Illustrated Guide for Building a Spira International **Stitch And Glue Boat**

Plans for these boats may be found at:
http://www.spirainternational.com/

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Building a Spira International Ply on Frame Boat

by Jeff Spira

Hi, I'm Jeff Spira. I've been designing, building and sailing bosts for nearly 40 years. I'd like to thank you for deciding to buy a Spira International boat plan. These are, I believe, some of the easiest modern home built boat plans available anywhere.

I have a Mechanical Engineering degree from California Polytechnic State University in San Luis Obispo located in coastal central California. While I was at Cal Poly I apprenticed under a Naval Architect and Boat Carpenter helping to design and build boats. I also commercial fished out of Morro Bay fishig for Albacore tuna and Rock Cod (sometimes referred to as Pacific Red Snapper) I also lived on a commercial boat for quite a while while attending school. At this time I did everything I could to get out on the water, whether it was surfing, sailing, fishing, diving, and swimming. If it had anything to do with water, I was ready.

After college I stayed in the marine industry and designed and build heavy load lifting and moving systems for shipyards and offfshore drilling rigs.In 1977, I was the project engineer for the world's heaviest lifting device, the 25,000 ton shiplift platform built in Batangas Bay in the Philippines. This enormous platform could lift 700 foot long ships 60 feet out of the water then transfer them into the shipyard on wheeled bogies for repairs.

I did a number of other shipyards and heavy load lifting and moving systems as well, including the Denver Mile High Stadium east stands expansion (the world's biggest moving land structure at 16 stories tall and 5000 tons) and the moving drill floors for a number of offshore drilling rigs.

You may heve experience with some of my other engineering projects, including the nosewheel steering systems used on all commercial aircraft from the Boeing 737 up to and including the 777. I also designed critical components used in General Motors cars and trucks. So if you have a Chevy or GM truck, everything from an S-10 to the Suburban. full sized pickups and even up to 2-1/2 ton commercial trucks, you are relying on my engineering skills to get you safely home. That system was adapted to the luxury Buick Pontiac and Cadillac sedans as well.

It was into the 1990s though when I began selling my boat designs. I took my very different design philospohy and applied it to easy-to-build, extra strong boats that any beginner can build into a fun and safe boat without specialized materials tools or techniques. You may not think what I do is particularly revolutionary, but it is quite different from other designers and results in a light, strong, very quick to build design.

The boats I design are not wooden boats in the traditional sense. In traditional wooden boats, the wood framing is attached together and the planking is fastened to the frames with fasteners that are used to transfer the loads of the water to the various parts of the hull. Not so in Spira International boats. These boats are designed as unified structures, much like the unibody construction of cars or modern bonded monocoque construction of airplanes combines the framing and the skin into a single structure from a structural point of view.

In addition, traditional wooden boats absorbed water into the wood to become soaked, swelling up to seal the joints. In a Spira International boat, the wood separated from the water by a barrier of epoxy that is a hard plastic when cured keeping water out. These are intended to be hybrid composite boats, not wooden boats, so the standard rules of what constitutes a good boatbuilding material is not applicable to SpiraInternational boats.

Balsa and foam are sometimes used as the cores for composite boats, and these materials are very porus and have low strength, yet they can create very tough hulls, so don’t get too hung up on the strength of the materials you use thinking they won’t make for a sound hull. I’ve analyzed the strength of these structures to be amply strong no matter what species of wood you elect to use.

Tools for Spira International Stitch and Glue Boats

To build the one of these boats, you should also be familiar with using wood working hand tools and hand-type power tool such as saber saws, electric drills, and electric sanders. You could build this boat using only hand tools but power tools sure makes the construction go much faster. I personally find the time savings using power tools allows me to do a better job. For instance, if I set out to sand a boat, I get bored in a few hours and if I'm hand sanding, I won't have made nearly as much progress than if I'm using a power sander. In any case, if you have spent some time using wood working tools, you'll have no trouble building a boat. If this is your first endeavor into any kind of wood working, I'd suggest building a tune up project of some type before building the boat. One great idea is to build a pair of saw horses. You'll need them to build the boat and it will give you a give you a chance to get used to the tools.

To build a Spira International stitch and glue boat design, following is a list of suggested tools you'll need. This can be considered a minimum list.

Power Tools

- Saber Saw
- Electric Drill
- Power Sander (quarter sheet random orbital type)
- Electric Screwdriver (not required but sure nice)

Hand Tools

- Block Plane
- Screwdrivers (both straight & phillips)
- 20 (or more) 2" or 3" "C" clamps
- Hammer
- 3/4" or 1" Woodworking Chisel
- Back Saw
- Framing Square
- Yard Stick,
- 25' Tape Measure

Of course there are some other tools that could come in handy, such as a table saw, a power plane, and one of my favorites, an old fashioned drawknife. Don't concern yourself with having a full tool chest before beginning. You can add tools as you need them.

The concept of too many clamps is not one boat builders are able to grasp. A variety of different types of clamps make boat building easier.

Lumber for Spira International Boats

Not a day goes by that I don't get an email from someone who wants to know if such and such species is OK to use, or to say that their local Home Depot doesn't stock the species of wood I call out on my drawings. I'm in the process of redoing the drawings removing most of the species from them, but until I do, I'm sure I'll get a lot more questions.

The first consideration you should make is usage. If you are planning on a 5 year 'round the horn' sea voyage, obviously you should select your materials with more consideration and care than if you are building a small row boat to keep at your mountain cabin to use a weekend a month on the local lake during the summer months. Nonetheless, you are going to put lots of effort into the construction of your boat and should select the best materials you can, to fit your usage and budget.

There are essentially two different kinds of trees harvested to make lumber. These are Deciduous and Conifer. Deciduous trees are broadleaf treed like Walnut, Oak, Maple, Birch, Mahogany, and similar. These trees lose their leaves in the autumn and regrow them in the spring. Sometimes called broad-leaf trees, the lumber cut from these trees is usually referred to as hardwood.

