OUTFITTING A WHITEWATER CANOE Part I

By

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I have made nearly every mistake possible in outfitting the OC-1 whitewater canoe,¹ and thus can claim to be something of an expert on the subject. There are many websites that offer advice on how to do it, and I have shamelessly appropriated many of the ideas they have presented. I'll try to give them credit where it is due.² In addition, I have often posted questions on New England Riverrunners (a Yahoo group), Northeast Paddlers Message Board and C-Boats, and have received answers of varying utility. These message boards often contain useful information on outfitting, as well as many other subjects. I've also had many conversations with other open boaters, and with outfitters; all have educated me at least to some degree. Here, I am trying to write a compendium of what I have learned.

This paper assumes that anyone who wants to outfit an OC-1 must have spent some time in one and knows the basic nomenclature that relates to canoes and outfitting, such as painter, hull, bow, and stern. On the other hand, if you *really* know what you're doing, there won't be much here you don't already know. In that case, you can read this for its entertainment and undeniable literary value.

This paper serves best as a compendium of ideas and resources, rather than a manual. The fun part of home outfitting is that you can experiment, think of new ways to do things, make mistakes, and ultimately get your boat outfitted exactly as you want it (or have to live with the mess you made). If you're not really into appearances you can get some very ugly and very functional results. That's what I did. If you are into appearances you can make your canoe really beautiful, as well as functional. That is my next project.

Much of this content will not apply to the outfitting of canoes made of twin-tex (e.g., Zephyr) or fiberglass. These take more expertise and more sophisticated methods and tools. Here, I'm addressing canoes made of Royalex or one of its cousins.

I. Purchasing Materials; Useful Tools

1. <u>Purchasing On-Line</u>. The chances are pretty good that you'll have to buy something on-line unless you happen to be at one of the whitewater outfitters. Even then, they may not have exactly everything you want.

¹ I never glued the saddle in backwards.

² We can begin with the C-Boats outfitting page: <u>http://www.cboats.net/outfitting/</u>. For bulkhead outfitting, see http://kayakoutfitting.com/tips/wwcanoe/index.html.

(a) Shipping cost is a consideration of some importance when buying on-line. There is a minimum cost to ship things and so it is best to wait to order until you know everything you might want to buy from that vendor.

(b) Sometimes the vendor will offer free shipping for orders over a certain value. You may find you can save money by purchasing something you don't really need in order to get free shipping. Anyway, there's always something else to buy.

2. <u>Where to Find Things.</u> You'll need two main vendors, and maybe three. Of course, there will be some overlap of products offered.

(a) One vendor likely will be a whitewater specialist such as NRS, Zoar, or NOC, just to name a few. Surfing the web will turn up others, and I don't mean to favor anyone here. From these vendors you can get the saddle, the knee cups, the toe peg rails or toe cups, thigh straps and the vinyl anchors. They will likely have all sorts of other whitewater stuff you can't live without, but you just don't know what it is yet.

(b) If you want to make your own thigh and knee straps, you may need another vendor for webbing, plastic buckles, tri-glides, separate D-rings (not attached to vinyl), cord locks, shock cord and swivel hooks.³ See **Figure 1** below for a picture of a swivel hook and a tri-glide.

(c) Cord for your air bag cage and rope for your painter are available from many sources. You can often get from the same people that sell outfitting or buckles and webbing, or at a hardware store, but you'll often find what you need at a marine supply store such as West, or at an outdoor store such as EMS, REI, or Natick Outdoor. Outdoor stores generally stock plastic buckles and such like (but I had to order the 2-inch swivel hook on-line; nobody local had one).

(d) The marine supply store is a good place to shop for pumps, hose and accessories, as well as rope and cord. They have switches, electrical connectors, through-hull fittings, and batteries, too. Perhaps they are a bit pricey compared to an on-line store (until you figure in the shipping), but there is certainly convenience in finding everything you need at the same place. Electrical and electronics stocks (e.g. Radio Shack) are good for switches, connectors, wire, batteries, etc.

(e) You will find references to vendors' web sites along with the discussion of the relevant parts of the outfitting, below.

(f) I have not done a price comparison, so I don't know which of these sources is the least expensive. Do not assume that the on-line vendor will be the cheapest.

Figure 1

Here you see a swivel hook (on right) and a tri-glide. These are made of heavy plastic. You can get metal, but I don't think you need it for most purposes. Also, metal may rust.

³ The whitewater specialists have these too, but the selection tends to be limited.

This swivel hook won't be called upon to bear strain, and so plastic will do. If you want to use a strain-bearing swivel hook, then get one of heavy duty stainless steel or brass.



3. <u>Anchors.</u> An *anchor* for present purposes is defined as something that is glued to the canoe, can bear a lot of pulling strain, and has a loop or D-ring to which you can attach things, mostly thigh straps, but also air bag cages and sometimes pump mountings or even your saddle. Most anchors start with vinyl pads, but some are made of a hard, relatively inflexible substance such as polycarbonate ("lexan").

(a) I doubt that the shape of the vinyl pad matters much, except in fitting into the space available. Some anchors come with loops made of webbing and some come with metal D-rings. Some anchors come in small and large sizes (usually with one or two inch D-rings) and that may matter depending on the space you have available. Then there are "dogbones" which are two D-rings on a single pad.

(b) I have never had lasting success with the hard anchors. I just can't get them to stay glued down, whatever glue I use. Maybe you can do better, but I'll stick to flexible vinyl. I've been told that these work better because the boat flexes and the vinyl can flex with it.

(c) I prefer two inch D-rings wherever they will fit. They put more vinyl on the canoe for a more secure bond and the two inch D-rings will fit on more things than the smaller ones. They are slightly more expensive than the smaller anchors, however. You may decide you can get along with a small anchor, for example, if you are using them to anchor cord for the air bag cages.

(i) You can always make a small D-ring bigger by attaching a carabiner to it (or even more than one), and the cheap carabiners you find at the checkout

counter are fine for almost everything except rescue (obviously) or thigh strap anchors.

(ii) You can cut down a large vinyl pad to fit a given space (up to a point).

(iii) You can even make your own anchors, but that is a fair amount of trouble to save a few bucks. You'd have to enjoy the process for itself. Since I put my life in danger whenever I pick up a needle and thread, this is not for me.

(d) What if you need to add room to a D-ring but your attachment needs to bear a lot of strain? You could use a rescue carabiner, but those aren't cheap. Go to the hardware store and see what they have that opens so that it can be attached to your D-ring, but is made of fairly heavy metal. You'll certainly find something that will suit you. See **Figure 2** below, where I used such an object to attach a loose D-ring to a Northwater three-hole anchor. I believe the thing is called a "turn-sleeve." Hardware stores also have big carabiners that are cheaper than the ones climbers use.

(e) How many anchors do you need? That's a matter of preference to some degree.

(i) For the thigh and knee straps you'll need three for each side of the canoe if you anchor both the knee and thigh straps at the same point on the floor, and four for each side if you give each its own floor anchor.

(ii) Then you will need two anchors fore and two aft for the air bag cages (although you can get away with one).

(iii) If you install a pump, you'll need two more to anchor it down (more on pumps later).⁴

(iv) If you want to anchor down your saddle rather than glue it, you'll need four more.

(v) If you want to anchor movable ankle blocks, you'll need two more (but first see whether you can tie the ankle blocks to an anchor already installed for another purpose).

Figure 2

This is a Northwater three position vinyl anchor. You can see a D-ring attached to the brass grommet, using a turn-sleeve. The turn-sleeve is useful; it is heavy duty, can be moved or removed, and you can attach multiple D rings to it. You can also see a snap hook toward the front, which I used for the $1\frac{1}{2}$ inch knee strap. You could also use a swivel hook for this purpose, but it would have to be a strong one. There is a lot of strain on that point. Note that hardware stores are full of, well, hardware, and you might find something even better just browsing around.

