the gloss coat will not run in.
6.1.7	Next, tape around the rail again as we did with the lam and hot coats. Look where the overlaps were and try to position the tape at a different point on the rail just to distribute the areas where there is build-up from lapping coats.	The board is taped and ready for gloss coating.

Step 6.2: Apply Gloss Coat

This step is quick and simple to do, but if it comes out badly, it means more sanding, and possibly another gloss coat. Success comes down to environment more than anything else.

The glassing room should be as dust-free as possible with minimized air movement. Any contamination in the air from foreign fumes, dust, or forced-air heat can cause problems. You should have on clean, dust-free work clothes, and should have no sanding dust in your hair or hands. The temperature in the glassing room should be in the neighborhood of 65-75 degrees Fahrenheit optimal.

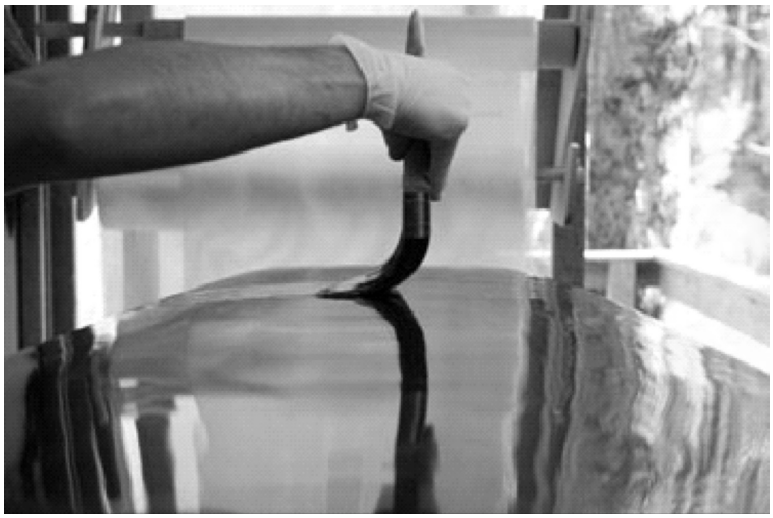


FIGURE 2-29. We want it glassy.

If you are using a chip brush or any other type of bristle brush, have your tweezers handy for removing bristles from the coat. Every now and then, check the brush to see if there is a stray bristle about to fall out, and pull it out with your fingers.

Gloss coat glass-on fins when you are doing the top so that epoxy will sag *down the fin to the tip* rather than onto your board.

This entire Step will be repeated for the other side of the board later.

Goal: Brush a perfect, glassy, gloss coat over the entire board.

Step	Action	Result
6.2.1	Bring the board to the glassing room, and wipe down with denatured alcohol the side of the board that you will be coating. Be thorough, and ensure that there is no contamination or dust on the board. Even the oils from fingerprints will mess up the gloss coat. Don't use any other solvents unless they are specifically designed for epoxy - even rubbing alcohol will cause problems - you want "denatured" alcohol.	The board is dust-free and oil-free.
6.2.2 	If you are using a bristle brush, flex the dry bristles aggressively and comb through them with your fingernails to try to break out any loose bristles. We want as few to fall into the gloss coat as possible. You can wrap some masking tape around your hand, sticky-side out, and rub the brush back and forth (with pressure) against it to pull out errant bristles.	The brush will not drop as many bristles.

Step	Action	Result
6.2.3	Mix up a batch of epoxy. If you don't mind the weight, you can plan to apply a heavy coat for a better chance that the gloss coat will come out well, but if you are weight conscious, you will want to mix slightly less epoxy than you needed for the other two coats.	The epoxy is thoroughly mixed with hardener and then with Cabosil. Some cloudiness will be present due to presence of the Cabosil, but that's OK.
6.2.4	As with the hot coat, work in sections, first brushing across the board, then finish-stroking lengthwise. This time, you should be able to apply the epoxy rail to rail as far as you can reach. Start at one end or the other, and pour a proportionate amount of epoxy on the board. Brush it across the board immediately.	The epoxy will be quickly spread and will not need to be "worked in" like the hot coat did.
6.2.5	Examine the area you just brushed for bristles, and using tweezers, remove them.	Bristles are removed with minimal disturbance to the coat.
6.2.6	Stroke the epoxy down over the near rail, moving right around the nose or tail to the other rail. Stroke epoxy down over that rail too for the area you are trying to cover. Once the area is covered, stroke the rail out lengthwise to even out the application of epoxy, then do the same over the surface of the board and back around to the other rail. If it doesn't look perfect, move on quickly. We will tip off the whole board at the end if there is time.	The area should look very good right down over the nose or tail and both rails, with perhaps some brush strokes visible, but with an even application of epoxy that is slowly floating level.
6.2.7	Move up to the next section of the board and repeat Steps 6.2.4 and 6.2.6 until the board is fully covered. Where flush hardware is encountered, brush right over the tape that is protecting the openings and over-load epoxy around any protruding plugs that will be removed later.	Masking tape should be wet all along its upper edge, and the board is looking glassy as the epoxy slowly floats.
6.2.8	Walk all around the board inspecting the rail areas, especially right at the top of the rail where the curve starts, and just above the tape. The epoxy tends slough in these areas more easily, so bend down and examine them with light shining along them, and apply epoxy heavily where it looks like it is not coating.	There is a good covering of the entire rail with no runs or drips or uncoated areas.
6.2.9	Take a good look at the surface of the board with light cast from the side. If you see any areas where the epoxy has drawn away in a circle from the hot-coat underneath, drip a dollop of epoxy on. You can even do the same for any little "fish-eyes" that look like miniature craters, only use just enough of a drip to turn them into a pimple.	The board's surface looks mostly glassy and wet and brush-strokes are floating themselves level. There may be some isolated humps and pimples from your fixes.

