# PH15 Building Method

Building sequence outline:
- Set up **vacuum bagging** table
- Build (vacuum bag) flat parts
- Plank foam on slat jig, slat jig is on vacuum bagging table, plank with drywall screws
- Vacuum bag outside skin
- Flip over, remove jig, support hull
- Vacuum bag inside
- Install framing and tunnel
- Sole
- Bulkheads and frames above sole
- Deck

The steps to build this hull by the open mold method (without vacuum bagging) follow the same sequence.

**About vacuum bagging, resin infusion and hybrid methods:**

The ideal building method is resin infusion. Vacuum bagging involves a wet laminate that is cured under vacuum. The vacuum pulls out the excess resin and the result is a high fiber content laminate, light and strong. Resin infusion is a variation of vacuum bagging in which the resin is infused in the dry laminate after the vacuum is created. There are several names for that method and some patents: SCRIMP, VARIS, VARTM etc. It is not a new boat building method. The designer of the PH15 saw vacuum assisted resin infusion used for the first time in France in 1971, during the building of the Carter design Vendredi Treize. Vacuum bagging and infusion are well proven methods that require a careful set up but produces very clean and light fiberglass parts without any compromise in strength. There is almost not fairing, or sanding required. As a result, despite the set-up time, the total time required building with vacuum bagging or infusion can be shorter than in open mold. Open mold is the method used to build our plywood-cored boats. The PH15 foam sandwich version can also be built using the open mold method: wet the glass with resin and squeeze the excess resin out with a squeegee. Open mold parts will weigh around 33% more than vacuum bagged part. Any method combination is valid. A good hybrid method would be to vacuum bag the flat parts like stringers, frames, sole deck etc. and install them in a hull build by the open mold method. The resulting hull would weigh only 35 lbs. more than a hull built completely with vacuum bagging or infusion. Our lamination schedule can be used for any of those methods. There is no difference in fiberglass or fabrics specifications between open mold and vacuum bag. All weights listed on the plans refer to parts built under vacuum. In the text, we will use the words vacuum bagging, but this can be read as resin infused or open mold layup.

**Kevlar:**

There are two different lamination schedules for the foam cored PH15: with or without aramid (Kevlar). The hybrid Kevlar hull is 30 lbs. lighter than the listed weight. Each version uses some carbon fiber.

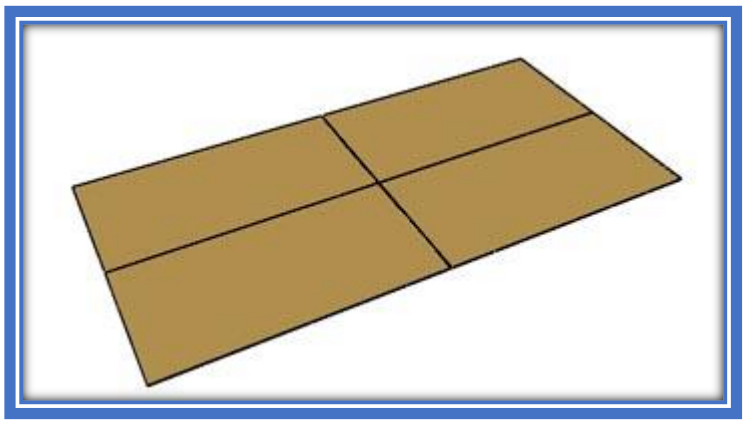
**"No wood":**

If you choose the foam version mostly because you want a "no wood" boat and don't worry too much about the weight, the complete boat can be built without any vacuum bagging. It will weigh around 130 lbs. more but considering that we have a PPI of 320 lbs. at 4" draft, this means that a boat built without vacuum bagging will float around 3/8" deeper than a vacuum bagged boat. We recommend starting with all the flat parts, small ones first. This will give the builder some practice with the vacuum bagging technique. Use a small safety margin when cutting those parts, they are easy to trim later.

**Set up vacuum bagging table**

We suggest building a large vacuum bagging table from 4 sheets of plywood arranged in such a way that the complete boat hull will fit on it. Raise it above the floor if convenient but pay attention to the surface. It must be smooth and perfectly flat. Laser levels are inexpensive today and should make the job easy. We will call it the "table" in the text below.