The vinyl pad is glued down under the saddle, which is then glued on top of it.

⁴ There are other ways to get the pump to stay in place, but this was the easiest for me.



4. <u>Painters.</u> It is useful to have a rope to tie up your boat on the river, or even on your car rack. Whether you need one on each end of the boat is debatable.⁵ If you buy 30 feet of rope you'll be able to have 12 feet or so of effective length on each end.⁶ Rope can be very expensive and the temptation to cheap out is great. I'm usually all in favor of that, but not this time. The rope should be mildew-proof, buoyant, brightly colored so you can find it in the water, and feel soft and sort of floppy in your hand (so that it will not be painful to haul with it). It should be of a substantial width (thick as your thumb, at least), not too skinny. You should avoid rope that will get kinky after being coiled up for a long time. But all that does cost a bit of money. Marine supply stores are a good source for rope.

⁵ In fact, the dictionary definition of "painter" is a rope attached to the *bow* of the boat.

⁶ The bowline knot is good here. See the following link for how to tie that knot: http://images.google.com/imgres?

imgurl=http://www.westmarine.com/boatsafe/images/bowline.gif&imgrefurl=http://www.westmarine.com/ boatsafe/knots_bowline.htm&usg=__NZf_5dAC8wRgX_kpA0OuliMdEVs=&h=387&w=431&sz=17&hl= en&start=2&um=1&itbs=1&tbnid=MHIAJdKf4JUDXM:&tbnh=113&tbnw=126&prev=/images%3Fq %3Dbowline%2Bknot%26hl%3Den%26rlz%3D1R2ADFA_enUS348%26sa%3DX%26um%3D1.

Some people think painters are unsafe and won't have them. If you do have a painter, make sure you stow it properly so there is no risk of entanglement.

5. <u>Air Bag Cord</u>

The cord should be of a size that fits through the grommets that are found on the gunwales on most boats. It often comes in pretty colors and is available from many sources. It should be of a material that won't shrink and that can be wet without coming apart on you. Again, the marine supply store is a good place to find this item, although outdoor and hardware stores usually have it, too. I have found some very nice nylon parachute cord in a hardware store at about ten cents per foot. Make sure you get enough; they'll be out of your color when you go back for more.

6. <u>Tools</u>

(a) Putty knife, sharp, to remove old glue;

(b) Heat gun (maybe a hairdryer will work) to remove old glue or pre-heat surfaces before gluing;

(c) If you are making or modifying a saddle or anything else made of minicell, you'll want Dragon Skin (a brand name for this stuff that you can use to abrade away minicell). It works like a cheese grater. Whitewater outfitters usually stock this. Hardware stores stock something called *open mesh cloth* in the drywall section (see **Figure 3** below), which is slower to do the same job, but leaves a smooth surface like suede. It's pretty good stuff to have around. One roll will last several lifetimes, but it is not too expensive and you can leave the remainder to your heirs.

(d) Sharp knife for cutting rope, webbing and string. You want a *very* sharp knife so that your cuts will be clean and free of frayed ends. That way, when you burn the end of the rope to melt it so it won't fray, you'll get a nice clean end. Otherwise, eventually it will start to fray and even unravel. All these terrible things can be prevented by using a good, sharp knife.

(e) Compass saw or other fine tooth cutting instrument for cutting minicell. You can use a kitchen knife, too, but:

(i) It might not be long enough; and

(ii) It won't cost you anything or require a trip to the store. No economic stimulus there.

(f) Coarse grit sandpaper (80) to rough things up before gluing. A power sander isn't really necessary, but if you already have one then feel free to use it. I've found that they work best when plugged into a live electrical outlet or an extension cord that is plugged into a live electrical outlet. Also, noise protection for your ears is good, even if it's just foam plugs from the drugstore. Eye protection is good, too.

(g) Wire cutting, crimping and stripping tool (optional and only for the pump installation).

Figure 3

Dragon Skin (brand name) and open mesh cloth from the hardware store drywall section. As you see, the mesh cloth comes on a roll that will last you the rest of your life, but fortunately it doesn't cost that much. Both are useful for abrading down minicell. The open mesh is slower to use but leaves a very smooth surface. Maybe you'll just use it for the finish work.

The AA battery on the right has no significance in this picture; it just happened to be on the table. I guess you can use it to establish the size of the other objects in the picture.



II. Removing Old Outfitting

1. If you are so lucky as to acquire a pristine, new boat with no outfitting, then skip this part.

2. Glue is sticky (would I kid you?). Heating it up makes it less sticky and easier to remove. I like to use a heat gun, like people use for stripping paint. I have not tried a hair dryer, but it might work. You'll also need a good sharp putty knife.

3. To take off a vinyl patch, use the heat gun to heat it up and the putty knife to jimmy it off. The patch probably was glued on with vinyl glue such as Vyna Bond or HH-66. Acetone takes that stuff off. You can get it by the can at hardware stores, and it is also the active ingredient in nail polish remover (but smells better). Get plenty of air when using acetone.

4. Saddles and knee cups likely will have been attached with contact cement. Heating the minicell isn't much good here because it is thick and the heat won't penetrate to the glue. Also, it may shrink the minicell. Instead, heat up the putty knife with the heat gun or hair dryer and use it to separate the minicell from the boat. If you make a mess, that's OK. You can get the minicell and glue off eventually.

5. Contact cement is hard to remove completely. Keep in mind that if you're going to cover the spot with new glue you don't have to make an obsession out of it. If you get off 80% that will usually be fine. You can do a good enough job by heating the glue residue and removing it with a putty knife. This takes time and work, but it will eventually do the trick. Sometimes you can sand it, but I'm not a fan of that solution; it can leave a lot of grit in the glue. When you have just about all of it off, wipe the surface with acetone.

6. People at the hardware store recommended Goo-Gone or Goof-Off to take off contact cement. I haven't had to use them, but I've been told that they work pretty well and that they are very toxic to breathe. They might save some work (or leave you in a state where you don't care one way or the other, so remember that ventilation is very important).

7. If the glue is epoxy you will likely have to sand it off.

III. The Order of Installing the Outfitting

1. First, as a rule, the saddle, because everything else is relative to it. We'll come back to how to install the saddle in a bit. If you don't want to glue in the saddle, but instead to strap it down to D-rings, then you'll put the necessary anchors in first (obviously). You might find you want anchor pads for the thigh straps to lie partially under the saddle, in which case you'd glue those down before the saddle.

2. Then, all the remaining vinyl anchors.

3. Then the knee cups. These may end up on top of some of the vinyl anchors, which is fine. You may need to cut away some of the knee cup to allow the D-ring to work. Make sure your knee won't be on top of the D-ring.

4. If you like ankle blocks (I sure do) and you want to glue them in, do it now. I don't glue them in, however. See below.

5. Then the cage for the air bags.⁷

The order in which you install the pump will depend on how you configure it. Probably, it should go on after the saddle.

IV. Plan, Plan, Plan

1. You really must know where everything is going to go before you start.

2. You should have all the necessary materials and tools before you start unless you like running back and forth to the store (assuming it is open).

3. Make a diagram or find one on the web.⁸ Do you have everything that is shown in the diagram?

4. Mark all the spots on the canoe with magic marker or a dark pencil. Use chalk if you insist on a nice-looking boat with no leftover marks.

5. If you need to glue down vinyl before gluing down something else, you might as well know it beforehand. This will be true if you want to attach the saddle to anchors or if you find that the anchors for your thigh straps need to be partially under the saddle or the knee cups.