Step	Action	Result
6.2.10	If the epoxy is still very wet, and is not heating or setting in your mixing cup do this step, otherwise go on to Step 6.2.11. With a very light hand, start at one end of the board and stroke one, continuous stroke up the centerline walking the length of the board, then turn and do the same going back the other direction. You may find that you need to press some epoxy out of your brush back into a separate (even a used) mixing cup occasionally because you will be entraining air bubbles in the epoxy that you press out, and you want the epoxy remaining in your original cup to remain bubble-free in case you need it.  Watch carefully for bristles that you may drop into the gloss coat as you work and remove them with as little disturbance to the surface as possible.	You are removing any bubbles that may be showing up, minor fish-eyes, and lightly levelling out any remaining brush strokes.
6.2.11	In about fifteen minutes, come back for another look. Basically, do Step 6.2.9 over again, but this time, don't brush anything out. You're past the point of no return. Anything messed up now will have to come out in sanding.	There may be some isolated humps and pimples from your fixes.
6.2.12	That's it. Toss your brush, dispose of the mixing bucket safely, and leave the area clean. Clean any epoxy off yourself and your tools with citrus cleaner, isopropyl alcohol or vinegar.	Everything is put away and clean.

You will return to this Task once (if you haven't already) to do the other side after Step 6.3 is complete.

Step 6.3: Trim Tape & Re-prep

Goal: To ready the board for gloss coat on the other side.

Step	Action	Result
	Do not begin this step until the epoxy has come to a semi-hard cure. You don't want to flip the board onto the other side and imprint it with marks from the glassing stand.	
6.3.1	Return to "Step 2.2: Trim Tape & Re-prep" and repeat it. The only difference is that this time, you will not be removing any glass - only tape with epoxy over the top edge of it. If the epoxy is soft enough, you may find that very little use of the utility knife is necessary, and the tape will just peel up, neatly leaving an edge where the epoxy overlapped the tape. Apply very little pressure to the knife - you can score the glass unnecessarily if you press too hard.	The board is made ready for the next step.
	If you wait long enough for the epoxy to fully cure however, there is a greater chance of actually lifting and tearing the edges of the gloss coat. Don't pull quickly - be especially careful where the epoxy looks thicker over the edge of the tape.	
	Everything will be easier - including tapering the edge of the epoxy - rather than use a scraper, you may find that it is easiest just to use a hard block with 220-grit sandpaper on it. In any case, finish with the 220-grit block.	

Step 6.4: Gloss Coat Sanding

At this point the board probably looks fantastic. The worst is over and the board could actually be surfed as soon as it is cured. But there are a few more steps that Grain Surfboards performs in order to give the board the best look it can have. When you look closely at the finish, you will no doubt see a few imperfections and aesthetic issues that could be put right. That's what this step is mostly about.

It's entirely OK to just dress up the areas around hardware and at the lap on the rails and do nothing at all to the rest of the board. If you can spot-sand and be happy, then do it! The rest of this is alot of work that's all for aesthetics. A nice short-cut is to spot-sand using the finest grits you can to get the job done, work in the smallest areas possible, and follow with wet-sanding of those areas and perhaps polish. On customer's request, we occasionally do satin finishes (which have the additional benefit of making imperfect glass-jobs look much better) where the entire board is power-sanded with a random orbital to 600 or 800 grit. You still need to pay particular attention to Step 6.4.5 however.

If you want to give it the full treatment, however, carry on through the next few steps. By the end of this step, some or all of the board should be sanded at least to 220-grit and there will be no fisheyes, drips or irregularities. If you can use finer grits, do... the less you scratch the surface of the board, the less work. Where rails have hard edges (as on "release rails") sand up to, but not on, the hard edges.