The other type of trees, the conifers, are evergreens. Pine, spruce, fir, cedar, etc. are conifers. These are sometimes called softwoods. Softwoods are what is used as construction lumber thoroughout the world because it grows quickly, is easy to mill, lightweight, and is strong enough to create sturdy structures.

Traditionally, boats have been built of hardwood framing, and often had softwood planking but that was when each framing piece was required to carry it's full load rather than being part of an integrated structure.

Any softwood, if it is structurally sound is bonds well, is suitable to build the framing for a Spira International boat. In different parts of the US and in different parts of the world, different species of woods are used as construction materials. For instance, if you walked into a Home Depot in Florida and bought a 2x4 off the rack, it would probably be Yellow Pine, if in Oregon, it would probably be Douglas Fir. Either are equally acceptable from a structural viewpoint to build a Spira International boat.

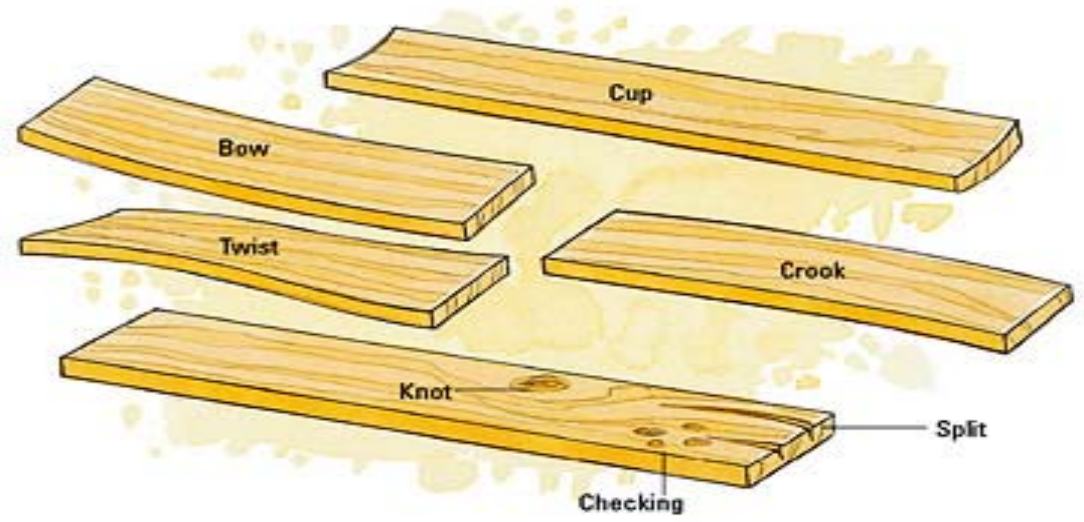
You can certainly also use hardwoods if you prefer, and some of these are excellent choices, like Mahogany - easy to work, rot resistant, not too expensive, but others might be a bad choice - like Teak - splits easily, doesn't bond well because of the high oil content, or Maple - very difficult to cut and form. It is always advisable to get some sample material before you start and try cutting, planing, and forming it so that you know what you're getting into before you invest heavily in materials and get started on a project that has as many labor hours as a boat.

Conifers include such species as: Douglas Fir, Grand Fir, Incense Cedar, Lodgepole Pine, Mountain Hemlock, Pacific Silver Fir, Ponderosa Pine, Sitka Spruce, Western Hemlock, Western Red Cedar, White Pine, Yellow Pine, and others.

Deciduous trees include Maple, Cypress, Hickory, Oak, Walnut, Willow, Cherry, Dogwood, Elm, Ash, Birch, Beech, Buckeye, Pecan, Ironwood, Poplar, Paw Paw, Olive, Sassafras Tree, Cottonwood, Sycamore, and others.

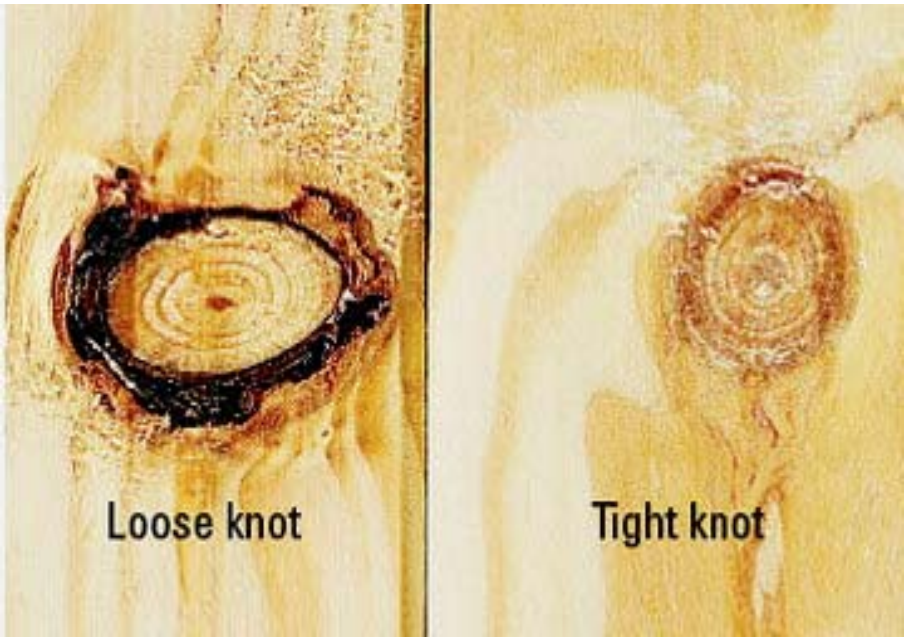
I've been asked if pressure trated lumber is a good idea for building boats. Well, it certainly isn't necessary, and there's really no need to go through that expense, however if you live in a very high humidity environment, where it rains frequently, you may wish to use pressure treated lumber even though though the wood is sealed with epoxy. The enemy of wood in boats is fresh water, not salt because "dry rot" is really a fungus that only grows in the presence of fresh water. Saltwater kills the plant. This should also be a strong hint to keep standing rainwater from collecting in your boat. A cover and open drain plug holes, when your boat is stored outside are always a good idea.