6. Glue drips. If you want a clean-looking boat you will want to mask the area around the spots you will be gluing.

V. Glue

1. Wisdom about glue: do it right and it will work, do it wrong and it won't.

NOTE WELL: ANY GLUE, GLUE REMOVER OR JUST ABOUT ANY CHEMICAL YOU WILL USE IN THIS PROCESS IS HARMFUL TO BREATHE. IF YOU CAN'T DO THIS OUTSIDE, THEN MAKE SURE YOU HAVE PLENTY OF AIR FLOWING THROUGH THE ROOM. THIS IS SERIOUS. ALSO, YOU MAY NEED GLOVES

⁷ You don't want the air bags in the boat while you are outfitting it; they just get in the way and you might damage them.

⁸ There are some very good diagrams on the open canoe web site. <u>http://www.open-</u>

<u>canoe.de/open/canoes/fitting/fitting_guide.html</u>. This site has a wealth of information, advice and encouragement for open boaters. For air bag cages, the Mike Yee site has very good pictures showing where to put things.

FOR SOME OF THESE CHEMICALS, AND EVEN IF YOU DON'T, IT'S A GOOD IDEA. 9

(a) To glue minicell to minicell or to the boat you can use contact cement. It does quite well if the surface isn't going to be pulled on (such as knee cups or the saddle). I don't recommend contact cement for vinyl anchors. Eventually it failed every time I tried it.

(i) There are several options in contact cement, including 3M #77 glue, Weldwood from DAP and others. You can use a brush applicator or a spray. I've used both, and the convenience of the spray is nice, but I always get it all over everything. Be prepared for a fast clean-up or, better yet, mask the area around the part to be sprayed. For a small area, a brush works better.

(ii) You can get contact cement in most hardware stores. It doesn't cost that much. There is no need to buy expensive glue for minicell; it's so porous that just about anything waterproof will do.

(b) I have learned the hard way that you should apply contact cement to both surfaces in a thin coat and then let it dry for about 20 minutes before you stick the pieces together. It should be nearly dry before you join the pieces. Put some weight on if you like. Then *just leave it alone* for several hours. If you do that, you'll get a really solid bond. I think it may be overkill to use two coats for minicell, but some people recommend it and there is no harm in it. If you do lay on two coats, let the first coat dry before you apply the second coat. Then let it dry almost all the way and then put the two pieces together.

(c) You can also use contact cement for a temporary bond, such as a quick trip to the lake to test the trim of the boat with a given saddle placement. Follow the instructions on the container, but be prepared to remove the stuff afterward.

2. Read the instructions. I hate doing this, but sometimes you do pick up something useful.

3. In general, you don't need to do anything to minicell to prepare it for gluing,¹⁰ but the plastic surface (that is, the boat) should be sanded with fairly rough sandpaper until it no longer feels smooth to the touch, cleaned thoroughly, and, finally, wiped off with acetone or rubbing alcohol (I use acetone, on the theory that it is more harmful to breathe so it must work better). The surface should be absolutely dry and clean before applying the glue. It may help to warm the surface with a hair dryer or heat gun, but not so much that it starts to melt. Then it will take the glue well.

4. Vinyl adhesive (often found under the Vyna Bond brand) can be hard to find locally, but all the outfitters have it. I finally found some vinyl and plastic glue at Lowe's recently, under the Loctite brand. It was \$2.99 an ounce, cheap. At that price get three or four tubes. I have not checked the chemical compositions to see whether they are the

⁹ If I followed my own advice I wouldn't always be walking around with glue on my fingers.

¹⁰ The smooth skin of minicell foam is best sliced off for best glue adhesion, it has mold release residue on it. Otherwise clean it thoroughly with a solvent.

same thing,¹¹ but the cheap stuff works, I can attest to that. There is also HH-66, which is available on-line in fairly large quantities. According to one expert, it's the same as Vyna Bond. Vinyl adhesive can stand a lot of pulling if you apply it correctly.

5. Fortunately, vinyl adhesive is not hard to apply correctly.¹²

(a) The usual rules apply: clean, dry surface, rough up both surfaces with sandpaper (and clean off all the grit), pre-treat the surfaces with acetone, air temperature as required by the instructions. Warmer is better, and you can use a heat gun or hair dryer to warm it up a bit—not too much.

(b) Apply the glue to both surfaces (just a thin coat; don't slop it on) and then wait until it is just about dry (no more than a few minutes, in my experience). Then put the surfaces together and press down to get all the air bubbles out. Be very diligent about getting rid of the bubbles. Again, you can use two coats if you think you need them. Let the first coat dry completely before applying the second coat. Then, let the second coat dry before you put the two parts together (you can also heat it slightly first). Don't put the parts together if the glue is still wet. It contains a solvent that will eat your boat.

(c) Put some weight on it if you like and then leave it alone for 24 hours. Don't test it until 24 hours have gone by. It probably does not need 24 hours, but if you give it 24 hours you'll know you gave it enough.

(d) Did I say read the instructions? I know; it's boring.

V. Building the Saddle

1. <u>Ready-Made Saddles.</u> You can buy a good saddle for about \$150 (including toe pegs), or you can make one for about half that and have fun doing it. My Esquif saddle is very comfortable and solid. It is glued in (came that way with the boat).¹³ There are others, which you can find on the web. The ones from people who know WW (Yee, Foote, and others) are generally very good, but don't buy one of the small ones unless you, too, are small. For most of us guys at least, the saddle as purchased should be at least 8 in. high at the seat, 8 in. wide, and have a nice, firm back for support. Then you can add or reduce to fit. If it comes with toe pegs, fine. If not, you can put them on or buy toe cups.

¹¹ The ingredients are not on the packaging.

¹² Here is a link to the technical specifications for Vyna Bond. Note that it says that for best results the air temperature should be at least 50°F when you apply it. That's pretty low, and is an advantage compared to some other glues. *See* http://www.usplastic.com/pdfdatafiles/38066techdatasheet.pdf.

¹³ Please note that the saddle you see in the illustrations *is not* the Esquif saddle.

2. <u>Build Your Own Saddle--Preliminaries</u>

(a) First, you have to buy some minicell foam. You can get enough minicell to build a nice saddle for about \$40, delivered. That's plenty. Ocean Kayak in Watertown, MA sells it, among others. They sell a block that is 3x24x24 inches. That's plenty. Do a web search for minicell and you'll find several vendors. You can get all different sizes and shapes, so shop around.

(b) The saddle you see in the pictures at the end of this section I made from bits and pieces of foam that I added to a saddle that must have been intended for a C-1. It was too low and too narrow for me (I am an average sized man). I wanted to see if I could do it, and now it fits me so well I'm going to keep it for awhile. It is about 8.5 inches high at the seat, 9 inches wide, and has a pretty good-sized back rest. It's quite comfortable and I can sit on it for more than an hour without getting up. That ought to be enough on any river.

(c) You can cut the minicell with a big bread knife or a fine-toothed compass saw or even an electric saw or carving knife. Remember this: measure twice, cut once. Make sure you know precisely what you're going to cut and where before you do it (this is not my preferred method, which is to just eyeball it, but my preferred method does not work, so I've given it up).

(d) I have been told that you can cut holes in the foam using something called a router. Maybe so. I wouldn't know. In fact, I don't know what a router is. But I have figured out how to get along without one, and I will explain how below.

(e) If you want to retain the option of anchoring the saddle instead of gluing it, you'll want to put in two channels through which you will run the straps that will attach to the anchors you've previously installed for that purpose. These channels should also be between the two lowest layers and will (of course) also serve as water channels so make them big enough (a 2 inch square should do it).

3. <u>Channels for Water (Also for Straps).</u> Let's say the saddle you want to build is 22 inches long. You want channels from one side of the saddle to the other in order to let water move back and forth as you roll.¹⁴

(a) You can hollow out a couple of 2-inch by 2-inch channels from the bottom of the saddle—obviously before you install the saddle, after you build it (or even if you buy one that doesn't have channels).

