Timber BoatWorks

Complete Stitch and Glue Manual

Instruction Manual for Jigs, Drilling, Stitching, Alignment and Gluing, Epoxy and Fiberglass, Polyurethane Painting, Gel Coat, Graphite Undercoating

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SECTION 1 Basic Overview and Tools Required

The stitch and glue method are when holes are drilled and wire is used to assemble larger flat panels to create and hold the panels in shape until an adhesive can be applied to the joints. Depending on the panel material very complex designs can be created including marine, airplane, remote controlled are planes and trailers. Once the panels are in position, they are glued with epoxy or polyester resin and then the stitches are removed and the surface can be finished or other fiberglass can be added to the inside and outside of the surface to solidify the shape. The stitch and glue method requires basic tools and skills, with an understanding of the intended shape panels can be quickly added to build the project before gluing and fiberglassing. We have found that most construction projects can most easily and affordably be accomplished by using the stitch and glue method.

To begin with the tools required are cheaply purchased or often already part of the craftsperson's tool kit. First off, a drill with a drill bit is required, nothing special about this tool as it will used to put holes in in the panels for the wire. Depending on the stiffness of the panel more or less drill holes are required. Depending on the plans or parts required a jig saw, band saw or table saw depending on the construction. If you are assembling a kit, the parts may already be cut to shape. The next is flat nose pliers, or regular plyers to twist the wire and pull the panels into the desired shape. The next tool would be an orbital sander to help smooth and prepare surfaces before and after an adhesive is applied. In some cases, wire cutters can be helpful to cut wires without damaging the surface of the panel. We also recommend having weights or bricks available to weigh down and hold parts to cure. If you are joining 8 foot parts into longer panels, the joints must be completely flat for the duration of the adhesive cure. Also, a putty knife can be a helpful tool for retrieving wires and if a wire has to be pulled the builder can pry against the putty knife instead of damaging the panel surface. There are non-essential tools that will simplify and speed up the building process depending on if there is epoxy or polyester resin is applied, there are particular tools that will help these steps. Syringes, spreading tools, aluminum rollers, clamps, and foam rollers to help with the fiberglassing stage, however, they are not required necessarily.

Tools Required:

1. Drill and Drill Bit (1/8 inch or smaller)
2. Hand Saw, jig saw, table saw or band saw depending on the plans or kit
3. Flat Nose Pliers or Needle Nose Pliers or Wire Twisting Plyers
4. Orbital Sander and Sand Paper (80 grit, 120 grit, 220 grit and 600 grit depending on the process)
5. Wire Cutters or Snips
6. Weights or Bricks to hold panels while curing
7. Flat plastic covered work surface to support the construction and gluing process
8. Putty knife and scraper
9. Good Lighting and comfortable work height (chairs or benches)
10. Basic epoxy or fiberglassing tools (syringes, spreaders, rollers, brushes, etc.)
11. Safety Gear and PPE, nitrile gloves, organics cartridge mask
12. **OPTIONAL TOOLS:** clamps, clamping jigs, spray gun, heat gun

Regarding safety a builder has to take certain precautions during the building and using chemicals and adhesives. Stitching the panels together and cutting the shapes is relatively safe with properly maintained equipment and even hand-held tools. Always maintain saws and power tools and use them in clean dry and well-lit situations for the builder. When working with chemicals, personal protection is absolutely required to protect the builder from active organics particles. Organics cartridge masks are required to protect the builder from chemicals like acetone, epoxy and polyester resin. Exposure to these chemicals is dangerous and flammable, and we always want the builder to continue being safe throughout their whole build or project. Epoxy dust and regular sanding dust carry certain risks as well, so dust free orbital sanders are available and the are should be well ventilated with the builder wearing a organics mast.

In general, when working on the project we want to have a work surface at a comfortable height, covered in plastic with the capability of being moved or rolled around the work space. The plastic covering on the work surface will stop accidently adhering the parts to the work surface, as well as make it easy to clean depending on stage of the build process. It is also more convenient to have a large enough surface area to assemble multiple parts and having a work surface that can be adjusted for sanding or drilling the panels. Foam pads or cradles can also be made to hold the hull in a stable position, or jigs can be made or purchased for shaping and holding parts in a specific orientation. Ultimately the most important factor in the work space is having a large flat plastic sheet covered work surface, all of the other ideas mentioned are for convenience or ease of build.

SECTION 2 Joining Parts into Panels

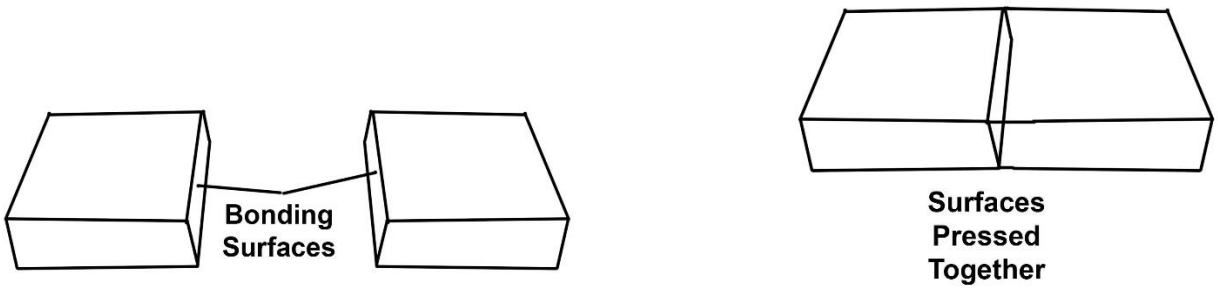
Joining panels into longer panels (strakes)

There are a couple types of joining panels, since panels that are longer than 8 feet long will have to be joined. The primary ways of joining panels are butt joining, scarf joining or puzzle joining. Butt joints are the weakest form of bonding because the flat vertical surfaces are in contact and then fiberglass is added over both sides of the joint. Scarf joining is a more stable way of joining panels, which is beveling the panels at a 1:8 angle so that there is a larger surface area for the adhesive to bond. This joint is then covered with fiberglass. Puzzle joints or ladder joints are the strongest way of bonding two parts together. The edge is locked with a puzzle shape and epoxy is added to the edge and fiberglassed on the top and underside of the joint.

We also must mention that the work surface has to be large enough to support the joint while the adhesive cures. If the table is a 4x8 foot piece of plywood saw horses or supports should be added so that the material does not flex downward and leave the builder with kinked or bent joints. We want completely flat joints for the best material for building.

Locate or source some weights, bricks or clamps for joining the parts into panels. Bricks are always an inexpensive option to hold joints flat while the adhesive cures. It does not require a colossal amount of weight to hold a joint flat, only a couple pounds, so small bricks or weights are useful.

Butt Joining



To begin butt joining the edges that are bonded together must be sanded. The angle of these two must be exact so that the panel is straight over its length, so the factory edge of the part or sheet of plywood should be used to keep the sheet square. If the parts have already been cut out of the sheet, alignment jigs and clamps may have to be used to keep alignment.

Place both parts on your work surface with the ends supported. Saturate the edge of the panels with epoxy, and then recoat them immediately with thickened epoxy. Thickened epoxy has wood flour or cab-o-sil added to it so that it will gap fill the bonded edge of the joint. Add the thickened resin to the edge of the joint and squeeze the joint together.

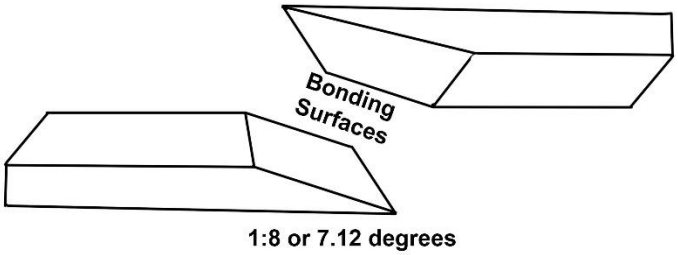
Cut a piece of fiberglass that overlaps both sides of the joint by one inch minimum. Saturate the cloth with epoxy until the fiberglass is transparent. Make sure the weave of the cloth is filled with epoxy.