The biggest concern with using construction grade lumber for building a Spira International type boat is deciding what defects in the lumber are acceptable and which are not. Here are a few of the common defects in construction lumber:



The cups, twists, and warps present no major problems if not too severe, but checking, knots and splits are of some concern. Examine your structural pieces carefully for splits, Any splits should be avoided in all framing. If you discover one after you've already assembled and glued up your framing - don't worry about it, but it is best to cut off any splits you find in lumber before you assemble frame elements.

Knots present a special problem. I often specify clear lumber, which is knot free, but small tight knots are not a problem so long as they aren't at the corner edges of the lumber. Here are some examples of tight and loose knots. Do not use lumber with loose knots:



Plywood for Spira International Stitch and Glue Boats

The question always arises on whether to use marine or construction plywood for building boats. Let's first discuss the different types of ply. There used to be a type of plywood called interior ply that was manufactured using natural glues that would let loose when wet. It is not made anymore. Nearly all ply made now, that I've ever come across uses synthetic, waterproof glues.

Plies made of softwoods, usually fir but sometimes pine, have knotholes. If these are left open on the surface laminations, it is called "C" grade. If the knotholes are filled with football shaped plugs, it is considered "B" grade, and if it has no knotholes, it is considered "A" grade. So ABX plywood would have no knotholes on one side, filled knotholes on the other and has been laminated with waterproof glue (X = exterior.) The problem lies in the interior laminations. In most plywood the knotholes are left unfilled leaving a void on the inside. In marine plywood these interior knotholes are also filled leaving the ply void free.

For my boats, I only recommend marine plywood in the event the builder elects not to fiberglass and epoxy coat the boat on the outside. If the builder decides to glass cover the boat ABX plywood is sufficient.

As an alternate to marine or standard plywood, hardwood plywood may be used. Mahogany and Birch are the most common. They have no knotholes, so don't have any voids. The only downside to using hardwood plys is that they don't bend easily so sometimes you need to laminate two thinner layers of plywood in an area where there is a lot of bends.

Fasteners for Spira International Boats

Screws? Nails? Bronze? Stainless? The array of possible fasteners for home built boats can be confusing, so I thought I'd offer a few guidelines on what may be the best for you. First, you need to know that stitch and glue boat designs don't rely on fasteners as do their older plank on frame ancestors. Stitch and glue boats rely on the epoxy adhesive for joint strength. Epoxy will not fail if properly applied - the wood will break before the joint will give way. This means that when you use epoxy, all the fasteners really do is hold the joint in-place until the epoxy cures. After the epoxy sets up you could theoretically remove the fastener and not affect the joint strength.

It used to be that stainless steel was very expensive, but with most of the fasteners coming from offshore, stainless just isn't that expensive any more and for most trailerable boats, stainless makes an ideal fastener. It doesn't corrode normally with a boat that is kept out of the water even when used in seawater. I can hear the comments from readers now, "but what about everything I read that it corrodes when in seawater and embedded under a sealed surface..." Yes, OK, it can corrode under certain circumstances, but in my opinion, these are few and far between, and see the paragraph above - If it does corrode so what?

For a boat that truly is kept in a slip in the ocean, silicon bronze is probably a good idea. It's the finest of all boat building fasteners. They don't come in deck screw shapes, so you'll have to pre-drill

starter holes, but you'll be able to drive them in with a cordless drill if you purchase Phillips head screws. You'll probably find silicon bronze ring type boat nails the easiest way to fasten the ply-wood planking to the framing on a ply on frame boat using bronze fasteners. The thought of drilling all of those starter holes in a ply covered boat would be a daunting task.

A good friend of mine and fellow boatbuilder suggested I look into Raptor Nails for use in boats. These things are incredible. They're composite so can't rust, weather or weaken due to environmental conditions - plus they can be cut with a saw, plan, sandpaper or rasp without damaging the tool's edge. You can pick up a pneumatic gun and shoot them in-place to fasten bonded joints. There's some buzz in the boat building community and those who tried them love them. In your next boat you might think about investing in these new fasteners. They sound like a boat builder's dream. They'd make the ideal ply fastening system.

For stitching wire, I generally use 18 gauge copper. I used to work for a company who made trans-formers and had lots of scrap enameled wire in their recycle bin. They were OK with employees taking some home for their home projects so I raided the bin on occasiona and always had an ample stock. If ther is an electric motor rewinding shop in your town, they'll probably sell you used wire for the scrap copper price and may even give you enough for a boat, especially if you show uo with a case of beer on a Friday afternoon. You can also use bare wire. It is just as effective as enamel isulated wire.

Some builders use plastic tie-wraps intended for binding together electrical cables. These work great and are inexpensive and covenient. There is also no advantage in removing them. I've heard of people using heavy gauge fishing line as well, but take it from a guy who worked on a commer-cial rock cod boat and has tied thousands of knots in 120 lb test monofiliment. Tying that many knots is not only difficult, it can be painful as well

Epoxy and Fiberglass Cloth for Stitch and Glue Boats

I often get e-mails from people asking about what kind of epoxy is best to use for building my boats. I've used an online supplier, John Greer, in the past and find his products excellent quality and very well priced. He ships quickly, answers questions promptly and also stocks thickening agents like cab-o-sil and microspheres, and also carries fiberglass cloth and tape, also at excellent prices. Check out his web site: http://www.jgreer.com/.