(i) One way to do this is to use the saw and cut out the channels.

¹⁴ When I first read about this I was extremely skeptical that water channels would make a difference for rolling but I have found out that they do.

(ii) Alternatively, you can hollow out the channels with dragon skin or abrasive mesh. This would be more work, but would allow for better control over the size of the channel (if you really care about that).

(iii) Here is another thought. You can hollow out some water channels *before* you glue the layers together, which is a very convenient way to do it. Just make a half-circle scoop out of the lowest layer and another to match it on the middle layer, and when they fit together you'll have a channel. You can put in three or four of these if you wish. Keep these channels down to about 2 inches in diameter; you don't want to compromise the structure of the saddle.

(b) Likewise, the time to install the toe peg rails is *before* you glue the layers together. Determine exactly where you want them, leaving room for adjustment. Then make a slice across the lowest layer about an inch or so deep (again, put it where you want it). Push the cross bolt down into the slice and screw on the rails. That way you won't have to get a router. Also, if you drill a hole slightly larger than the threaded rod, it will allow you insert a small plastic tube (about 1 inch shorter than the width of the saddle) over the metal rod. This will keep the rod from tearing the saddle over time.

4. I have attached a diagram of a home-built saddle. See Figure 4 below. There is enough foam in a 24x24x3 inch block to build this. I have not yet tried to build this saddle.

(a) I like the 3 inch height of the block I bought because it will allow me to make the saddle 9 inches high at the seat by gluing down three layers. Later, I will abrade or cut down the seat to about 8.5 inches, which is comfortable for me. But you can glue down a half-inch piece of foam (I've seen these for sale at outdoor stores) and raise the seat, or you can abrade it down further if you like a lower seat.

(b) If you like a wider seat (and this you can determine by sitting on it and seeing if you feel like you have enough support), you can glue a half-inch block of foam to each side (let the block extend from the front of the saddle to the back support, but only half way down so it won't get in the way of the water channels. It will give you plenty of support.

(c) If you like a narrower seat, just cut or abrade some away wherever it bothers you.

5. There are other configurations of saddle that are possible with the 24x24x3 block of foam and nothing beats imagination and experimentation when it comes to figuring out what is just right for you. You can also buy different shapes of blocks and make an entirely different design.

6. I envision the building of the saddle as follows:

(a) Cut the block of foam into three strips, each 8x3x24.

(b) Cut each strip down to 8x3x16.

(c) Cut out the water channels and/or strap channels, as you have decided.

(d) If you are using toe peg rails, install the cross bolts before gluing the layers of the saddle together.

(e) Using contact cement, glue the strips together in layers, so that you have a block that is 9x8x16.

(f) From the left-over foam, cut a piece 3x5x8. That's your back rest. Glue it down to the back of the saddle block so that you have a back rest 5 inches high and 3 inches deep. You may decide you want a wedge shaped piece at the base of the back rest for better comfort and support. Do this last, however. You should shape it to fit your own form.

(g) Cut a space out of the rear block that will hold your battery.¹⁵ Also, if you are installing toe peg rails, make sure the cross bolts won't bump into the battery.

(i) Batteries come in different shapes and sizes. You'll need a way of securing the battery firmly to the block of foam. Straps or shock cord would work, but be sure you have left a space under the block so you can run the strap or shock cord through it. You'll also need a space between the saddle and the rear block through which to run the strap or shock cord. I think a strap is better because you can really tighten it down. You might consider a web strap with a metal cam lock, such as people use to strap boats to their cars. Those are convenient and hold well.

(ii) Consider leaving a few inches of space between the rear block and the saddle so that you can work around it with the straps. In that case you would glue the rear block to the canoe with contact cement.

(h) Glue the rear block to the saddle base as shown on Figure 4 [or to the canoe, if you prefer]. But first read about toe peg rails, below.

(i) Make a pommel (if you think you need one) and glue it on.

¹⁵ Note: if you are not planning on having a pump, running lights or a radio, you might consider dispensing with the battery.





7. <u>Toe Peg Rails.</u>

(a) If you are good at this sort of thing you can drive the bolt through the minicell, but I doubt it will come out in the same relative place it went in. That's why I think putting the bolt in *before* gluing the saddle layers together is a good idea.

(b) Once the bolt is in place, screw the rails to the bolt on either side of the saddle.

(c) To put the bolt in the rear block you can screw it through one rail and keep screwing it through the rear block until it comes out the other side, and then continue to screw it into the other rail.

(d) Alternatively, you can screw the bolt through the first rail and then through the second rail while it is outside the rear block (either above or below it, but below should work better because then you'll glue the block in place, which will prevent movement of

the bolt), then run a slice across the rear block deep enough to set the bolt where you want it and push the bolt into the slice. Then glue the rear block in.

(e) Alternatively you can cut the block in half, separating it into the top half and the bottom half, then lay the bolt in the proper place (making a shallow channel for it to lay it onto the bottom half), then glue the two halves of the block back together.

(f) Alternatively, you'll come up with something even better than the suggestions above, in which case please let me know.

8. <u>Saddle Held Down by Thwart.</u>

(a) I own an solo boat in which there is a thwart across the top of the back rest on the saddle, which holds it firmly in place. This makes for a very firm back rest, which I like. A firm back rest is not only more comfortable but it gives the paddler something to lean back against for leverage while paddling forward. This makes for a stronger forward stroke. In addition, a thwart over the backrest of the saddle can help keep the boat from buckling if broached.

(b) I've heard people take both sides of the question of whether it is wise to have a thwart so close to the mid-line of the boat, and I am not sure who is correct. Some say it is harmless and adds integrity to the structure (as well as providing for a firm back rest); others worry about entrapment.¹⁶ I've bailed many times from my current boat without ever getting my foot caught, but in another boat I did get my foot caught a few times. Perhaps the thwart in that boat was too far back. However that may be, on balance I think an extra thwart to hold down the saddle is a good thing. Of course, if you find you're getting caught on it when you bail out, it's time to either remove it or reposition it to a safer place.

(c) To install a thwart you'll need to drill down through the gunwale, and also drill a hole in your pre-cut and pre-treated (with marine varnish or some kind of wood oil) piece of wood. Then run a bolt down through the gunwale and the wood. Don't forget a washer on top and a lock-washer or lock-nut on the bottom. You may want to cover the bolt end so that it won't scratch you. For visual aid, check the manner in which the other thwarts are installed to see how the manufacturer did it.

9. <u>Position of the Saddle</u>

(a) There are different ways of deciding where to put the saddle, but the primary consideration is that it should not be too far forward or too far back. Too far forward will cause the bow to plunge into holes and through waves instead of over them, while too far back will make it harder to surf and likely less stable, but it will ride over waves better. To some extent it depends on how you want your boat to behave.

(b) Subject to individual preference, the right place to put the saddle is where it will leave the bow and stern the same distance from the water when you are in the saddle.

¹⁶ They use the term "death thwart," which I think is a bit excessive.

This does not have to be determined down to the millimeter; you can have someone eyeball it for you. Take the boat to a lake and when the position seems right, make a mark or two to show you where to glue it in.

(c) One web site advised that the hip joint of the paddler seated on the saddle should be four inches behind the mid-line of the canoe. I tried this and it worked.

(d) You may find other hints in the instructions that came with the saddle or with the canoe, or on the web site of the canoe manufacturer or the saddle manufacturer.

(e) One advantage of securing the saddle to D-rings with straps is that it allows you to move the saddle around a bit, which will allow you to find the right place, or change it if the need arises.