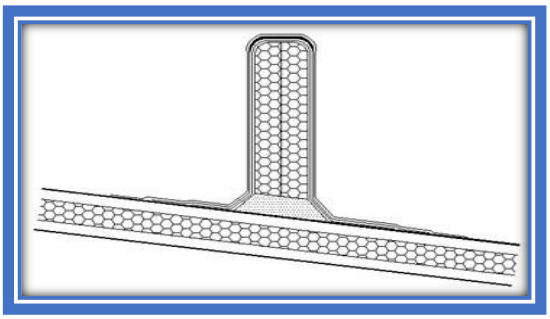
# PH15 Building Method



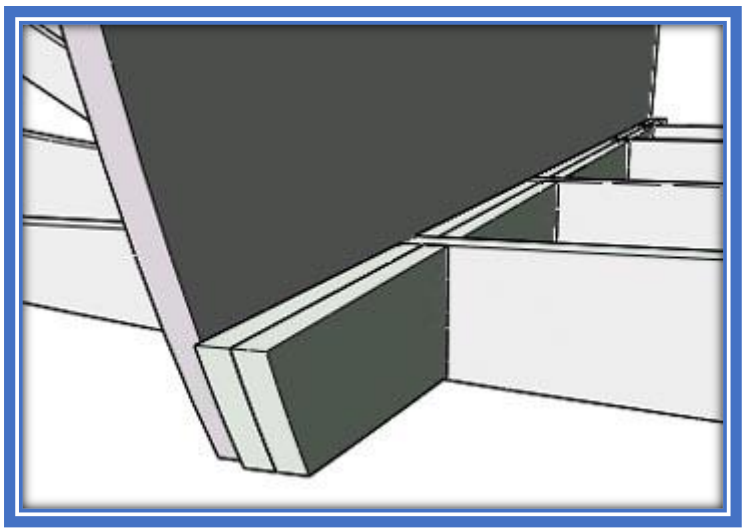
Coat the plywood sheets with resin or use Formica faced plywood. Fill the gaps between the sheets that form the table with any cheap goop or putty. In these building notes, we will give some tips about vacuum bagging but not explain in detail how to vacuum bag or infuse. Get the WEST system booklet, it is inexpensive and detailed. The techniques shown in that booklet are valid for any resin and fabric. We recommend using our System Three Silver Tip resin. It has the low viscosity required for good vacuum bagging. A lower viscosity will allow the resin to flow easily through the laminate and produce a higher glass content. The resin we specify also has a higher tensile strength than standard resins.

**Build (vacuum bag) flat parts:**

If this is your first vacuum-bagging job, start with a single part and build one face at a time. Once you gain experience, you can cure several small parts at the same time. A complete cure can take up to 8 hours, to build several small parts at the same time is a must. Unless you use resin infusion, for the small parts, it is usually more efficient to pre-impregnate the fabric with resin before applying them to the foam. This is just a matter of rolling resin on the fabric before applying it to the foam. When vacuum bagging, do not laminate the two sides of a part at the same time. Since we use a closed cell foam, air entrapment may inhibit proper suction on the hidden face. This can be . . . (see building notes for complete text)



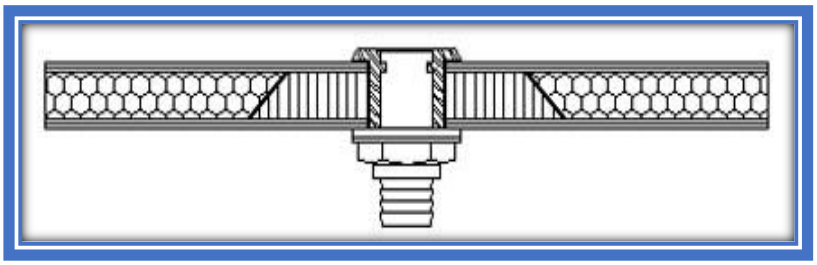
Note that in the finished boat, the stringers, floor frames and bulkheads are separated from the hull by a foam pad. Those foam pads have a trapezoidal section and are easy to cut on a table saw set at a 45 degrees angle. We use the same foam thickness . . . (see building notes for complete text)

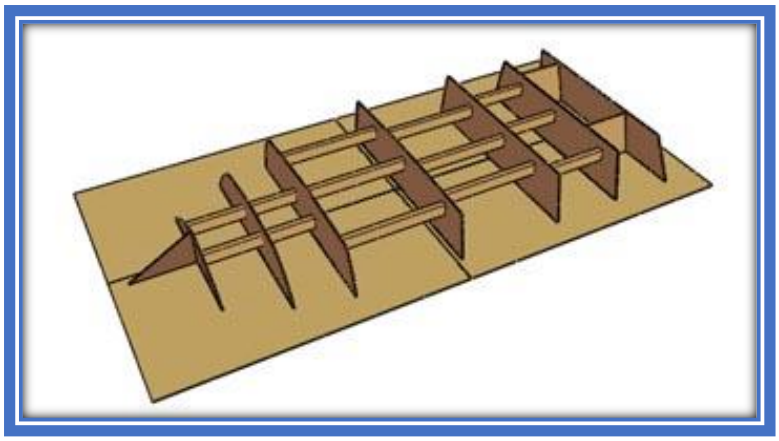


Proceed with all the other small parts and the stringers. The exact type of foam for each part is specified on the plans or in the lamination schedule. We use two types of foam: a light to medium density for hull and deck and heavier type of foam for the transom, inserts etc. Stringers are made of two layers of foam epoxy glued. Most floor frames are made of three layers but in some cases, that third layer is a bulkhead. Read the paragraphs about frame installation and see the construction drawing. Our preference is to assemble those parts as follow: (See building notes for complete text)