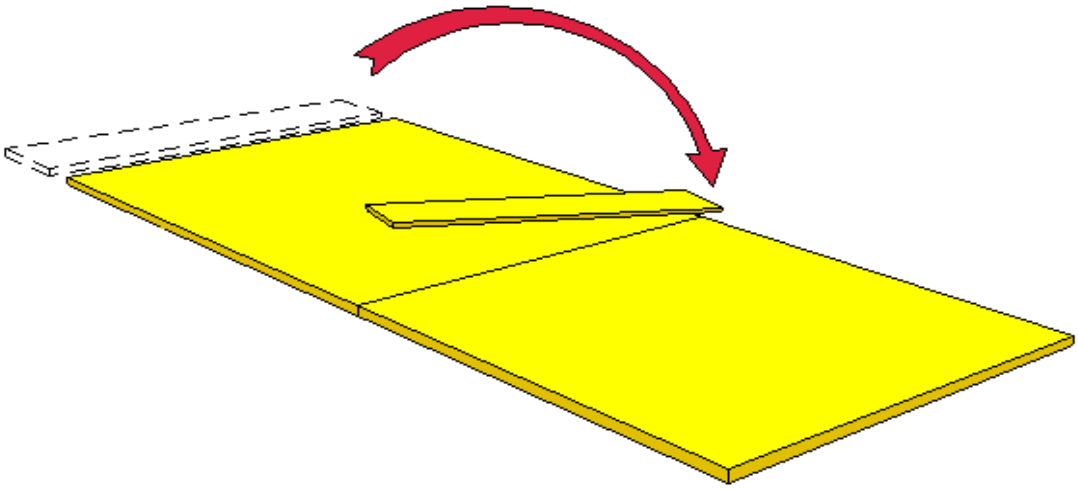
For most of my boats, 6 oz cloth is the best. On the larger hulls, you can use a layer of 10 oz to build up some thickness quickly, but you should use a 6 oz as the top layer. It will be much easier to sand out the texture.

Stitch And Glue Boat Building Procedure

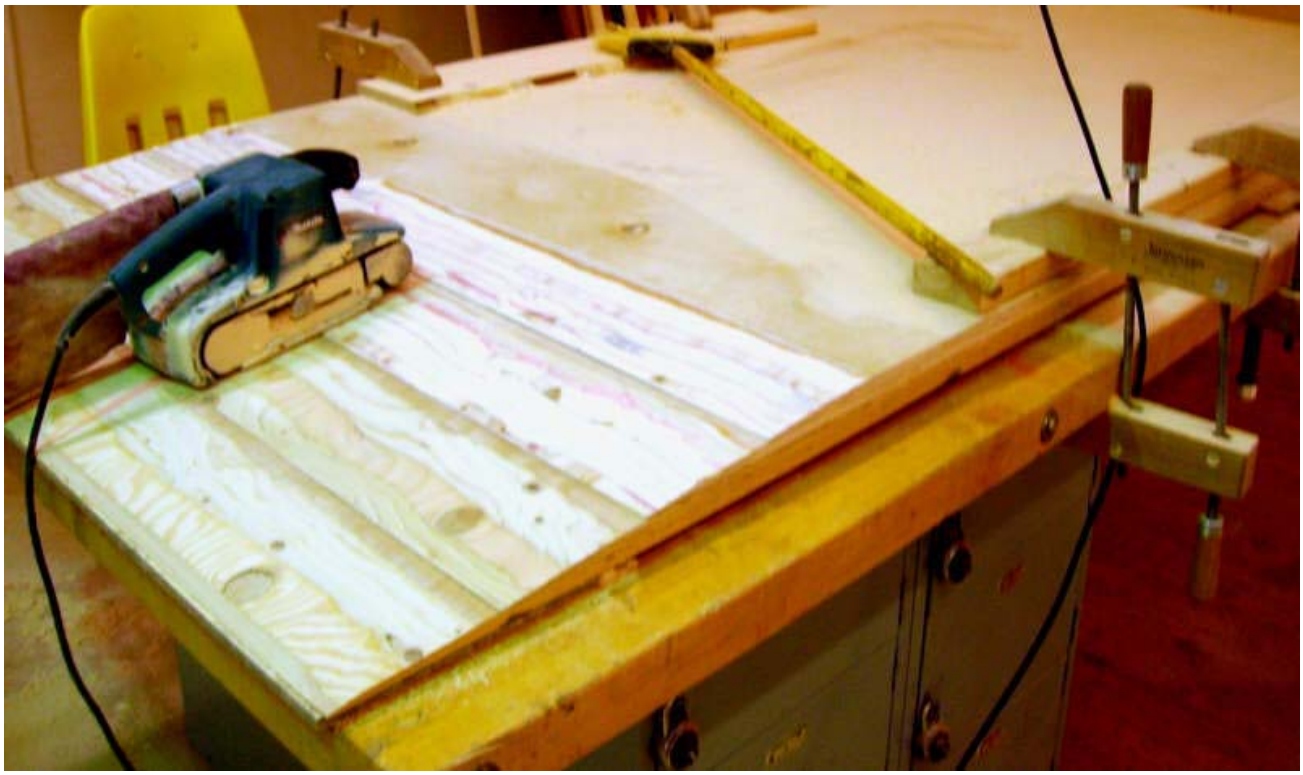
The Stitch-and-Glue boat designs are perhaps the easiest to build of any plywood boat designs available today. They are also reliable, seaworthy small boats able to handle most lake and near coastal conditions. Of course, there's no substitute for common sense and anyone contemplating taking one of these boat out in any rough water should be thoroughly familiar with small boat handling in poor weather conditions.

No special jigs are required to build most stitch and glue boats, unless they are called for on the drawings. They can be cut out and assembled on a garage floor, a low bench, or sawhorses.

Most of the stitch and glue boats call out for butted together panels. This is accomplished by cutting off a 6” wide butt block from the edge of one panel, then butting the factory finished edges together, spreading epoxy on them and epoxying down the butt block to reinforce the joint. Bricks, paint cans or other heavy objects are them stacked on the butt block while the epoxy cures.