Cut a small plastic sheet to cover the fiberglass. Lay the plastic sheet on the wet epoxy and use a trowel to lay the plastic sheet flat. Use the trowel to spread the epoxy and remove any air bubbles under the plastic sheet.

Cut a small piece of scrap wood wide enough to support the weight or brick. Place the scrap wood flat over the joint on top of the plastic sheet. Place a weight or brick on the top of the scrap wood to hold the joint flat.

Allow the joint to cure fully according to the directions on your given epoxy or polyester.

Scarf Joining



Scarf joining is when the joined edge is beveled so that there is more surface area for the adhesive. The scarf is cut or sanded into the surface at an 8:1 or 12:1 angle so that when epoxy is applied to the surface a large area is bonding for the best strength and stability. Alignment jigs may be required to keep the scarf joint aligned, or can be bonded and panels can be cut after the epoxy is cured.

Begin by laying the panels on your work surface and using a saw or sanding tools (belt sander, block sander or orbital sander) and begin sanding off the surface at a bevel. Remember the bonded surfaces will be opposite, so if your parts are two different colours or grain patterns they will be opposite. We want to book match parts so they are uniform in the construction for clear finishing. Even if the builder intends to paint from the start of the build, we always want similar or identical material and grain direction for the strength of the material.

Once the parts are beveled align them and align them as required so that the bevels overlap without one being higher than the other.

Mix regular epoxy and brush epoxy onto the bonding surfaces. Follow this with thickened epoxy with wood flour or cab-o-sil on the dissimilar surfaces. We do not want any voids in the joint. Press the scarf joint together.

Cut fiberglass cloth that is wider than the joint by a minimum of one inch on either side of the joint. Saturate the cloth on the accessible side of the joint until the fiberglass is transparent.

Take a piece of plastic sheet and place it over the wet fiberglass. Using a squeegee or trowel press the plastic onto the fiberglass and push out any air bubbles or excess epoxy.

Place a scrap piece of plywood onto the surface of the plastic covered joint. Place weights or bricks onto the joint to hold it flat.

Allow it to fully cure.

Puzzle joining

To puzzle join is the best and strongest way to bond parts into longer panels. The shape of the puzzle joints locks the parts together and the parts cannot move or be misaligned. There are companies that offer CNC cutting services, including BoatCraft, where puzzle joints or ladder joints are added to the long edge or short edge of the sheet. There are small CNC routers available with free online programming to cut puzzle and other types of joints. The build manual will follow this building technique, but all of the application techniques and methods are identical but the joint will appear as a puzzle joint.

Lay a plastic sheet on your work surface so that your panels are not going to accidently be glued to the work surface. Also, it is very helpful to have a flat surface, like a full sheet of plywood at a comfortable working height.

Begin by laying out the deck pieces as your space allows on your work surface.

Apply electricians' tape over the joint to stop epoxy bleed through. Avoid using tuck tape, duct tape or masking tape that may leave residue, pigment, fibers or allow epoxy bleed through.

Cut fiberglass cloth to cover the top side of the joint 1 inch wider than the joint. Set it aside close by, it will be installed immediately after the joint has epoxy injected into the joint.

Gently lift the joint to spread the puzzle. Inject or spread regular epoxy into the joint. Follow by injecting thickened epoxy that is the consistency of mayonnaise. This will fill any voids between the two surfaces. No matter how tight the joint may appear, the edge grain will absorb some epoxy and leave the joint starved and weak.

Press the panels flat onto your work surface, make sure that the joint is flat. Wipe off any excess epoxy that remains and return it to your thickened epoxy cup.

Use your acid brush to saturate the panel at least 1 inch wider than the joint on the surface of the panel.

Take your dry fiberglass cloth and place it on the epoxy saturated surface. Smooth it by pressing it down with your gloved hand.

Saturate the cloth with epoxy until the fabric is transparent.

Take a plastic sheet and place it over the fiberglass cloth. Using your fingers or a squeegee, press the air bubbles out of the fiberglass cloth and make a smooth transition between the cloth and the wood.

Place scrap wood or any flat material onto the plastic. Add weight to the top to hold the joint in place.

Allow to cure for 6 to 8 hours.

After the joints have cured, remove the weights, wood and plastic from each joint.

Be cautious with the unstamped side of the panel, this is the visible side of the deck.

Check that the joint has glued flat, if they have not glued flat, see the instructions at the end of this section.

If the joint is flat, peel off the electricians' tape and sand the excess epoxy that has bled through the unstamped side of the panel. Be careful not to sand through the veneer, this is the visible side of the deck.

Flip the panel over and cut the fiberglass cloth that overhangs the outside edges of the panel.

Use heavy grit sand paper and a block to sand the glass. Do not change the shape of the panel.
To remove the excess fiberglass from around your joints, use 40–60 grit sandpaper along the edges.

Angle-sand the edge of the fiberglass on a bit of a taper, by holding your sanding block at a 45º angle.
A rasp can also be used to cut the fiberglass.

A rasp can also be used to cut the fiberglass.

Use an orbital sander, or block sand the fiberglass cloth until it is smooth. We have to sand to prepare the fiberglass for coating at a later stage. Make sure the cloth is smooth without any bumps or sharp edges.

Fixing Previously Epoxied Joints

If you find that panels have been mismatched after the epoxy has cured, there is a solution. You will need to sand the fiberglass off the joint. Using a heat gun, heat the joint and keep the heat gun moving to ensure that the wood is not burned. Once the surface is heated over 130 degrees F. the joints will slip apart. Sand away any epoxy that remains in the joint, it will no longer cure. When redoing the joints, use 6 oz fiberglass strips and reapply the fiberglass using the same techniques as described above but with the correct parts or flat surface.

SECTION 3 Beveling and Fitting Panels

The concept and purpose for beveling panels before beginning to stitch the panels is that the flat surfaces of the joint can be adjusted so that the exterior of the shape has a clean edge. We do not want to have large gaps to fill with epoxy, since when we sand the external and internal surfaces we do not want huge joints filled with epoxy. The ideal joint for epoxy is around 2 millimeters wide, which is filled with epoxy and a thickener to be strong. Anything larger than that requires significantly more epoxy and filler and will have less strength. Conversely, joints that are too tight are difficult to fill completely with epoxy, which can lead to voids in the internal joint surface and weakness. We have found that 2 mm gap will allow for easy filling and less sanding away and shaping the epoxy joints after. This also will make fiberglassing the surface easy because there will be less gap filling and shaping so that the cloth can lay flat and smooth.

The joints require epoxy to enter from both sides, if the bevel is too tight you will not have epoxy in the core of the joint, leading to a weaker bond.

Diagram 4-1 Fitting the joint

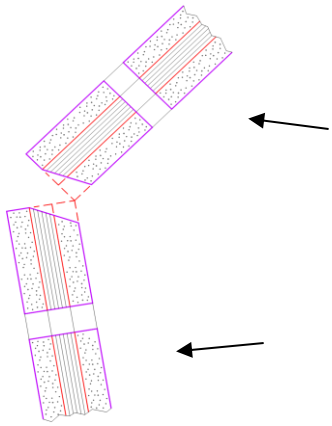
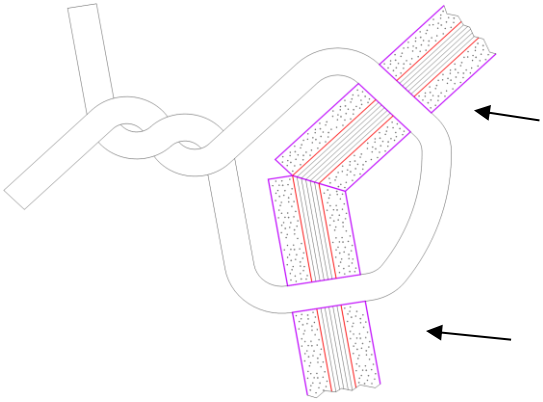


Diagram 4-2 Panel joint wired together



- The diagrams represent sanding away the internal surface of the joint. When the stitching wire is added the joint is pulled together on the flat angle of the bevel.
- If you choose not to bevel, a 4mm plywood at a 45 degree angle will have a 4 mm (5/32” or 3/16”) gap to fill with epoxy.