(f) Crosswise, unless you have a very specialized situation (none occurs to me at the moment), the saddle should be right in the middle of the canoe, equidistant from the two gunwales.

Figure 5

The world's ugliest saddle, literally made from scraps, inspired aesthetically by the Gaudi house in Barcelona. It was an experiment, and it works. I'm quite comfortable on it because I kept on adding pieces and then abrading them down until I was content. I can roll with it (it has a water channel cut out of the bottom). However, I will eventually replace it with a new one, made especially by me. I have installed a thwart over the back rest.

Those are Northwater toe cups, adjustable to five positions. They glue in. For that reason, installation is easier than toe pegs on rails. On the other hand, they are not as adjustable as the toe pegs. You have to get off the river to adjust them, whereas with toe pegs in general you can do it "on the fly." I have never learned to love them (they are rather confining and sometimes it is hard to get my foot all the way in), but they are OK.

The piece of white minicell is the ankle block.



OUTFITTING A WHITEWATER CANOE

Part II

VI. Knee Cups

- 1. These are available on-line from whitewater outfitters.¹⁷ They are made of minicell foam and can be glued to the boat with contact cement. You could easily make your own using a block at least half an inch thick so you'll be comfortable kneeling.
- 2. We want a wide stance for balance, which means that the knee cups should be positioned as far apart as possible without having them too high up the side of the canoe to hold the knees in. They should definitely be part way up the side, however. Experiment with placement for comfort and stability, on the water if possible.
- 3. Let's face it—knees are a source of a lot of pain in open boating. Take a lot of time and make sure your knee cups are comfortable and placed carefully. Put a generous amount of foam under your knees.

VII. Thigh and Knee Straps

- 1. Thigh and knee straps are supposed to connect you to the boat so you can use your torso and hips to maneuver it, and also to keep you in it when capsized so that you can roll. At the same time, they should never prevent you from leaving the boat quickly if that is what you want to do.
- 2. There are several nice strap sets for sale. Check the NOC, Zoar, Mike Yee, Middleton, or Northwater web sites (to name just a few) or just search for whitewater thigh straps on Google.¹⁸ But you can make your own for less money, and it is not hard to do.
- 3. If you are going to make your own straps, read on:

(a) A word about webbing. There is some beautiful smooth webbing out there, all shiny and it comes in lots of nice colors—you don't want it. You want the nubby kind that won't slip in the buckle. Even with the tri-glide the smooth stuff won't hold in a roll, and you'll always be adjusting it even if you don't roll. But make sure the webbing you buy won't be too stiff to work through the buckles (you may have to call the vendor to make sure you are ordering the right thing; I didn't and now I own several feet of unusable webbing).

¹⁷ Looking at web sites of vendors of outfitting can be very educational in terms of knowing what's available, what you might make yourself, and what you really need to buy. The Esquif, Northwater, Mike Yee, Nanatahala Outdoor Center, Zoar Outdoor sites are all good. Also, there is an outfitting page on the C-Boats site that's very good.

¹⁸ The Mike Yee site has some nice illustration pages on installation of outfitting, including air bag cages, saddles and thigh straps.

(b) For the thigh straps, you should need about six feet of 2-inch webbing. Get a few extra feet and be sure; it's not that expensive.

(c) I don't want to endorse any particular vendor and there are many. Look on-line for webbing or swivel hook and you'll find all you need. Again, try to save on shipping cost. Figure out everything you'll need from any one vendor before ordering. You ought to be able to get webbing, buckles and perhaps cord (including shock cord) from one vendor.

(i) You will also want about six feet of 1.5 inch strap for the knee straps (buy extra);

(ii) Two 2-inch swivel hooks for your thigh straps. Why swivel hooks? Because you can run the upper strap through it and then connect it to a grommet on the gunwale with shock cord. It will prevent the strap from flopping down to the floor of the canoe (I really hate that¹⁹) and also keep the strap flat and stable for you. It is very nice to have and costs very little.²⁰

(iii) Two 1.5-inch swivel hooks for your knee straps. Note that you'll be using slightly smaller webbing for your knees than for your thighs. I might as well say here that you could get away with using the smaller webbing for both;

(iv) Two buckle sets (male and female) for the 2-inch straps and two for the 1.5-inch sets. That means for each buckle set: a male part [the part fits into the female part], a female part [the part that the male part fits into] (I love thinking about sex, don't you?) and three tri-glides. The buckles and tri-glides are fairly easy to get in the $1\frac{1}{2}$ and 2-inch sizes. REI and EMS both had them, and all the web sites for webbing had nice selections.²¹

(d) The buckles *must* have a quick release feature. You need to be able to get a buckle open with one hand, underwater. My buckles have a side release.

(i) You should also be able to pull up on the male end of the buckle and loosen the strap that way, again with one hand and underwater.

(ii) You should be able to fall out of the boat from a fully strapped in position without doing anything to the buckle or the strap. If you can't, fix

¹⁹ And for good reason. In a turbulent eddy you want your posterior on the seat and your straps on your legs pronto, before you tip over or get dragged into the current. Anyone who has put in at the Magalloway will appreciate this point, and even the Dryway put-in is quite active. I've cut down on my swims materially by having non-floppy thigh straps.

²⁰ Here I must brag a little. I'm the first person I have ever known to use swivel hooks for this purpose, and this is my personal contribution to the sport.

²¹ I highly recommend looking at some of those sites just to get ideas of what is available. Some of them will really get you salivating over the variety of D-rings or buckles you can get. For example, <u>www.ahh.biz</u> has all manner of buckles, D-rings and fittings. This is certainly not the only company that offers useful hardware, but it is a good example. To be fair, www.umei.com is another. It is very satisfying to see something you never saw before on a web site and realize that it's just the thing you need for whatever obscure or perverse plan you have in mind for your whitewater canoe.

that problem before your next trip. If you want to have major angst about getting out of your boat, you might as well be in a kayak.

(e) Three feet of small gauge shock cord. You can use it to connect the swivel hooks to the gunwale grommets;

(f) Four cord locks for the shock cord (optional).

(i) Make sure the shock cord will fit in the cord locks. I have not found any cord locks that will take even medium sized shock cord, so make sure your shock cord is the right size for the cord locks. If it won't fit you can just tie it and skip the cord locks. One authority says the cord locks are important for safety, so maybe you do want them.

(ii) If you can't find the right size shock cord go get one of those things girls put their pony tails in and cut it up. Scrunchies, I think they are called. They are made of shock cord, sort of.

(g) Other Configurations. Some thoughts:

(i) Do you really need knee straps as well as thigh straps?

(ii) Do you really need all those buckles? Could you instead us a continuous loop so that you tighten down the knee and thigh straps at the same time?

(iii) Maybe you would prefer a bulkhead made of minicell, in lieu of straps?

(iv) Maybe you would prefer a lap strap such as Mohawk sells?

(v) In the past there was a commercial semi-rigid knee holder called *Knee Boots*. They were made from the same reinforced vinyl as is used for D-ring anchors. Your knee fits into them. They are rigid enough to stand up by themselves, but flexible and adjustable. I know one open boater who uses some of those for his boat, and he can get back into it when it is upside down and then roll it up! You might have to make your own, though.

(h) <u>Hip Pads.</u> You can glue minicell pads to the sides of the canoe to get a more secure fit. They should just touch your hips, but should not impede falling out. This will add to boat control when leaning or turning.

Figure 6

This shows the shock cord tied to the grommet (you could use cord locks instead) and then clipped to the swivel hook. The webbing is run through the swivel hook, which keeps it flat and in place. This arrangement has worked out very well.

Also, in this picture you can see the nubby webbing (black) and also shiny webbing (blue). I have since replaced the blue webbing with nubby black webbing.