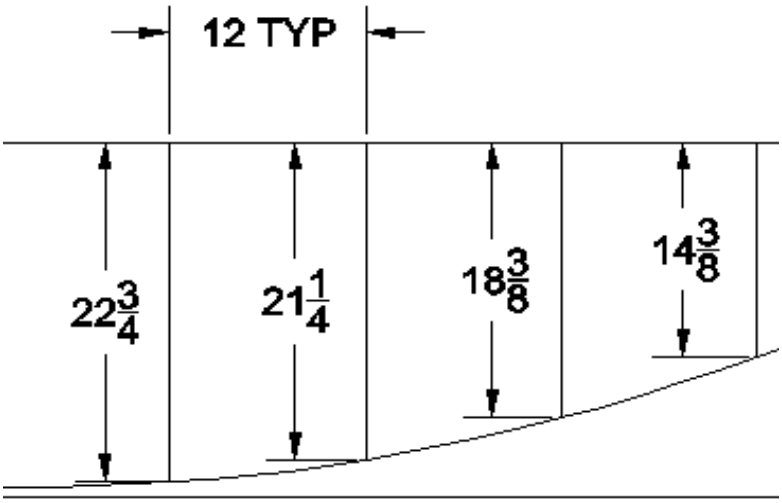
Some builders may prefer to use scarf joints. These are stronger and result in a more smoothly bent joint, but are more difficult to make. An 8:1 scarf jint is best. Some use a plane to make the joint, some prefer a sander, but the easiest of all is a scarfing saw.



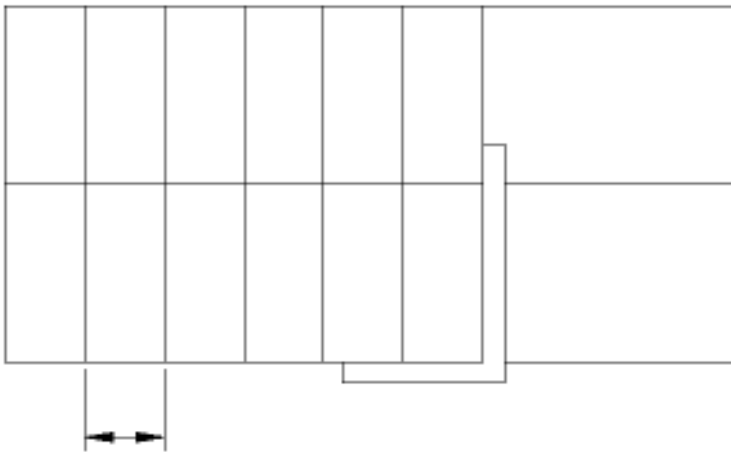
Stitch and Glue Plywood Layout

Understanding the terse nomenclature on drawings is sometimes difficult if you haven't taken a formal course in drafting or engineering, and I occasionally get questions on what something means, so I thought I'd put together this guide to show how the plywood panels are lain out and cut out for stitch and glue boats.

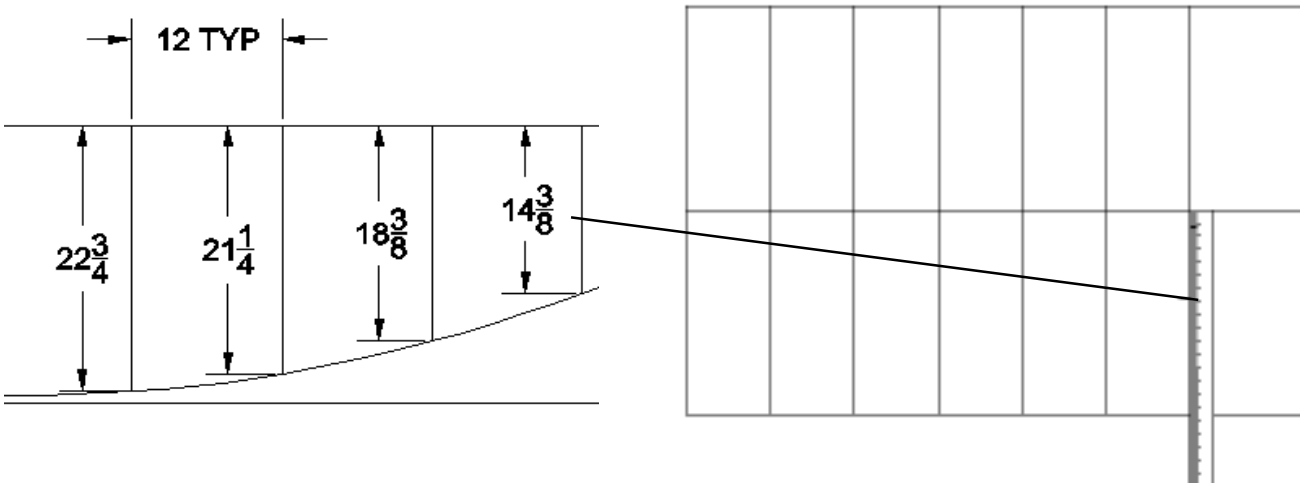
Here is a section of the Mission Bay drawings showing the panel dimensions:



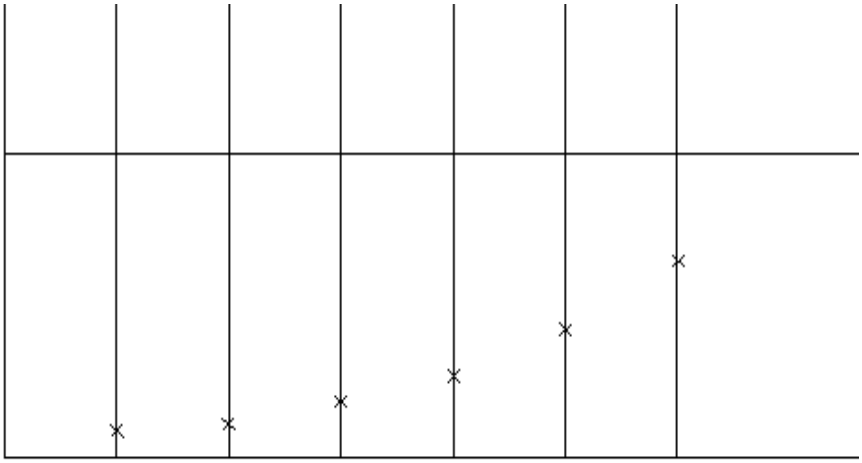
The 12 TYP, means that the lines you need to draw are spaced 12” apart typically, in other words, all lines. Occasionally this may be written 6x12 meaning 12” apart, 6 times (6 spaces = 7 lines.) The easiest way to accomplish this is to use a framing square and draw the series of lines:



Once you have the grid of evenly spaced transverse lines, you simply measure and mark the distances along those lines as indicated on the drawing:



That will result in a series of points that describe the curve you wish to draw and cut out:



Next, the plywood panels are cut out using a saber saw or similar tool. Some builders like the small panel saws because they cut straight so well, but they’re more difficult to get to cut nice curves. In any event, the panels are usually cut out slightly oversized then trimmed to size using a block plane

For symetrical panels or duplicate panels, you can use the part you cut off as a pattern for the other side, or the duplicate panel. This makes sure the two panels are identical and saves you a lot of layout work as well.