- Start by using a pencil to draw a continuous “guide line” on the interior edge of these panels. Draw this pencil line $^{5}/_{32}$” (4 mm) from the edges.
- Using heavy grit sand paper, bevel the inside veneer and the core. This bevel can be adjusted a bit once the panels have been stitched together.
- Use the pencil guide line to remove the material. We only want to remove the inner veneer and core. DO NOT BEVEL ALL THE WAY TO THE OUTSIDE VENEER. The outside veneer is the accurate shape of the panel, and by sanding it we are changing the intended shape of the hull.
- If the outside veneer is beveled too fine the veneer can easily be damaged and sanded through when the hull is being sanded before fiberglass.
- A rasp or block with sand paper is the ideal tool for this job. Resist using power tools since each bevel will be at a different angle, we want to bevel them correctly for the desired shape, running the material through the mill to the same angle may not be the ideal shape.

1. Beveling the bow and stern

The curves at the bow and stern ends should also be beveled. The keel panel will curve up to join with Panel 2 at the bow and stern. The bevel should be started at each end and carried back, decreasing the bevel to none at approx. 32” from each end. This is where the “V” curve along the keel line begins to flatten out. **Do not remove more than the inside veneer for the bow and stern bevel.**

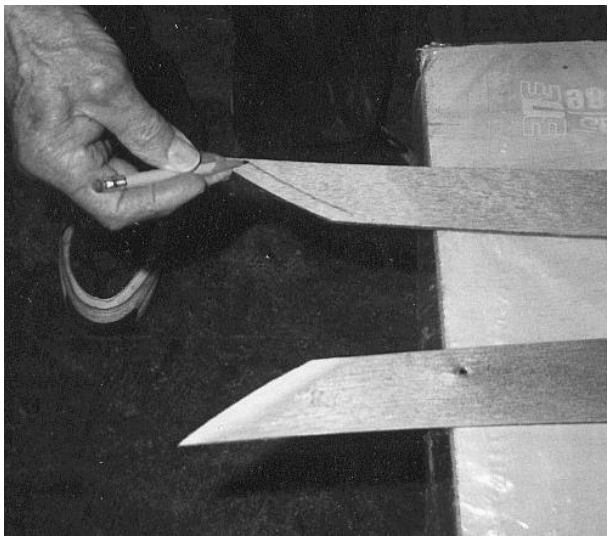
Approx. 32” from ends

Approx. 32” from ends

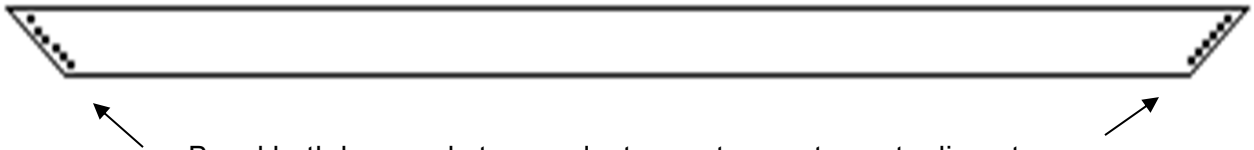
2. Panel 2 and subsequent panels

The bevels on your number 2 Panels are made on the bow and stern ends, which will create a “water-entry line” for the completed boat. The long joint where panel one and two will be beveled using the method for the keel panel. The bow and stern are also beveled.

Photo 4.2-1



- Lay both Panels 2 interior up on your work surface.
- Use a pencil to draw a guide line 1/8” in from the edge on the bow and stern ends
- Using 40–60 grit sandpaper on a sanding block, bevel these edges (1/2 of 1 lamination) uniformly, from the scribe line to the edge.
- **Do not remove more than ½ of one lamination.**



Bevel both bow and stern ends, to create a water-entry line at

	DO NOT OVER BEVEL panels on the bow and stern ends. Otherwise, your water entry line will be too fine and will lose strength. You will also change the way your deck will fit at the bow and stern.

3. Sheer Joint (Deck to Hull Joint, or Gunwale to Hull)

The interior sides of these two edges require beveling, so that when they are joined, the seam will be tight and even. This is a highly visible joint, so we want them to match exactly.

SECTION 4 Drilling and Stitching the Hull

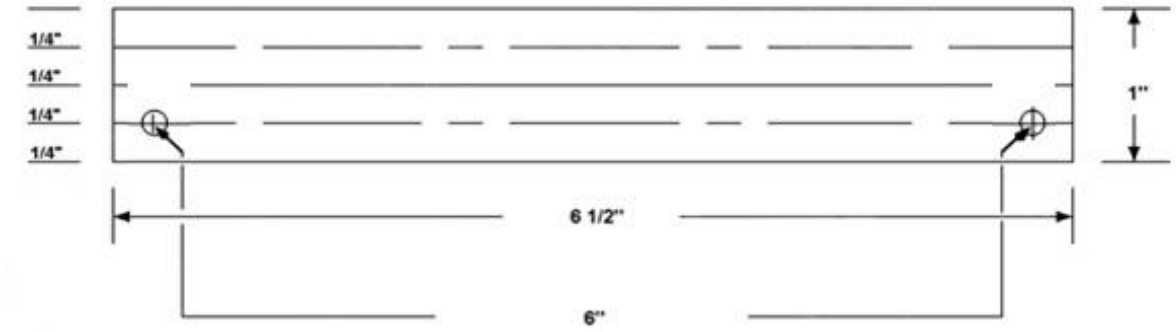
For an easy way to have identical spacing of the drill holes is to build a drilling jig. This is simply a piece of scrap wood with two holes with a consistent distance between the two holes. One hole is used as a pin to align with the previous hole, the other hole is for drilling the next hole.

The other option for drilling is to measure and mark each hole with a tape measure. The distance between holes is required by how complex the shape is and how much flex the material has. The stiffer the material you will require more stitches per foot.

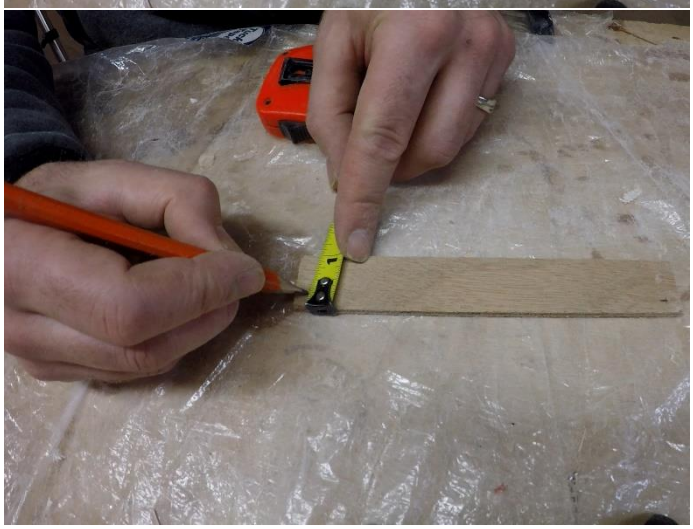
The instructions below are for a symmetrical designed hull shape (mirrored left and right) for flat bottom designs or strong back and frame designs the techniques may change slightly but the over all techniques and tools are the same.

Prepare a Drilling Jig

You will need to drill a lot of holes for the stitches in the hull pieces. In general, you will be drilling a $^{1}/_{16}$" hole every 6 inches and ¼" from the edge of the panels. For the best appearance, we recommend that you make a drilling jig (guide) – a little wooden tool, as shown below. The drilling jig will assist you to make each hole exactly 6" from the other and exactly ¼" from the ends of the plywood. If you choose not to use a jig, measure your holes as described.



- Find a piece of scrap material (provided in kit) and cut the scrap to 1 inch x 6 ½ inch. Cut the material along the factory edge of the plywood so that this edge is straight as possible.
- From the short edge, measure ¼ inch and mark on each end.
- On the long edge measure ¼ inch along the factory (straight) edge.
- Where the lines intersect, drill a 1/16th inch hole with a drill.
- Using a finishing nail, a drill bit or a small fastener in the hole. This will provide a pivot point for the drilling jig.
- The final distance between the holes in the jig should be 6 inches.