In this picture you can see that I had to cut the vinyl anchor so that it would fit next to the knee cup. This is not optimal, but the knee cup was already there and I didn't want to have to take it out. So far it works fine, although the strap does not lay as flat on my knee as I would like. It would have been better to glue in the anchor first, cut a notch out of the knee cup to allow it to fit over the D-ring, and then glue down the knee cup. Next time!



VIII. The Use of Tri-glides

Tri-glides are used to connect webbing to a fixed point (like a D-ring) so it won't slip, or to fix the webbing in the non-adjustable side of the buckle. The tri-glide keeps the webbing from slipping. It looks like this:



How to run the webbing through the tri-glide and D-ring to attach the webbing to the anchor:

- 1. Up through Slot A and then down through Slot B.
- 2. Through the D-ring from under the metal piece to over it.
- 3. Up through Slot B and then down through Slot A.
- 4. Adjust so that the tri-glide is close to the D-ring.

5. One end of the webbing is run through a D-ring anchor glued to the canoe. The other end of the webbing goes through the buckle.

6. Where the tri-glide is fixing the webbing on the buckle end, the buckle takes the place of the D-ring. Note that you don't want a tri-glide on the adjustable (male) side of the buckle for obvious reasons. Thus, you'll anchor down the strap on the male side to the bottom of the canoe, then run it through the buckle.

7. The female part of the buckle will be anchored on the side of the canoe at about the hip and somewhat below it (experiment to find the best place for you), while the male part will be anchored on the bottom.

(a) First, anchor one end to the D-ring attached to the canoe, using a tri-glide.

(b) If you are using swivel hooks, now run the webbing through the swivel hook.

(c) Next, run the webbing through a second tri-glide and then through the buckle.

(d) Then run the webbing back through the second tri-glide in the opposite direction.

(e) Adjust the strap to place the buckle where you want it (more to the inside of your thigh than to the top).

(f) Run some shock cord through a convenient grommet below the gunwale and tie it off, leaving room to clip the swivel hook to it.

XI Thigh Strap Position

1. Play with this until you are satisfied that you know how much webbing you need for each end. Then cut yourself the right length of webbing and heat the ends until they melt a bit in order to prevent fraying. You can use a match for this. Leave some extra webbing at each end for later adjustment if necessary. You never know.

2. Note well. The adjustable side of the buckle (the male side, in my experience) should be attached to the D-ring on the bottom of the canoe so that you can pull it *down* to tighten it. Pulling up is awkward and not likely to hold well.

3. It is more comfortable and secure if the buckle lies against the inside of the thigh, rather than over the top of it. Adjust accordingly.

4. You should be able to make the strap really tight across the knee or thigh, as the case may be. That does not mean you'll have it that tight all the time, more likely you won't. But you do want to have the ability to do it. Even when really tight, the strap should allow you to fall out of the boat if necessary. You want to have the choice of staying in or falling out, every time.

X. Placement of Anchors

1. Place the anchors so that the webbing will fit snugly on the knee or thigh, as the case may be. Before you glue anything, play around with it and make sure it works for you. You might want to tape the anchors first just to see how they will fit.

2. When you glue down the anchors, see to it that the D-rings are positioned to allow the webbing to lie flat against your leg.

XI. Ankle Blocks

7. One of the many sources of pain in WW canoeing is the ankle, which is being stretched beyond its normal range of motion and bearing a load in an odd way. Put some support under it and most of that pain will go away. I use a block of minicell shaped to be comfortable. I don't glue it down because I found I would keep kicking it out. Instead, I run some cord through it and tie it do a D-ring that I'm already using for the thigh strap. If I leave some extra string I can move it around depending on where it hurts. This is quite useful because the strain does move around on the ankle.

8. At first I worried about having something loose on a string down there but I have had no trouble with it, and on reflection it seems that the string is too short for anything connected to the paddler to get tangled up with it.

XII. Air Bags

1. You can buy air bags at outfitters or on-line. They are expensive and prone to leaks. I wish I knew how to make a substitute at home, but I don't. I do not know of any brand that is superior to the others.

2. If you buy, say, a Brand X air bag, and the bag leaks the second time you use it, I can almost guarantee that when you start to complain about this there will be this old boater in a Blue Hole or some such thing who'll show you his Brand X bags that he bought when Clinton was president for two dollars at an estate sale for some guy who drowned and have given flawless service ever since, including the time he ran Victoria Falls (had to roll at the bottom, though) and in Tibet.

3. If you have plenty of time, you can spend your day finding the leak (rub soapy water on the bag and look for a stream of bubbles, or else immerse the whole bag in your neighbor's back yard pool or a local lake). Another technique is to put your eye near the bag because you eye will sense very faint puffs of air that you might not notice otherwise. Mark the spot with a bit of chewing gum or something and when the bag dries glue a vinyl patch on it. That will keep you occupied until bed time and might work unless the leak is in a seam. The better solution if you have any money for the purpose is to get an extra set of bags, and if you're going away for more than a day trip, take it with you.

4. You can have fewer leaks if you take some precautions:

(a) Leave the bag a bit floppy. Overfilling makes leaks more likely. Remember that as the sun heats the bag the air in it will expand.

(b) Be careful what you put near the bags. Avoid scalpels and things like that.

(c) Keep the bag out of the elements when you are not using it.

(d) Keep the bag sufficiently inflated so that it won't flap during transit on a car, or else take it out before traveling (too much trouble for me).

(e) If you don't care about weight, you can put something over the bag to protect it from branches and sun damage. Spraying with a protectant such as 303 might also make the bag last longer. I don't really know about that.

XIII. The Pump System

Those of us who have installed electric bilge pumps wonder how we ever survived without them. They weigh very little, take up little space and throw water out of the boat at ten times the rate of a hand pump. They allow you to paddle and pump at the same time, which is a major advantage over a hand pump. They are not expensive—perhaps \$120 for the whole rig (although you can pay a lot more to save weight). Some people even install two pumps, although I opted for one bigger one.

These are the parts of the pump system.

7. <u>The Pump.</u> This handy little device usually weighs only a couple of pounds and costs between \$30 and \$100, depending on its power. The Atwood 1250 is very popular due to its light weight and moderate cost (about \$40), and it will, in theory, pump 20 gallons per minute. I'm using a 1600 gallon per hour (GPH) heavy duty pump from West that cost \$65, but it doesn't weigh that much more.

(a) In fact, the efficiency of the pump is likely to be lower than the advertised rating due to the length of the hose through which the water must travel to get out of the boat and back into the river where it belongs, and also because it has to go uphill to get out.

(b) Pumps are also rated by the amperage they use and most light bilge pumps will draw between 4 and 10 amps.

8. <u>The Battery.</u> Bilge pumps such as these run off a 12 volt battery. The sealed lead acid variety (the newer type is the absorbed glass mat or "AGM")²² weighs about three pounds and costs about \$25. For a lot more money you can get a lithium ion battery that weighs less than one pound.

(a) 12V batteries are rated by amp-hours (AH). This measures the number of amps the battery can deliver continuously for one hour. Thus, a 2.9 AH battery can deliver 2.9 amps for one hour. But, it can also deliver 5.8 amps for half an hour.

(b) You can save battery life by just dumping the boat when you get a chance. That works faster, too.

(c) These batteries are rechargeable. You can buy an inexpensive charger and recharge the battery hundreds of times. It might also be useful to have a transformer that will convert the current from your car electrical outlet to house current for the charger. That way, you can charge the battery on your way to the river or at a campsite. I've charged my battery in the men's room at a campground; they generally have outlets for people's hair dryers or electric razors, and since I don't dry (or even comb) my hair or shave when I'm in a campground (I do shower, if you must know) I feel like I'm entitled to use up some of the electricity on my battery.