Read through *"Step 2.3: Hot Coat Sanding"* on page 23 one more time to refresh your memory of cautions and pitfalls of sanding epoxy. Green epoxy is dangerous to inhale and even the dust that is left on the floor becomes airborne when you shuffle your feet around in it. ALWAYS wear a respirator in any room that epoxy has been sanded in until the entire room - walls, floors, stands and tools - has been thoroughly vacuumed and cleaned up.

Goal: Repair minor issues in the gloss coat.

Step	Action	Result
6.4.1 	If the entire board will be sanded, this operation can be a hand-sanding operation using an 8" hand-sanding pad (which is easiest to control), or a random-orbital sander. If there are any waves in the surface of the board that were caused during sanding of the hot coat, or by ridges left from brush strokes in the gloss coat, you will want to get them out, and a hand-sanding pad is great for that. If you noted serious problem areas, you can use 120-grit paper to get them worked out, but try not to. Use a small block for drips and similarly small areas, and a hand-sanding pad (or sander) for most other areas. Stay away from the rails except for repairing drips and other localized issues and remember that it is *really easy* to remove all of the epoxy when sanding on a convex surface like a rail - that's why your sanding block is small for repairs on the rail.	All obvious irregularities have been sanded out to at least 120-grit. The leash cup and vent and fin-boxes are usually all done in this step as they often need minor levelling.

Step	Action	Result
6.4.2	On the bottom surface, around and between glass-on fins, there will be thicker areas of gloss-coat. As you sand, take advantage of that extra fill to ensure that the areas feel like they follow the contours of the board. Don't get carried away and expose weave.	There is no weave showing on the glass used to install fins, and the gloss coat feels consistent with bottom contours.
6.4.3	Glass-on fins also tend to look a little rough because the gloss-coat tends to sag more than flow on the vertical surfaces of the fin. Sand the sags aggressively with a sanding block small enough that you aren't sanding into the leading and trailing edges of the foil.	The sides of the fin are generally leveled out.
6.4.4	Once the problem areas are fixed, sand over the whole board with 220-grit. Use a sanding sponge on the rails, and pads on the flatter surfaces (just as in Step 2.3: Hot Coat Sanding except that we should be less aggressive than we were in that step, as there should be alot less to do.)	The board is sanded to 220-grit.
6.4.5 	Wipe down the board with a slightly moist cloth once in a while and let the water evaporate. Any parts of the board that are still shiny either haven't been sanded, or are dips or fish eyes. Those will be *very visible* when the board is fully polished, so be patient, check again and again, and get them out.	There are no imperfections on the surface of the board. We aren't relying on varnish or surf-wax to hide anything!
6.4.6	You will flip the board and do both sides and all the rails.	The board is uniformly sanded to 220-grit and is level and smooth everywhere.

END OF "TASK 6, GLOSS COAT"

FINISHING THE BOARD

TASK 7: POLISHING

At Grain Surfboards, we polish the boards as a final step. It results in a beautiful, uniform finish and is *entirely unnecessary* but we're including this section because people have asked us for it in the past. Just be happy that you can stop now or anywhere during this step at which you like the finish on the board... there's nothing that says surfboards have to be glossy and reflective (and the glossier the board, the more minor imperfections in the finish show up). We often polish our "satin" finishes (which are sanded to 600 or 800 grit) as well.

Polishing takes practice, so don't expect perfect results if you've never done it before. Shoot for a finish that has medium reflectivity. This complements the wood, and can be done by anyone. Hi-gloss polishing takes more skill and more time, and is pretty hard to get done perfectly.

In essence, what you'll be doing is sanding or polishing scratches into the board that are increasingly fine, and always uniform. In other words, removing the deeper scratches from the previous grit and replacing them with finer scratches, always very close together. Think of using a pencil to draw swirls across paper. If you make the swirls very tight and close together, it looks more and more like you have simply made the white paper into grey paper especially when you move your eye farther away. That's essentially polishing. If you use a sander or polisher, move it slowly and with decreasing pressure on the work surface as you go along in each grit. Don't heat up the epoxy/varnish too much, or it will go dull and "burn".

Finally, it *is* possible to hand-polish, but it's a tremendous amount of work, and most people won't bother with this section unless they have a random-orbital polisher or sander with a foam or wool polishing head on it.

Step 7.1: Polish

Goal: Reduce any variations in reflectivity and bring the board to any degree of glossiness that you have patience for.