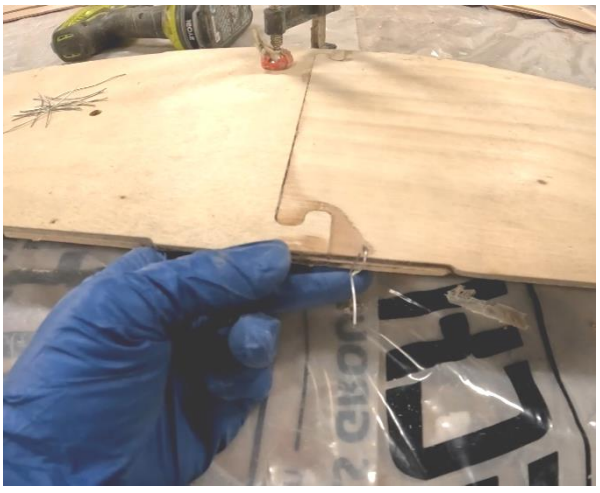
<u>How to use the drilling jig:</u>
Place the drilling jig on the panel/s you wish to drill, aligning the dashed line with the edge of the panel. Drill a hole through the panel/s. Leave the drill bit (or a thin finishing nail) in the first hole, while you swing the free end of the jig to the next hole location. Hold the jig firmly and drill at that free end of the jig. Continue along the length of the area to be drilled. This will space your holes evenly, as described.

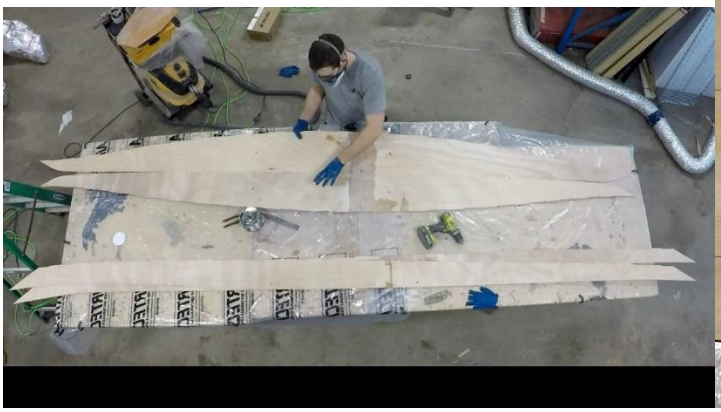
Caution 	• Do not apply too much pressure when drilling – you are drilling, not punching. • Always check the spacing from one panel to the next, keep everything visually consistent. At the bow and stern this may require pencil marking the drill holes to compensate for the recurve in the bow and stern.

5.3 b) Drilling First Panels or Keel Panels

Start at the Keel Line

1. Lay the keel panels back-to-back, to drill a hole through both at the same time. This will mirror the panels.
2. Mark your first drill hole on the keel line of the panel. The first hole is ½ inch from the puzzle joint towards the bow and ¼ inch from the bottom of the panel. With both the panels back-to-back drill this hole.
3. Now that the first hole is complete, use your drilling jig to drill the remaining holes along the keel line. Use a drill bit to hold the drilling jig in the previous hole, drill through the second hole. **In general, you will be drilling a $^{1}/_{16}$" hole every 6 inches and ¼" from the edge of the panels.**
4. Leave the wires loose so that the hull panels can be opened and laid flat.
5. At the bow and stern of panel 1, mark and drill holes that are 4 inches apart and ¼ inch from the edge. Do not install wires at this time.
6. Next, drill holes the same way on the top edges of Panels 1 to begin alignment for the next panel. Begin at the same point ½" in front of the puzzle joint. Drill the entire length of this edge using the same method as the first edge. The two Panels #1 are now ready to be stitched together.
7. Open the panel 1's so that they lay flat on your work surface.





All Other Hull Panels

Panels #1 and Panels #2 will join to form the first chine. The holes you already drilled in the tops of Panels #1 will serve as the guide to where holes should go in the Panel 2 bottoms.

- Place each Panel 2 beside each Panel 1 on your workspace, in the proper orientation, so the puzzle joints line up.
- Start drilling at the same point you began on Panel 1. You can use the drilling jig to drill holes that match panel 1. Check that the holes do not increase in distance when you approach the bow and stern. “Eyeball” and drill holes along the bottom edge of Panel 2, ensuring that each hole is directly adjacent to the hole on Panel 1.

Drill Tops of Number 2 Panels:

- Drill the **top** edges of the Panels #2: Start at the same position, ½” forward of the puzzle joint. Lay the panels down beside the panel 1, and mirror the hole location of the bottom of panel 2. At the bow and stern ends, you may need to add additional holes – they can be drilled as close as ¼” from the end and ¼” from each chine line. This will allow you to draw the ends of the panels together to form the bow and stern stems.

SECTION 5 Stitching First Panels

Keys to Success 🗝	• Work at a comfortable height. The panels will have to be lifted and lowered to pass the wires through the holes. Make sure that this is comfortable and well lit.

- Lay out the two Panel 1 pieces across your workspace.
- Line up the puzzle joint and begin inserting wires from the underside of the panel and twist on the top side.
- Wire loosely, the panels will still have to be manipulated to have all the hull panels and bulkheads installed.
- At approximately 32 inches from the bow and stern, begin wiring from the outside of the panel. You will not be able to twist the wires with your plyers from the inside.
- Check the alignment of the puzzle joints and the pencil marking tabs. Everything should match.

- The goal of this step is to have the main hull panels wired together flat, once the first few panels are added, bulkheads, station and forms can be added to give the hull shape.
- Once the hull panels are loosely wired, begin wiring the bow and stern stem from the outside of the hull. The hull will begin taking shape.

Adding the Remaining Hull Panels

Keys to Success	
🗝	• When stitching the hull panels, always begin beside the puzzle joint and work toward the ends. Periodically check that the joints are still aligned exactly on the outside. This will give the best appearance and shape to the boat. The wires act like clamps, to hold pieces tightly in place. Hand tighten the wires first, then check joint alignment—both the vertical joint and along the chine. As you are satisfied, then tighten your stitch with pliers. • The wires in the ends of the kayak (about 32” from each end), are reversed, that is, you twist them from the outside, after inserting from the inside. • As panels are added to the hull, the bulkheads are tightly wired at each chine, so there are no gaps between the bulkhead and the hull pieces. All bulkheads should be wrapped with masking tape on their edges (to prevent bonding). • **Do NOT attempt to align the panels in one stage. First get all wires to a medium tightness – then, start to align and tighten firmly. Over tightening too early will not allow them to fit to the temporary and permanent bulkheads.**

Adding the Bulkheads

Check and cut the appropriate bulkheads, stations and forms for your build. Once cut, put electricians' tape around the perimeter of the bulkheads so they are not glued in place when you apply epoxy to the hull joints.

We recommend temporarily installing the bulkheads until the hull shape is exact and the inside of the hull is fiberglassed. If the bulkheads are impeding the correct alignment or shape of the hull, it is very hard to correct this if the bulkheads are permanently glued and fiberglassed in the incorrect position.

To drill the holes on panel 1 and 2, mark with a pencil on the top and bottom each joint ¼ inch wider than the pencil line. We are going to cross stitch through the bulkheads, so one hole is on the lower panel and one hole is on the opposite side and on the next panel.