(d) More battery life (that is, more AH) means more weight, so you should think about how much pumping time you really need. Thirty minutes of pumping time is more than you need for the average day on the river, even the Dead. At 1600 GPH it only takes about three minutes to empty a solo boat if it is almost full, and that mostly doesn't happen. Remember, it is often quicker and easier to just turn the boat over. For multi-day trips you might want to bring a second battery.

9. <u>The Switch.</u> If the system has a soft spot, this is it. Ten bucks will buy a perfectly good switch, but it won't last long due to inevitable corrosion. Be prepared to replace it annually. There are more expensive switches that in theory will last longer. There is not much anecdotal evidence on the value of a more expensive switch. A big hardware store or a marine supply store will have a variety of switches. The utility of an automatic float switch is debatable. I think you'd want a manual switch as well just in case the thing refuses to turn itself off.

10. <u>The Fuse.</u> You need a fuse (some say, and some say not) to keep the pump from burning out if too much electricity is flowing down the line. When that happens it burns out the fuse and cuts off the flow of electricity to the pump. Fuses burn out a lot (they are

²² Read about batteries at <u>www.windsun.com</u>.

made to die so that the pump can live and they behave accordingly, bless their little metallic hearts) and you need to keep extras handy.²³ They're cheap enough, anyway.

(a) The instructions that come with the pump will tell you which fuse to buy.

(b) The fuse lives in a fuse holder that allows for the necessary wiring. Don't forget to buy one.

(c) In my experience the fuse holder connection is more likely to come loose than any other part, so make sure the wire goes all the way into the connection, then bend it over into the little slot that I guess must be there for that purpose. After that you can crimp the connection down, and that ought to do it.

11. <u>Wiring</u>. The pump will come with quite a bit of wire, but you may need more, and you can get it at any hardware store, marine supply store, or Radio Shack. Just make sure the wire you buy is the same size as the wire that comes with the pump. THE WIRING AND CONNECTIONS DO NOT HAVE TO BE WATERPROOF. So don't drive yourself crazy waterproofing everything. Lots more on wiring below.

12. <u>Positioning of Pump Things.</u> Think about where the battery, pump and switch will be and how you will attach them to the boat. As you consider how to set up the pump, keep in mind that you want to avoid placing anything where it will get in your way or where you'll kick things loose while getting in and out. Here are some ideas (use your own imagination and creativity; don't assume that what you read here is the best way of doing anything):

(a) You can make a cradle for the battery out of minicell foam and glue the foam to the bottom of the boat. Leave some room to run a strap or shock cord around the cradle to hold in the battery. It should be really tight in there because the water will try its best to pull it out if the boat turns over. On the other hand, you do need to be able to remove the battery to recharge it, so you can't use a permanent installation.

(b) The pump must be securely fastened to the bottom of the boat, but ideally will also be removable.²⁴ You can use two D-ring anchors, one on either side of the pump, and then use a strap or shock cord to hold down the pump. A strap is more secure. Industrial strength Velcro might also work, but I found that the regular Velcro is not strong enough to hold a pump in turbulent water. Also you want the pump right on the bottom to pick up the most water and Velcro will raise it slightly. You can even glue the bottom of the pump to the boat, but then you can't move it.

(c) Most people put the battery and pump close together right behind the saddle, but others put the pump in front and the battery in back, etc. The less wiring the better, I say. Also, I think that running all the wiring through the saddle is a good way to keep it secure and out of the way of your hands and feet.

²³ I have now learned that other people's fuses don't burn out a lot, which should tell you something about how much store to put in these instructions. Also, some very knowledgeable boaters don't even use fuses. ²⁴ That way if you have more than one boat, you can get along with only one battery and one pump.

(d) There are different points of view about the placement of the switch. I like it in front of the saddle. I can find it there by touch and I won't be kicking it as I enter and leave the boat. I then run the wires back to the battery and pump by running a slice down the side of the saddle and stuffing the wiring into it. It is safe and secure there, and out of the way of my feet. A very good paddler I know mounts his switch on the inside of the gunwale for quicker access. He likes being able to operate the switch without changing the position of the paddle too much. He is willing to put up with wiring running up the side of the boat.²⁵

(e) Switch Mounting.

(i) You can use a small block of minicell for the switch mounting. You'll put the switch into the block of foam and then glue the foam to the front of the saddle.

(ii) The switch handle will extend forward though a hole in the foam.

(iii) If you want to use a switch plate you can buy a cheap one at the hardware store and glue it to the foam, or cut a piece of ABS to size, make a hole in it and glue it to the foam.

(iv) If you want your switch plate to be even more secure, you can screw it into the foam, but in that case use an anchor bolt because the foam won't hold the screw very well. I suspect that glue alone will do the job.

(v) One advantage of a gunwale mounting is that you can screw the switch plate into the gunwale. This is easy and secure.

(vi) It's not going to be waterproof so don't worry about that. It will work anyway.

13. <u>Wiring</u>. The pump, battery and switch all may come with simple wiring instructions. Briefly:

(a) One wire goes from the switch to the fuse and then to the positive (red) terminal of the battery;

(b) The black (negative) wire goes from the pump to the negative (black) terminal of the battery;

(c) The other wire out of the pump goes to the switch. Since you want to be able to take the pump out, you should have a way to detach and reattach this wire. Cut the wire and put on a male and female spade connector set. That will do the trick.

(d) The battery is made to connect with the wires using spade connectors (female) at the end of the wires (the battery terminal is the male end). I've found that these wash off in turbulent water and I'm covering the connections with duct tape. However you decide

²⁵ Having tried this in another boat, I think it is pretty good.

to do it, you'll want to devise some means of keeping the connection secure with water sloshing all around it. If you are using spade clips, you can squeeze the female end with pliers to make a tighter fit.

(e) It's nice to have a wire cutter and a wire stripper (often found on the same tool). You can use a sharp knife for this, but the tool is mighty handy. It probably also has a crimping function, which is handy, too.

(f) <u>Extending the length of a wire.</u> Strip about half an inch off each end of wire you want to join. Then, insert each end into a butt connector. Get the kind that has a heat shrink feature, so that heating the connector causes the tube to shrink into place. Use a match to shrink the connection, or a heat gun is even better. In addition, crimp it down. You'll get a waterproof connection, but more importantly, the wires should stay in place. The water moving around the connection is quite mischievous and a good mechanical connection that can stand some stressing is a plus.

(g) You can also just twist the wire ends together and wrap electrical tape around the joint, or use a heat shrink tube. This is not as good in terms of resisting water action trying to undo the joint.

14. <u>The hose goes from the pump to the outside of the boat</u>. If you don't want to cut a hole in the boat, just run it over the side and secure it somehow. If you don't mind a hole, you can buy a *thru-hull connector* in a marine supply store or on the web. It makes a nice, neat fitting. The hose connects to it. You can get either a straight or a 90 degree thru-hull connector. The latter is good for avoiding kinks in the hose, but it does reduce the GPH moving through the fitting.

(a) Make sure that the hose fits the outlet on the pump, which is usually 1-1/8 inch.

(b) For maximum flow, the hose should be smooth, not corrugated. Place it out of the way of your feet, but where you can see the outflow to determine whether the pump is working. The pumps are quiet and you may not be able to hear yours in a rapid.

(c) The efficiency of the pump decreases with the length of the hose, so shorter is better. Pumps that exhaust through the stern look pretty cool, but they do not empty the boat as fast as pumps attached to a shorter hose.

(d) If you do want to cut a hole, you can do it with an electric hand drill and an attachment that will cut a one-inch hole (available at most hardware stores). Then, use a file (preferably rounded) to make the hole just a bit larger. The thru-hull fitting should be the appropriate size for the hose.