About every 4 inches or so, drill a 3/32” hole, about 1/2 inch from the edge in both adjoining panels along the seam. Thorough these holes insert a 6” piece of 18 gauge copper wire and twist the ends together to make a “stitch.” Some guys use plastic wire tie wraps also. Your first time through should be very loose. Then gradually tighten the “stitches” just until the joints just come together and touch - not too tight.

Tape the outside of the seams with plain old masking tape after the stitching is complete to prevent the joint filler from dripping through too much. You’re going to stitch and glue the inside first.

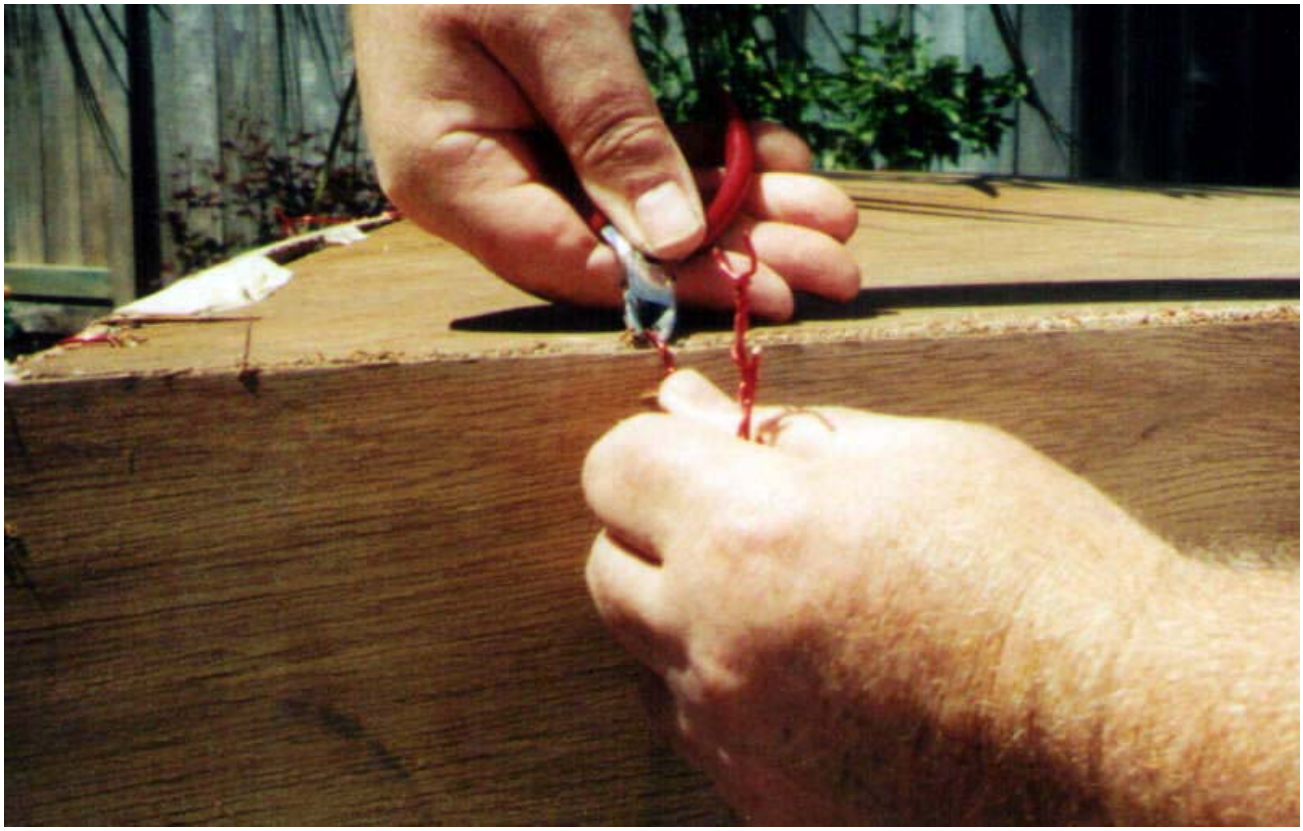
Mix up about a pint or so of epoxy and add a thickener. You can use Cab-O-Sil a silica based filler, microspheres, talc, or wood flour (clean out your sanders for the perfect filler.) After you stir the 2 part epoxy thoroughly, start adding the filler while continuing to stir until the mixture gets to a putty-like consistency that will not run, to make a fillet of thickened epoxy in the joints. Begin on the inside and make a fillet along all the joints - both the planking joints and both sides of the bulkhead to bulkhead joints.

While this joint is still wet, mix up another batch of unthickened epoxy and use it to epoxy down fiberglass tape over top of the seam fillet you just made. This makes sure both wet out well and the joint becomes very strong. Some of the larger stitch and glue boats require several layers of fiberglass tape lapped in such a was that the number of layers tapers from the center of the joint to the edge. Consult the plans for specifics if this type of joint is required for the boat you are building.

Once the epoxy sets up, flip the hull over.

You can elect to remove the stitches now or not. Most people remove them if they are using copper wire. The easiest way is to just use a car battery and jumper cables. Untwist the stitches and touch the leads to the two ends of the wire stitch. It will heat the copper enough to release it from the epoxy and it can be pulled out easily.

If you are using tie wraps or elect to leave the stitches in, simply clip off the stitches and file or rasp the surfaces smooth.



Spend some time now to clean up all of the edges on the outside of the hull. You'll want everything nice and smooth. Mis up another batch of epoxy and fill it to make another batch of filler putty and carefully fill all of the cracks on the outside seams. While you've got your filler putty mixed, fill any holes, or voids in the outside of the plywood.