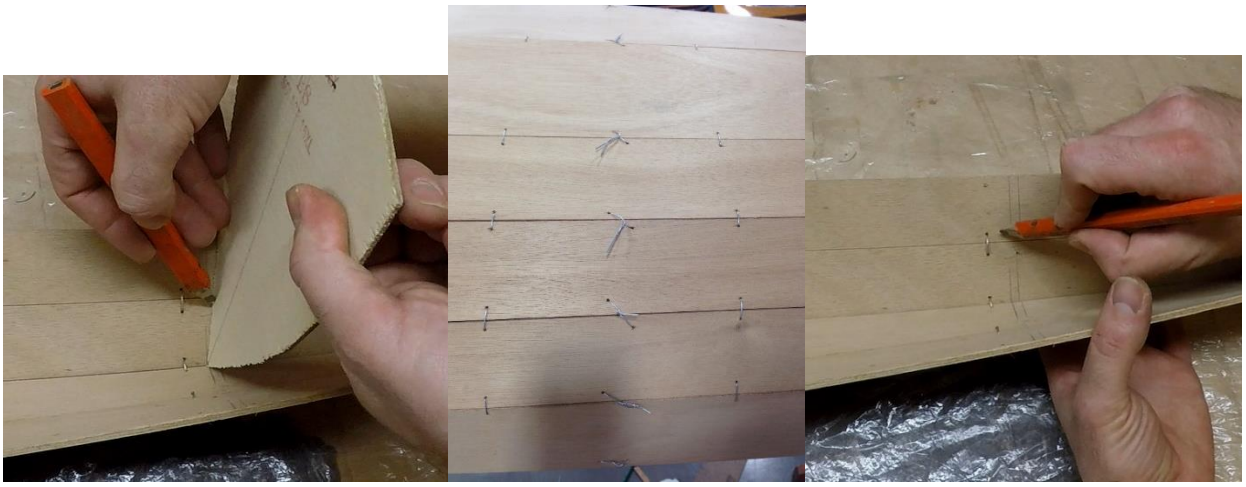
Drill an angled hole through the bulkhead ¼" above the keel, making sure that this hole aligns with the two that you drilled in the number 1 panels. This drilling pattern creates a diagonal stitch when the wire is inserted. Eventually every chine should be attached to the corners of the bulkheads with the same diagonal stitch.

To drill the bulkheads, mark with a pencil your drill hole on the center of each joint. The mark should be approximately ¼ inch from the edge of the bulkhead.

As seen in this photo, the cross stitch both tightens the joint as well as holds the bulkhead in position.

Drilling and stitching will have to be done in stages as we add the remaining hull panels. Each panel that gets added will have to have the stitching holes drilled for the joint, as well as holes for the bulkheads.

Wire the bulkheads loosely until all of the hull panels are in position.



Adding the Remaining Hull Panels (Stitch and Spread Technique)

This technique drills and stitches the ends of the panels first, and wires them loosely. Then the panels as a unit are spread over the bulkheads and positioned.

- Place both Panel on the work surface interior to interior. Match the pieces up at the bow.
- Drill two holes ½ inch from the top and bottom of the edge, and ¼ inch minimum from the edge or every 6 inches per your drilling jig.
- Line up the stern edges of these sections and install two wires there, hand tighten.
- Lift both panels that are now wired and spread them over the bulkheads and place them onto the lower panel.
- Beginning at the puzzle joint, drill a hole though the top and bottom of the joint ½ inch away from the puzzle joint. Try to duplicate the spacing of the hole drilled in the number 2 puzzle joint.
- Wire the puzzle joint to stop the upper panel from sliding around. Wire the panels from the outside of the hull to the inside.
- Follow the drill spacing of the lower panels and drill holes in the panel top and bottom edge.
- At 32 inches from the bow and stern, begin wiring from the inside of the hull towards the outside.
- Mark and drill the holes for the bulkheads, Wire the bulkheads in the cross-stitch pattern.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Aligning the Hull

To align the hull, begin positioning the puzzle joint to be even and aligned. Flip the craft so that the outside of the hull is facing up on your work space, visually check for low spots and misalignment on the puzzle joint. If the puzzle joints are not aligned follow the steps indicated below for mis-aligned joints.

The techniques below will be used if there is an issue, if you do not have these issues continue tightening wires and prepare to glue the hull.

? Possible mis-aligned joints

- The puzzle joints should be exactly aligned, if they are not, begin by loosening all of the wires along the joint(s) that you wish to move.
- Remove two wires to allow the panel enough flex to fit the vise grips and two pieces of scrap to protect the panel veneers.
- Lift the panel with a putty knife, and leave the putty knife as a guard against scratching the next panel.
- Place a wood piece behind the panel, and one on top, and clamp tight with the vise grip. Not too tight to crush the plywood.
- Gently tap with a hammer in the direction to align the puzzle joint. This process can be duplicated many times until the desired movement is achieved.
- Reinstall wires and tighten all wires.

Low Spot?

For a droop or “low” spot, simply…

- loosen the area and add some small wooden shims, from the interior, until the keel line is true.
- If the low spot is not at a bulkhead, strap the hull upside down to saw horses. Use long sticks cut to length that are measured from the floor to the underside of the hull. The sticks will press the floor and lift the low spot.
- Re-tighten the wires once the shims have been added, re-check low spot and joint gaps.

High Spots

If you find you have a high spot at a lateral puzzle joint you may have to remove a few wires to open the area. Gently open the keel joint by inserting a screwdriver or a similar tool. Using coarse sand paper, remove a small amount of material between the joint. This is most common where the puzzle joint has been fiberglassed and the fiberglass is wider than the panel.

Twist in Hull?

If the hull will not stay lined up with the above noted method …

- Position two sawhorses approximately 8’ apart, and LEVEL them to each other.
- Turn the hull upside down and tie or strap the hull tightly enough so the sheer points touch the saw horses.
- Grab the sheer line panels and twist the hull in the opposite direction to correct the hull twist.
- Recheck the result of the twist. You may have to do this multiple times depending on how severe the twist is.
- Re-tighten wires if they have loosened or changed position while being twisted.

Caution

- Do not over tighten the cords; you do not want to distort the shape of the hull.

Aligning and Stitching the Bow and Stern

Using a dowel to align the hull is an optional method if the materials are available to you. The dowel will help have a consistent curve at the bow. This tension can be achieved with tape as well, using the tape to control the height of the joint and tension in the correct areas.

To help align the bow and stern, use a ¼ inch dowel wrapped in electrical tape.

Using the straight dowel find two or three stitches that are in a straight line. Loosen those stitching wires enough to slide the dowel behind the wire.

Tighten the wires, and the dowel will bend to create an even shape for the bow and stern. Extra wires and dowels can be added if the panels are twisted. Check the shape against the shape of the internal bow bulkhead which are already installed.

Once the dowel is installed, tighten the keel panel 1 first. Then work your way from the stitching wires that are facing the outside of the hull towards the bow and stern. We want to incrementally pull the panels into shape.

You can add as many dowels or tape, as required to help align the bow and stern.

More stitching wires can also be added where the dowel intersects with the joint. Avoid putting drill holes in the center of the panels at the bow and stern unless necessary to resolve a low spot.

The hull should now be true and is ready for final tightening of wires.

Begin by tightening the keel panel 1 at the puzzle joint and then panel 2, and so on. It is most important to have equal spacing between the joints and do not over tighten wires to the point that they damage the drill holes or veneers. As you work your way towards the bow and stern, tighten the bulkhead cross stitches. Always work on both sides (port and starboard) at the same time, we do not want to put tension on one side and pull the boat out of alignment. Check and recheck the bow and stern, we do not want the panels to slide out of position.

Keys to Success	Make sure you are satisfied with the hull shape, because this is your last chance to adjust anything.
🗝	• Feel and eye each seam – tighten all wires/stitches as necessary. All stitches must be firm – they are acting like clamps.

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SECTION 6 Gluing the Hull and Bow/ Stern Tapes

6.1 Gluing the Hull Exterior

The amount of epoxy and additive required will depend completely on if the builder had taken time to bevel the panels and align the hull with equal joints. Regular and thickened epoxy (wood flour added to epoxy) is injected into the joints to have no holes or voids.