(e) The hose and thru-hull fitting are available at marine stores. As with other items, you can save time and money by deciding in advance all the things you want to buy from that one vendor. The marine store is pretty good for all the pump things, including the electrical connections and batteries.

Figure 7





Figure 7A

Thru-hull fitting from the outside.



Figure 8

Here you can see the following

1. The battery is lying in a cradle made of foam. The cradle is glued in.

2. There are two one-inch D-ring anchors, one on either side of the pump. There is a shock cord running from one anchor to the other, and also some oneinch strap that attaches with a buckle. The strap runs over the pump outlet and holds the pump in place quite firmly.

3. There is also a strap to hold the battery in place. It runs under the cradle (so make a channel for it before you glue in the cradle).

4. That yellow thing is the fuse holder.

5. The wiring will be easier to deal with if you tape the wires together into bundles. I used electrical tape for that.

6. The vinyl on top of the pump was a mistake. Ignore it.

7. Note that the wire coming out of the fuse goes to the red terminal on the battery. The other end goes up to the switch.

8. Do you see the light blue thing in the lower right quadrant of the picture, near the center? That is the spade connector that connects the pump to the switch. You need that so that you can remove the pump.

9. The negative (black) wire from the pump goes directly to the black terminal on the battery. Thus,

(a) One wire starts at the switch, goes from there to the fuse holder, and from there to the red terminal on the battery.

(b) One wire (generally black) starts at the pump and goes directly to the black terminal on the battery.

(c) One wire (the one that is not black) starts at the pump and goes to the switch, but has a connector on it so that it can be detached in order to remove the pump.



Figure 9

Gunwale mounted switch. The switch itself is mounted to the hard plastic (ABS). I found a nice piece of it laying in the road; it must have come off a truck or something. You can find a lot of free stuff in the road. The plastic mounting is screwed into the gunwale. It is on the left side because I happen to be left handed.

The wiring from the switch runs under the gunwale to the air bag cage and then along the cage down to the pump and battery, both of which are in front of the saddle in this boat. In my other boat the switch is mounted on the front of the saddle and the wiring runs back though the saddle to the battery and pump installed behind the saddle. On balance, I like the switch on the gunwale where I can see it and I don't have to reach down to it.



XIV. Attaching Things to the Boat

I've been criticized for having things hanging off my boat,²⁶ which supposedly makes it harder to rescue. So, I finally fixed it up. Here are some ideas:

1. Buy a dry bag with clips on both ends so you can clip it down to a thwart. You can also glue a D-ring to the bottom of a bag (so that now you can attach it at both ends) and then clip the top of the dry bag to the thwart and the bottom to the air bag cage using an inexpensive carabiner.²⁷ Make sure it's out of the way of your feet.

2. My wife bought me a *big* carabiner and I clipped it to a D-ring at the bottom of the boat that I also use for the air bag cage. I can clip other things to it. You can see it in Figure 10.

3. Add a D-ring in an opportune place and use it to keep things in the bottom of the boat.

Figure 10

²⁶ Water bottle, dry bag, and throw bag are the principal offenders.

²⁷ This word can be spelled properly with either a "C" or a "K."

This shows a cheap, do-it-yourself air bag cage. It works just fine and the whole thing probably cost \$15, front and back. I ran a string through a D-ring on the floor (which I also use to secure gear on the river) through a metal circle such as you see as a key-ring, ran the cord through the webbing connected to the metal circle, and then over to the other side. It creates a triangle. As usual, I used whatever I could find around the house, so it is not pretty, just functional. You can make it pretty, of course, and maybe some day I will. I didn't have any more of the cord I used for the top of the cage, and used white for the triangle because that's what I had.

Ideally the bag will not have room to float up when there is water in the boat. Some people run a strap from the D-ring on the floor forward (or back) to the little end thwart. I wonder whether the strap adds anything if the bag is already held down by the cage.

If the stern bag is getting in the way of your feet or you think there might be a risk of entrapment, then try securing the corners of the bags (these have grommets, but not all do) to the metal circles or tie them to one another to keep them out of the way.



XV. Skid Plates

A. <u>Purpose.</u>

Skid plates are designed to alleviate wear on the hull of the boat in the bow and stern. They consist of a piece of kevlar cloth that is laid down on the hull with liquid resin and hardener. Outfitters sell them as kits or you could buy the components separately at a hardware or marine supply store.

The advantages of skid plates are

- 1. They will take the shock of a collision with a rock much better than royalex will. They really can take a beating when it comes to hitting things head-on;
- 2. They reduce the guilt of dragging the boat instead of carrying it. If you can manage to make the skid plate the point of contact with the ground while dragging, you will reduce the amount of wear on the boat to a mere fraction of what it would be if the hull will in direct contact.
- 3. In short, skid plates extend the life of the boat, possibly by years depending on how you are using the boat.

B. Installation

If you install the plates on both ends of the boat, they won't affect the trim. In fact, I have not noticed any change in the performance of a boat on the water after I added skid plates.

The disadvantage is weight. Skid plates weigh a lot. It is interesting to note that the boats with a lighter layup are the ones that need skid plates the most, but then the skid plates tend to cancel out the weight advantage. Such is life. Anyway, even a tough, heavy boat will last longer with skid plates.

The resin and hardener are nasty. Do this work outside and wear gloves. One nice thing about the kits is that they generally come with gloves so you have no excuse not to use them.

The kits come with instructions or you can search on-line for "canoe skid plates" and you'll find plenty of information and pictures.²⁸ Basically, you put the cloth down on the boat so that it covers the curve of the rocker. Then you combine the resin and hardener in exactly the specified proportions, wait the specified amount of time, then apply the liquid to the cloth. Then let it dry. Do this correctly and the skid plate will last for a long time. Follow the instructions very carefully.

Here are the instructions provided on the Northwest Canoe web site:

²⁸ Here is a useful link: http://skidplatekit.com/.

1. Turn your Royalex canoe upside-down on sawhorses and stage your work area before mixing resin and hardener.

2. Surface preparation is critical. Trim away loose delaminating outer skin. Clean off dirt, grease, oil and surface crud with detergent (like Dawn or Simple Green) and water.

3. Lay the dry felts (i.e. the cloth) on the canoe and trace the outline. As a general rule position your plates ten-to-twelve inches below the gunwale, tip an inch or two above the waterline [felts saturated with resin will gain 10-15%, primarily in length].

4. Set the dry felt aside. Sand inside the lines. Use a clean rag and wipe the sanded area with acetone.

5. When installing on polyethylene canoes [Old Town calls the material PolyLink3; Mad River, TripleTough; Wenonah, TPR], you must flame the surface. Adjust the blue cone to 1" and rapidly sweep your torch back and forth across the area receiving the skid plate. This open flame step is critical. You want to BLUSH the surface, not heat it.

6. Mask the prepped area to catch the inevitable drips.

7. Pour ALL of one hardener can (B) and one resin can (A) together and stir for two minutes. It's pre measured. You have plenty of resin to saturate one felt.

8. GET THE CATALYZED RESIN OUT OF THE CUP. You have 15-20 minutes of working time. Pour a line of resin onto your work surface (this is where the trash bag comes in), lay a felt in the pool of catalyzed resin, pour the other half on top of the felt. Work the felt with gloved hands like bread dough or by dabbing with the brush. The felt must be thoroughly saturated "wetted-out" with catalyzed resin.

9. Place the wet skid plate on the prepared surface and smooth it out with your hand, working from the center towards the edges to evict any trapped air bubbles.

10. Clean off runs and drips with a putty knife, or rag and acetone while the resin is still gooey.

11. Starting at step 6, repeat for the opposite end of the canoe.

12. Pull the masking tape in about 1 hour.

The right time to add the skid plates is before you put any dents in the boat. The skid plates need to lay flat to work properly.

Figure 11



<u>A skid plate.</u>