Mix up another batch of unfilled epoxy and apply yet another layer of tape just like you did on the inside. On some hulls, like the larger v-bottom stitch and glue boats, several layers of tape are required. You can put these on while the layer below is still wet or tacky if you wish, or you may allow them to cure before adding additional layers I prefer the former, applying all three when the layer below is still wet.

Once the epoxy is fully cured, it is time to sand the outside of the hull. Take your time to get everything smooth and ready for the fiberglass coat atop - if you plan to use it. On the smaller hulls an overlayer of fiberglass it is not required, but on the bigger hulls it is. If it is not desired, after sanding, saturate the outside of the hull with straight epoxy to seal and strengthen it.

Once the hull is smooth and sanded, it’s time to fiberglass.

Some people elect also to use fiberglass tape on the seams. This is a good idea as it reinforces the joints well.

To glass the hull, begin by cutting out the fiberglass so that it overlaps all edges and its own panels by at least 3”

It is best to cut all panels out first, bottoms and sides, because you’ll want to make sure that once you mix up a batch of resin you use it all before it starts to harden - usually 3 or 4 hours. You could apply both layers of glass for most boats in this amount of time. It is perfectly acceptable to add a layer of fiberglass over another layer while it is still wet. In fact it is preferred.

If the plans call for a layer fiberglass between two layers of plywood, have the second layer of plywood cut out and ready to go, too. You’ll want to get it on before the epoxy is fully cured.

Next, mix up a batch pf epoxy resin in accordance with the manufacturer’s recommendations and paint or squeege it on the area you wish to fiberglass:

Then spread out the glass cloth on the wet epoxy, apply a second coat and squeegee it in until the glass cloth turns from white to transparent. This tells you the glass is wetted out properly.

You can lay the second layer of cloth right over the first that you just wet out if it is still tacky. If the epoxy is cured already, apply another coat of epoxy resin over the cured epoxy fbefore laying the next layer of cloth on.

Once it is cured you will be able to see the texture of the cloth on the surface.

This will require considerable sanding to get smooth. A trick to minimize this effect is to use plain old waxed paper, the kind your grandmother wrapped sandwiches in. Just lay it on the wet glass/ epoxy surface after wetting and roll down. After the epoxy cures, the waxed paper will peel off and leave a smooth surface that needs only minimal sanding.

Once you peel off the waxed paper, three things need to be done: 1) sand, 2) sand, and 3) sand some more.

The sander can also be used to trim the excess fiberglass that extends above (below when upside down) the sheer line. This is probably the easiest way to do this.

About now, you'll start to wish you had taken up basket weaving instead of boat building, but keep at it anyway, and eventually you'll get the finish nice and smooth.

The rub rails come next. These are put outside of the fiberglass so that they can be changed or repaired ore easily. Their purpose to to absorb bumps and dings so that your hull doesn't take that abuse, so expect some wear over time:

Next comes time for paint. Often boat builders are confused on which type of paint to use. Your paint selection will depend on your intended use and application. If it is going to be used occasionally in fresh water, and stored dry in a garage or shed, you don't have to be too picky - any expterior enamel will work just fine. If you intend to store it outdoors, you may wish to use an epoxy paint, as the next step up, and if you intend to keep it in saltwater for extended periods of time, a marine paint will give you the best endurance. Ask your paint supplier if a primer is recommended with teh type of paint you intend to use. I nearly always use one for exterior enamel, rarely for epoxy paint.

You can apply with either a spray gun, if you have the equipment and experience, or with a brush:

If your plan is to let the wood shine through, apply several coats of polyurethane varnish over the outside of the hull are called for. This will seal the surface, make it shiny, and protect it from both ultraviolet rays from the sun and from degradation from the water.

Now, you'll want to flip th ehull over and work on the inside. The larger hulls call for fiberglassing the inside but most do not. All they need is a layer of epoxy to seal and strengthen the wood.

Congratulations! Your hull is now done!

Most of the stitch and glue boats have the seating and such worked out for you. These may be used as designed or modified to suit your needs. Once your hull is complete you need only attach any desired accessories, like cleats, oarlocks and such and enjoy!

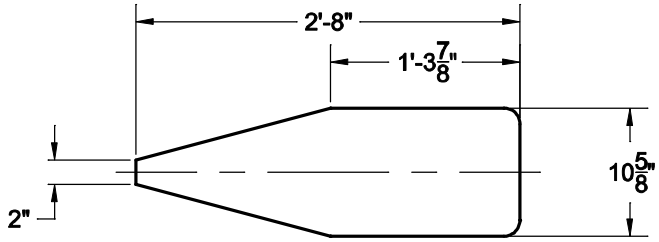
Appendices

These drawings are offered as optional information. They may or may be applicable to your particular boat.