- First, gently turn the hull upside down, supporting it well on parallel sawhorses.
- Check alignment of the joints before you begin gluing. This is the last opportunity to make adjustments.
- Mix a half batch of epoxy. Pour the epoxy into your small syringe.
- Using the syringe run a small amount of the un-thickened epoxy into each joint on the outside of the hull. As you did with your seat, stop running in the epoxy about ½" from each wire.
- Work cleanly - if you drip epoxy on the hull, wipe it with your rag immediately - otherwise you will be doing a lot of sanding of unwanted hardened drips later.
- Immediately following the un-thickened epoxy, mix thickened epoxy with the consistency of syrup or ketchup. Using your syringe, inject the thickened epoxy into the same joints that you have just applied un-thickened epoxy. This will ensure that there is no voids or gaps in the joints.
- Wipe up the excess epoxy with a squeegee, this excess epoxy is put back into the syringe and used in the next joint.
- Work systematically, do a small section with un-thickened resin, then thickened resin, then wipe excess. The pot life of your epoxy is 20 minutes, working with a method will allow you to work faster.
- At the bow and stern, you will use more un-thickened epoxy because the joints are much tighter than the center of the hull.
- Wipe off excess epoxy, we do not want epoxy drips.
- Check the alignment of the bow are you are gluing, make sure that everything is straight and smooth.
- The bow and stern stem has to be glued as well. Inject un-thickened and thickened resin along the stem. Smooth with a finger. It is okay

to cover the wires with epoxy, we can heat the wires to release them from the epoxy.

- Allow the seams to cure for 6-8 hours.

Interior Fillets and Tapes at Bow and Stern Ends

A fillet is a bead of epoxy over a joint that can be shaped with your finger into a round “caulked” edge that fiberglass can easily contour.

To strengthen the bow and stern we will fillet and apply fiberglass to the inside of the joint. The reason to fiberglass the inside of the hull is the stiffness of the hull is made by reinforcing internally.

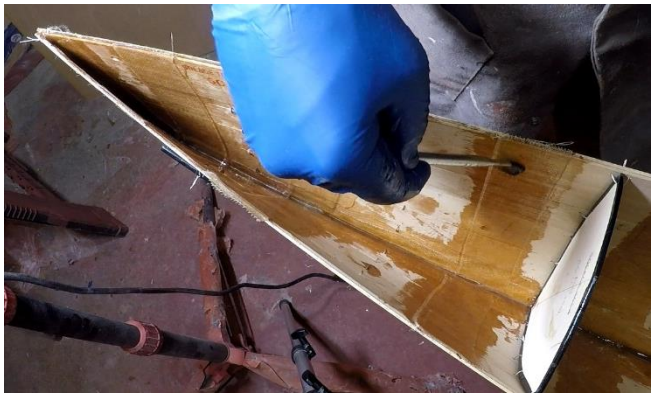
The fillet and tape are applied over the stitching wires, we can heat the wires to release them from epoxy. Set up a work space that is covered with a plastic sheet. We will require this to saturate the fiberglass tape before adhering them to the hull.

- Mix a half batch of epoxy. Mix well.
- Using an acid brush, apply regular epoxy to the keel joint on the inside of the hull. Try to wet out 1 inch on either side of the keel
- Take half the volume of your epoxy and mix it with wood flour to make thickened epoxy. The thickened epoxy should be the consistency of ketchup.
- Using your syringe, inject thickened epoxy directly over the epoxy on the inside of the keel.
- Using your gloved finger, mixing stick or filleting tool, smooth out the thickened epoxy so it has a smooth rounded transition from side to side.

- We begin by cutting strips the 2 inch fiberglass tape to the correct lengths to cover the inside of the keel at the bow and stern.

- On your plastic sheet, lay out one of your keel fiberglass tapes. Using regular epoxy, saturate the cloth on the plastic sheet until it is transparent.
- Lift the saturated cloth gently off the plastic, do not pull too hard on the cloth or it will distort or disassemble.
- With your fingers gently fold the cloth to find the center of the cloth. Slowly place the cloth down into the keel.
- Using your acid brush, press the cloth into position, making sure not to wrinkle the cloth as it is installed.
- Do not press the cloth into position hard, you will have to press it into position evenly or it will crease.
- If the cloth is not fitting very well, you can lift the fiberglass back out and attempt to install it again. Steady hands and patience will allow you to install the fiberglass in such a tight location.
- Press the cloth down until all of the air is removed and it is pressed against the fillet you have just installed.

- If there is a lot of panels vertical fiberglass tapes can be applied to stiffen the bow and stern. If the whole interior of the hull is going to be fiberglassed it is best to install the vertical fiberglass first.
- To install the vertical fiberglass tapes, wet out the tape on your plastic work surface.
- Gently lift the fiberglass without pulling it out of shape. The saturated cloth is fragile and prone to stretching, lift it off of the plastic as if it was wet paper towel. Easily torn.
- Using your fingers, acid brush and squeegee smooth out fiberglass, and saturate with epoxy so there are no air bubbles behind the vertical tape.
- Once installed, let cure for 6-8 hours.



SECTION 7 Bow and Stern Stem and Filling Holes in the Hull

Keys to Success	
🗝	• Remove the wires gently - remember the hull is only held together at this point with a thin glue line. • Avoid leaning on the hull or prying too hard on the panels.

- Cut and remove the wires from the hull. If you have a wire glued in, heat (as required) and gently remove. This will be necessary on the bow and stern where the inside tapes have covered the wires.

- Cut the wires and gently remove them. Do not “lean” against the hull as your craft is in a fragile state at this time.

- Once the wires are cut you may find some that are more difficult to remove than others. Keep in mind the strength of the hull is not great right now. You may need to use pliers to pry some wires loose use a clean putty knife on the surface of the hull to shield it as you pry against the putty knife with the pliers.

- If the wires are glued with epoxy, heat up the wire with a heat gun, lighter or soldering iron for ten seconds or less. Then gently remove the wire as the epoxy softens.

- Remove the wires that hold the bulkheads as well. You should only have the shell of the hull remaining.

Filling Wire Holes/Voids

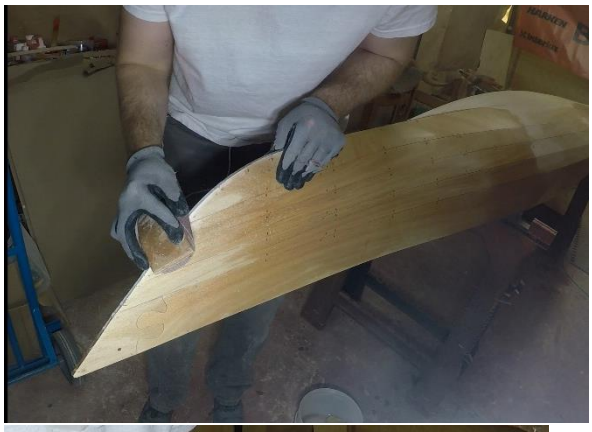
Keys to Success	
🗝	• Work cleanly – do not smear any epoxy on the face of the hull; keep it in the joints. Immediately wipe clean any drips or runs. • Match the color of the thickened epoxy to a coated section of Okoume. This is important to remember when working on the hull/deck or visible panels in the build.

- Flip your hull so that it is sitting upside down.
- Using a syringe and thickened epoxy, fill the drill holes and seams that were beneath your stitching wires. Take time to ensure that all of the drill holes are filled.
- Make sure you fill the holes and voids enough so the epoxy can be sanded back. We do not want to sand the veneers to fair the hull, we want to sand the epoxy.
- Allow this to cure before sanding (8 hours).

Filling the Bow and Stern Stems

Both the bow and stern ends need a bead of peanut butter consistency epoxy to be added along the exterior stem. This is the part of your boat that will slice through the water, so you want it to be nicely rounded and smooth. The bow and stern stems are also going to face impacts so they must be about 3/8 inch or larger to have enough strength.

- Sand the bow and stern stem so that it is flat.
- Mix thickened epoxy and inject a large bead of epoxy from the bow tip to approximately 36 inches or until it blends into the keel line.
- Using your fingers or squeegee, smooth and feather the bead of epoxy until it covers the edges of the panel at the bow. Make sure the bead is large enough that it can be sanded and shaped later.
- Duplicate this process for the stern.
- Allow these fillets to cure before sanding (8 hours).



Filleting the Hull Interior

Your hull interior must be well sanded before you can begin filleting. This is important to do over the bow and stern reinforcing tapes to prepare them for the fillets. Remove any sharp edges on the bow and stern tapes.

Note: the shape of your hull is quite round leaving very low angle between the panels thus reducing the need for fillets. It is important to fill the back of the hull joints to support the hull.