Step	Action	Result
7.1.1	Determine whether this is really a good idea or not. We're really careful to get our board surfaces fair and flat. If your hot coat and/or gloss coat looks wavey, decide whether you think it can be sanded flat and perfect. If it's too wavey, it will be accentuated by a shiny polished finish, so in those cases, you'll be happier if you go for matte/satin finish - the board will look better as a result.	You've surveyed your board to see if it's a good candidate for polish.
7.1.2	In the previous Step-Action table, you will have sanded some or all of the board using the finest grit manageable. Begin by sanding those areas with the next finer grit paper you have. If most of the board is unsanded, just re-sand the areas you've sanded already and step up in grits until you get to 400 or 600 grit. Between each grit wet the board down - even if you're wetsanding - and wipe all the sanding dust off. There's no use in sanding to finer grits if you're leaving sanding particles of coarser grits to be ground into the finish.	All areas sanded in Step 6.4 have been sanded in stages to 400 or 600 grit.

Step	Action	Result
	In the coarser grits, you may prefer to do the rails by hand. It is extremely easy to burn through the gloss where the sander's contact area is small. From here on, where there are hard rails, do not sand them at all - sand *up to* the hard edges, but not on them. You can take a loose piece of sandpaper in your hand and just rub once or twice over those areas to get them to the same finish as the rest of the board.	
7.1.3	Now sand the entire board in 600 grit and step up in grits from there - we go to 2000 for a full-gloss polish. Remember to move the sander slowly and suspend the sander to keep most of its weight off the board, and keep those swirls tight. If using variable speed random orbital, keep the speed down. Once into these finer grits, you may prefer to wet-sand.	The entire board is sanded to the finest grit you're shooting for, and the finish looks evenly dull everywhere with no outstanding scratches.
7.1.4	Once you've reached the highest grit you want to use, wipe the board down thoroughly and switch to polish. You can use auto polish if you have nothing else, but we usually use two or three grades of polishes starting with a scratch & swirl remover. As you get to finer polishes, foam pads work better than wool at getting glossy finishes. Wash the pad between polishes. Work up the board with slow back and forth movements (not circular) overlapping and making several passes as needed. Rails go very quickly - move the polisher a bit quicker there as the small contact area means you can be applying more pressure and generating more heat than you think. Consciously hold the polisher's weight off the board.	The degree of gloss being sought is achieved, and there are no overly-dull spots visible.
7.1.5	Wipe the board down with water, and let it dry. Inspect the entire surface to find any areas that do not have an even gloss (or matte if that is the finish you're going for). Polish those areas again with the last grade of polish used, and if that doesn't correct the problem back up again to the previous grade and step back through the grades again.	It's as perfect now as you know how to get it, or perhaps as perfect as you want it. Wax. Go surfing.

END OF "TASK 7, POLISHING"

CARE & FEEDING

of a Grain HomeGrown surfboard

Grain custom surfboards and boards build from Grain HomeGrown Surfboard Kits are designed not only to be one-of-a-kind works of personal craftsmanship, but also to be rugged machines for riding waves. They are coated with a single layer of 4 ounce e-glass fiberglass cloth laminated with Entropy epoxy. The core of the board is a marine ply frame with a structural skin of northern white cedar.

Because the core (before glassing) is far more structural than unglassed foam, Grain boards are generally more difficult to damage. For instance, they will not pressure ding under normal use or show many of the effects of regular use that you may be used to as your foam board ages. However there is some super-critical care you need to provide your Grain board:

1. VENT PLUG: The vent plug vents air; it is not a drain plug. Grain boards are NOT designed to get wet inside, and there is a real possibility that a board interior that gets well soaked may suffer damage as a result. The vent plug allows expanding air inside the board to escape before increasing pressure causes structural damage. To get an idea of the forces that build inside your board try this: remove the plug, pucker up over the vent hole and try to inflate the board. When a board comes out of cold water and is set in the hot sun with the vent plug still closed, the air inside expands with much greater force than you can muster with your lungs. ALWAYS - WITHOUT EXCEPTION - LOOSEN OR REMOVE THE VENT PLUG WHENEVER THE BOARD IS NOT IN THE WATER. Some people will also vent hollow wood boards after cooling them in the water before their session to prevent contracting air from sucking planks in, although we have had problems with this so far. If you're using a Gore-tex plug, never remove it unless you're replacing it with a fresh one.

2. BOARD TRANSPORT: It is an excellent idea to transport your board in a board bag or other UV protecting covering, especially if you regularly scrape up the finish by beaching the board.

3. EPOXY SKIN DAMAGE: You can definitely ding or otherwise damage Grain boards by surfing them into rocks, or by dropping them on hard edges or against pointy or sharp objects. A dimpled area and visible cloth weave indicate a compromised skin. If this happens, the cedar will begin soaking up water if you surf the board without repairing it. Repair is similar to that of a foam board, except you will use epoxy for the repair.