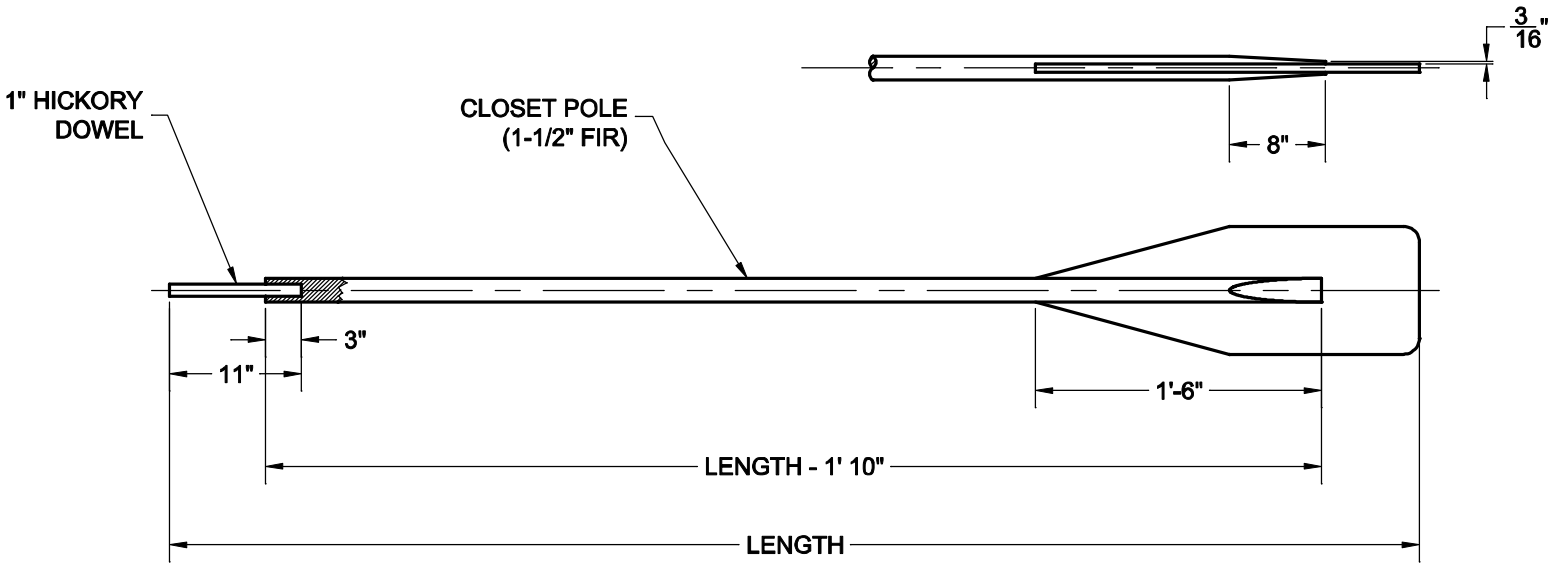
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

NOTES:

1. SUITABLE LENGTHS 6' TO 7 - 1/2'
2. EPOXY ALL JOINTS
3. WRAP HANDLE WITH CORD OR USE HYPALON GRIPS
4. SATURATE ALL BARE WOOD SURFACES WITH EPOXY
   OPTIONAL: COVER WITH 1 LAYER OF 6 OZ FIBERGLASS CLOTH & EPOXY.



PADDLE BLADE - 1/2 PLY - 2 REQ'D

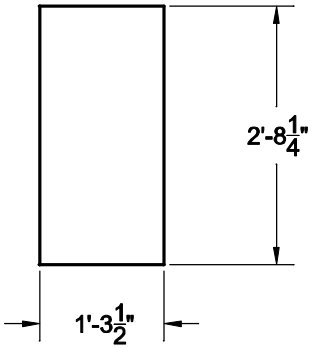


Spira International, Inc.
Huntington Beach, California

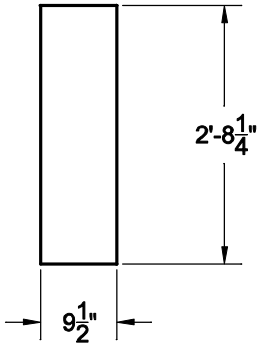
HOME BUILT OARS

DRAWN BY:	DATE:	DRAWING NO.
J. SPIRA	04/10/09	OARS01
SCALE 1-1/2" = 1'		SHEET OF

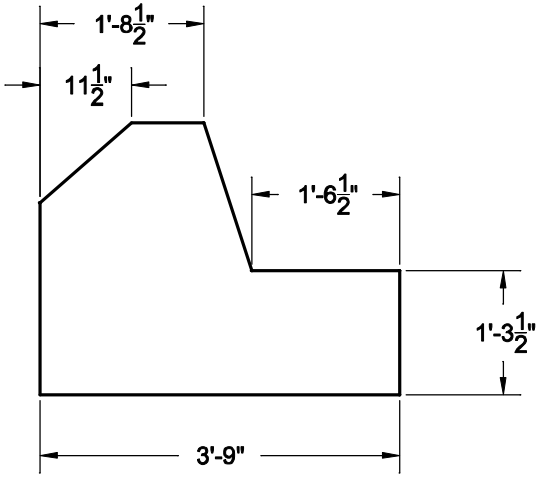
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	UPDATED TO NEW FORMAT	01/07/09	JJS



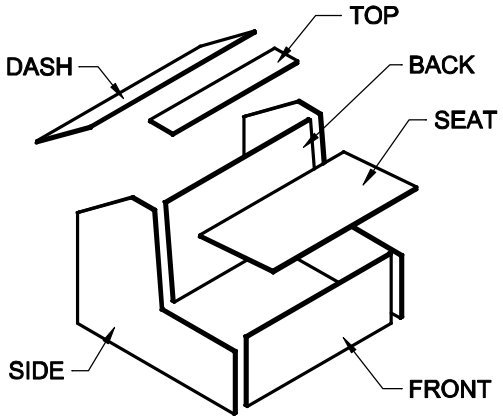
DASH

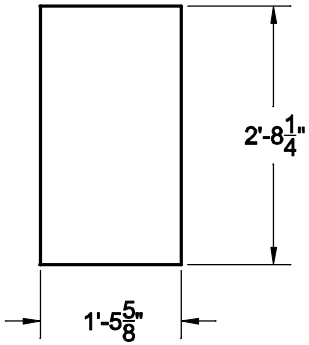


CONSOLE TOP

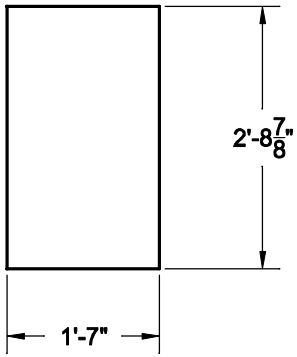


CONSOLE SIDES
2 REQUIRED





BACK



CONSOLE SEAT

ALL PARTS MADE FROM
1/2" PLYWOOD

Spira International, Inc.
Huntington Beach, California

CONSOLE DETAILS
VEE BOTTOM FISHING BOAT

DRAWN BY:	DATE:	DRAWING NO.
J. SPIRA	04/09/02	SAND06

SCALE 1" = 1' SHEET OF