- Flip the hull so that it is sitting well supported in the upright position.
- Prepare a filleting tool, squeegee of putty knife to smooth out and round the epoxy fillet.

- Using unthickened epoxy and a small brush, wet out the chine joint. Only spread epoxy in 24 inch lengths until you are familiar with the working time.
- Mix some peanut butter consistency epoxy.
- Run a bead (approx. 2 feet long) of thickened epoxy along the chine joints.
- Using a mixing stick (or similar shaped tool), smooth the fillet into an even contour
- Remove excess epoxy with a putty knife.
- Do not apply fiberglass tape over the fillets. The whole interior of the hull will be fiberglassed in a later section.

SECTION 8 Sand and Fair Surfaces for Fiberglassing

Never sand through the outer lamination. Good lighting is required to see the orbital sanding swirls, all of the imperfections will be highlighted

- Then, do a general sanding of the outside of the hull (using 120-180 grit sandpaper)
- Carefully inspect each joint and wire hole. If necessary, fill any holes or hull joints that are not filled with epoxy.
- Remove any orbital swirls with a block sand with 220-600 grit sand paper.
- When your hull is well sanded/faired, remove any dust particles with a vacuum brush, or by wiping with a slightly dampened cloth.

SECTION 9 Fiberglassing with Epoxy

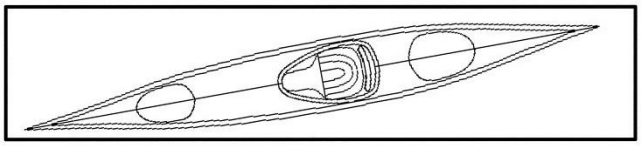
Cutting Fiberglass Cloth for Hull

Keys to Success 🗝	• To successfully cut fiberglass cloth, use very sharp scissors. Create a clean-cut edge by removing all hanging strands, to make gluing and sanding easier.

Caution 	• Be sure you cut the large pieces (e.g. hull exterior) absolutely correctly • Remove any dust from the hull. Any dust or debris on the fiberglass cloth with be visible. The trapped debris will be visible in the cloth.

- Drape the fiberglass cloth over your hull diagonally. Place one corner of the fiberglass on the bow tip. When you roll the cloth to the stern, place the opposite corner on the stern tip. The rectangular fiberglass cloth with cover the hull corner to corner.

- When applied, the “diagonal/bias” cut to the cloth maximizes the hull strength of your craft. The bias is when the vertical/horizontal weave of the cloth is rotated 45 degrees. This shifts the weave to have twice as many strands on the hull of the kayak.
- **Do not throw away cut fiberglass! It can be used for the inside of the hull at a later stage.**



- **Review cutting Diagram above** before cutting, to ensure proper alignment.
- While cutting, avoid letting the fiberglass touch the floor. We want it to be as clean as possible.
- Cut the cloth with sharp scissors and leave a 2 inch overhang around the perimeter.
- The fiberglass can be slit at the bow and stern so that the cloth lays flat against the hull. Cut the cloth to match the shape of the bow and stern with some overhang.

Relief Cuts on Fiberglass

You may find that the cloth has some wrinkles at the bow and stern area. You will have to cut some slits into the fiberglass cloth, so the fiberglass can lay flat. The slits will overlap and when saturated with epoxy will be transparent. We do not recommend cutting out triangular shapes into the cloth.

Saturating Woven Fiberglass with Epoxy

FIRST HULL COAT

We strongly suggest warming the resin (part A) in hot water or a space heater before saturating the fiberglass. This will thin the resin and give better saturation and clarity. It also increases the bond strength without affecting the cure time. The resin can be warmed to 38 degrees Celsius. Warm the Resin before mixing in the hardener, do not add heat to the epoxy once it is mixed.

Safety:

Wear gloves and an active organics cartridge mask when working with epoxy. Epoxy is an active organic particle for 7 days after the initial cure. This includes sanding and disposing of used epoxy. Work in a well ventilated area and clean up fiberglass sanding dust. Limit your exposure to the chemicals and always follow the labels on the container for disposal and personal protection.

- Drape the hull with the previously cut fiberglass cloth. It must cover the entire hull.
- Using your clean, dry bare hand, smooth out the wrinkles in the cloth, starting from the center and pushing gently to the ends of the boat.

- Mix epoxy and pour most of the volume onto the center of the hull. Begin spreading the epoxy until the fiberglass becomes transparent.
- Work your way from the center of the hull towards the bow and stern. Saturate the fiberglass 2 square feet at a time.
- At the bow and stern, use your squeegee to press epoxy through the cloth. It is helpful when working vertically to pour epoxy onto the squeegee while it's pressed against the cloth and press the epoxy into the cloth.
- Some fiberglass texture will remain after the first saturation coat. This texture will be filled with the second epoxy coat 1.5 – 4 hours after the first coat.
- Watch your cure times. The larger the volume of epoxy that you mix in a smaller container will shorten the tack time. With a small volume poured onto the hull will have a 20-23 minute pot life.
- Do not overwork the epoxy. If you spread the epoxy vigorously it will become cloudy. Any epoxy that becomes cloudy has to be removed from the hull for the best transparency of fiberglass.

APPLY THE SECOND COAT (and/or THIRD COAT)

After the first layer of epoxy has begun to cure (1.5 - 4 hours after initial saturation coat) you will apply a second coat of epoxy. This coat will fill the remaining texture of the cloth and give the fiberglass its ideal strength. Once the second coat is applied allow it to cure for 8 hours. If there is still heavy texture of the fiberglass, you may want to apply a third coat.

Section 10 Finishing and Painting

Which finish to choose on your build will depend on three main factors, ease of application, durability and intended use of the craft. Both graphite coating with epoxy and gelcoat are two-part adhesives, so the application has to be done in incremental steps for the best result. Polyurethane marine paint or varnish can be applied over fiberglass, but if the boat is going to be used in rocky conditions or is going to be beached, the polyurethane finish will have a shorter life span. If the boat is going to be submerged permanently, antifouling, graphite in epoxy or gelcoats are required for long life span. Above the waterline and on the decks, polyurethane paints are ideal because they are roller and brush applied to a semigloss finish, gelcoat is applied best with a HVLP spray gun 1.4 - 2.0 nozzle size depending on how thick you want to apply.

Safety

When working with solvents and paints always wear an organics cartridge mask and gloves. Work in a well-ventilated area and follow the guidelines on ventilation for flammable products. Clean and store your chemicals properly, remove all used rags or paper towel after use and dispose of in a fire proof container. Limit your exposure to the chemicals.

Preparation for Paint

The surface to the fiberglass must be smooth and fair without any rough edges or exposed fiberglass texture. If there is texture, body filling and fairing must be done before paint. Paint and gel coat is not a filler, it will only highlight any imperfections in the surface. In some cases, it is best to prime the hull, which will show any deficiency that can be sanded, faired and filled before moving to paint or gelcoat.

Sand the surface to 120-240 grit so there is some tooth on the surface but not heavy scratches. Vacuum up all the dust and the dust on the floor. Wipe the surface with acetone to remove fine dust and contamination from the resins.

Tech Tip: If possible, wet the floor of the shop area or spray area. Any dust that is disturbed by painting will stick to the wet floor and not the wet paint. Keep the floor wet until the paint is tack free, any airborne dust will stick to the floor and far less will be floating around during application.

Final Epoxy Coating (optional)

- A final epoxy coat will fill small holes and help fair the external surface. This is ideal for clear finishing canoes or kayaks where body filling will be visible.
- Mix a batch of regular epoxy.
- Working on sections of approx. 1 – 2 square feet at a time, saturate a foam roller and apply a very thin coat of epoxy to the deck, hatch covers, hull and any other areas that need it. Tip off each section with a foam brush to reduce any air bubbles and help the epoxy level. Apply and tip off the epoxy in an overlapping pattern, to avoid leaving ridges between sections.
- Allow this epoxy to fully cure 8 hours.
- This epoxy coat should be extremely smooth, any imperfections will not be masked by the varnish. This is the last opportunity to sand the epoxy layer.
- Vacuum of all the sanding debris, including the hatches and cockpit. Once we begin varnishing any fine dust will land on the finish of the kayak.

Gel Coat Application (basic)

- Gelcoat is either waxed or unwaxed. Waxed gelcoat is going to cure when catalyzed with MEKP every time it comes in contact with air. If you are applying multiple coats of waxed gelcoat you have to scuff sand and acetone wipe to remove the wax before another layer is applied.
- Unwaxed gel coat when mixed with MEKP catalyst remains tacky after application so that multiple coats can be applied without sanding and decontamination. Many even coats can be applied to build the desired thickness of the gelcoat for durability. In the final layer of unwaxed gel coat and mekp, air dry (wax) must also be added to the mixture for it to create a barrier to air and all the layers will cure at one time. This is the best way to apply a semigloss finish in gel coat.

- Gelcoat is best to be applied with an HVLP sprayer and thinned using Styrene resin thinner.
- Gelcoat can be hand applied with a squeegee or bristle brush, but the surface will have to be sanded and polished after for a semigloss finish.
- Mix pigment into your gel coat until you have the desired colour. If adding pigment to neutral base gel coat, you must add 10% v/v of pigment to gel coat.
- Gelcoat cures very quickly so only decant and catalyze the volume you can spray in 10-15 minutes. The HVLP gun will have to be cleaned out completely with acetone between each mixture of gel coat. Gelcoat that has cured in the nozzle will give you poor results and affect the smoothness of the application.
- Thin coats of gelcoat must be applied because gelcoat shrinks as it cures, so applying thick coatings will crack. Multiple thin coats have to be applied.
- Gel coat is thinned with Styrene Resin thinner before MEKP is added. Thin the gelcoat so that is sprays evenly with small particles, if you are spraying large particle there is not enough thinner in the mixture, the mixture has begun to cure in the gun or the psi to the nozzle is too low and not atomizing the mixture correctly.
- In the final layer of gel coat, add styrene, MEKP and Air Dry (wax) which will force all the lower layers of tacky gelcoat to cure as one surface.
- Wet sand and apply cutting compounds to polish the surface. Apply carnauba wax with a buffer to polish the surface.
- Boat Wax should be applied to gelcoat every year to stop UV damage to the gel coat.

Coating Hull with Graphite

Graphite powder mixed in epoxy provides very good abrasion resistance on the bottom of the craft. Even under very rough treatment (like rubbing over rocks in rivers), the surface will scuff, but it will very seldom leave a deep scratch.

We want to apply the graphite coatings in thin consistent layers, generally this will take two to three coats. The thin coats will not run down the sides of the hull.

This step can be done with the boat turned upside down and supported on saw horses or with the boat suspended from above. Consider what is the most comfortable working height, the three coats have to be applied consecutively for the best result.

Make a Guide Line with Electrical Tape

- Make a “water” line by placing electrical tape along the length of your hull
- Make sure the electrical tape is pressed down well, as this will be your edge for the black epoxy. (When properly applied, electrical tape will leave a nice clean line with no chance of “bleeding”.)

- Divide your graphite powder into three equal volumes. One of these portions will be added into the epoxy for each coat.
- Mix a batch of epoxy and add part of one of the graphite portions. Do not add the whole portion of graphite into this initial batch of epoxy until you are aware of the coverage and working time of the epoxy. Mix thoroughly. Smear the lumps against the inside of the container to break them up.
- Do not expect to have a proper graphite coating in one coat, applying epoxy in thick layers will cause it to slouch. The key to success is to apply multiple thin coats during the tack time to achieve the results seen in the photos.

- Using a foam roller, apply this graphite mixture in thin layers to the bottom of your boat, being careful not to go past your electrical tape line. Tip off bubbles. The first two layers may still show some of the wood panels below. This is why we are planning for three coats of graphite
- Warning: if you apply the epoxy in thick layers, it will bleed and run over the tape onto the hull. Wipe off any epoxy drips with acetone.

- After the first coat has cured for 90 minutes or is tack free, apply a second graphite-epoxy coat. After 90 minutes hours a third coat may be applied (optional) in the same manner as the first two coats if the finish appears translucent.

- 1 hour after the last coat has been applied, remove the tape. It will come off leaving a clean edge.

- Let the hull cure for at least 24 hours.
- Do not varnish over the graphite!

Polyurethane Varnishing or Polyurethane Marine Paint

To reseal the can of varnish or paint after using it, set the external seal with a rubber mallet and then flip the can once upside down and then right side up. This will set the seal on the inside of the can. Some of the varnish will create a skin on the top of the liquid varnish, remove this skin and continue using the varnish.

Decant the varnish into a second container or tray for rolling and tipping. Do not dip your brush into the can, this will put debris into the can that will end up on the surface of your kayak.

Read the back of the varnish can for application instructions.

The technique for applying single part polyurethane marine paint and varnish is the same, the photos below are for applying varnish. Follow the steps for hand applying a semi gloss finish, spray application techniques for a high gloss finish.

- Finish sand your deck and hull surfaces to 220-600 grit. You can use fine sand paper between your first and subsequent coats.
- Wipe your surfaces with a lint free paper towel or cloth with acetone to remove all surface wax and contamination.

CAUTION: <u>Keep the acetone away from your varnish, soaking varnish with acetone will cause it to lose its bond. Acetone in large volumes will dissolve varnish.</u>

- Tape off any area that you do not want painted or varnished at this time. In some cases the hull should be painted first and the deck should be painted last since its most visible.
- You should roll and tip with a foam roller and foam brush on small areas (one to two square feet), completing one side at a time.
- Use your foam roller to apply a thin coat of varnish. Expect to see some bubbles on the surface.
- Take a foam brush with varnish and gently brush the surface you have just rolled. This is called “Tipping off.”
- By rolling the varnish on, and tipping it off you are using the “Roll and Tip” technique.
- Allow the varnish to cure for 12 hours at 21 degrees Celsius. The varnish has to be fully cured before the next layer can be applied.
- We recommend that you apply a minimum of three coats of varnish or paint to the exterior of the deck

and hull. The more coats applied at the beginning will extend the life of the craft, as well as reduce UV damage and scratches.

Recoating Varnish

- After you scuff sand the deck with high grit sand paper (240-1000 grit), wipe it down with a clean paper towel and acetone.
- Stir the varnish and decant the volume required for a second coat.
- Roll and tip the varnish.
- Allow to cure for 12 hours at 21 degrees Celsius.

Spray Applying Polyurethane Marine Paint or Varnish

The techniques described are basic knowledge and information for single part polyurethane paint and appropriate thinner through an inexpensive HVLP spray gun with a 1.2- 2.0 nozzle size. The thinners are formulated for each manufacturer, thinning with incorrect thinner will not lead to an ideal result.

Safety

Ventilation is mandatory for spraying airborne varnish or polyurethane paint. Negative air pressure will remove chemicals from the air and reduce dust particles. The builder should wear a TYVEK suit to keep all airborne particles off the builders' skin and body. Active organics cartridge full face mask is ideal for keeping active particles from entering your eyes, face and lungs. Gloves are required for applying the paint as well as acetone for cleaning the gun after use.

- Set up all of the chemicals, thinners, sprayer, safety gear, ventilation, mixing buckets and acetone.
- Set the pressure regulator on the compressor to the correct psi for even application. Do not set the regulator on the spray gun, the pressure will be too high in the hose and the gun cannot stop this pressure. The hose can be used to equalize the pressure so that your atomization is consistent.
- Mix your varnish or paint in the can until it is fully integrated.
- Pour a small volume out into a mixing container (200ml max)
- Add the correct thinner for the product you are using.
- Add it to the pot of the sprayer.
- On a sample piece of material (preferably scrap of the same surface you plan on spraying) set your pressure on the compressor, adjust your nozzle fan size and the volume control
- Begin at the edge of your craft and spray even smooth passes with overlap.
- Keep the spray nozzle 6-8 inches away from the spray surface, only the particles are contacting the surface.
- Coat the whole surface evenly.
- Some paints can be reapplied when the paint is tacky. Some paints have to be fully cured and scuff sanded between coats
- Two to three coats should be applied on new fiberglass and epoxy.