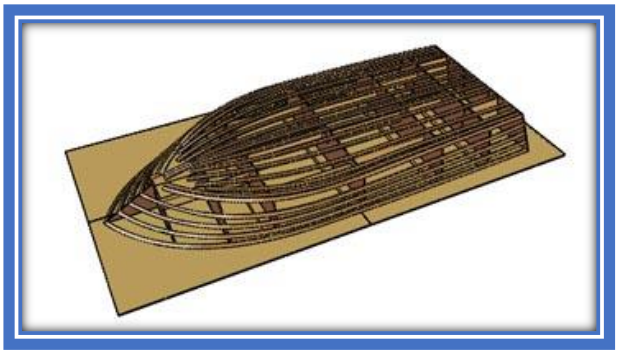
# PH15 Building Method

The larger parts, deck and sole are built last. Plan for the console installation. (See building notes for complete text) On the deck, plan for hardware installation. While it is possible to install hardware later, it is easier and cleaner to include high-density foam inserts for cleats, poling platform and other hardware at this stage.



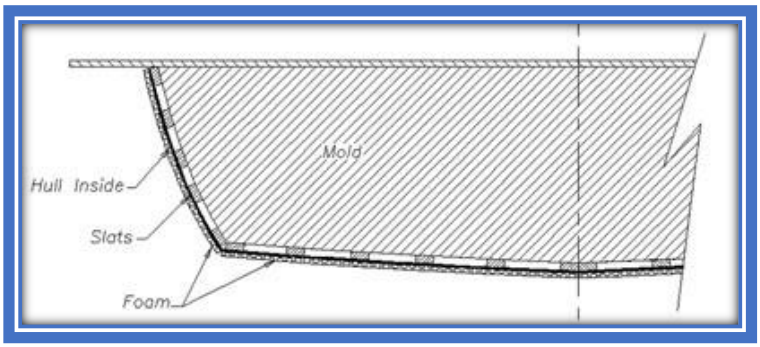


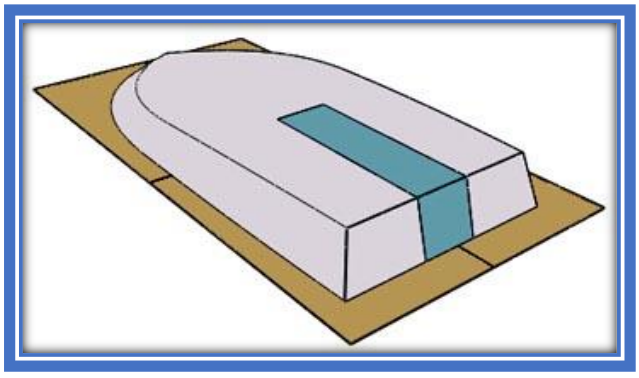
Set all your flat parts aside and start the jig assembly. Build the jig (male mold). The PH15 hull is assembled on a traditional slat jig. That type of jig is sometimes named a ribband mold. It is made of molds covered with widely spaced longitudinal battens.



The molds can be made of particleboard. They should be sufficiently thick to take screws for the slats. Take the molds dimensions from the stations drawing.

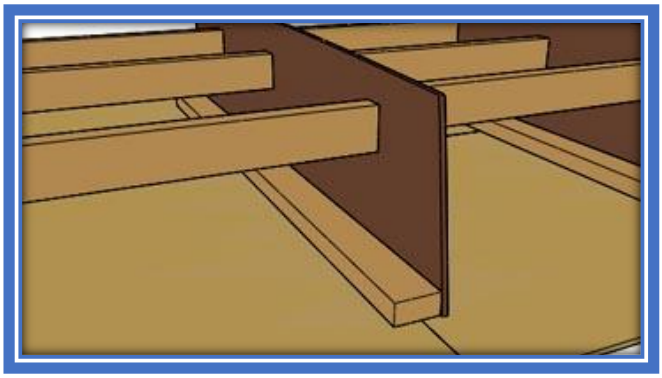
The stations are located at the molds. The station dimensions are taken inside of the hull. To make a mold. (See building notes for complete text)



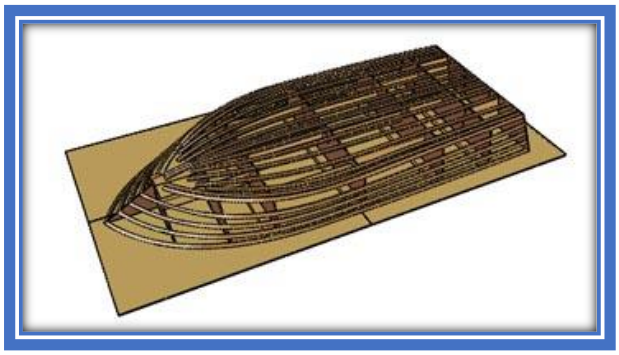



Finish with the transom. Our PH15 has a false transom and a true transom. On the finished boat, the false transom is the part that closes the sponsions, the extreme rear panels of the hull. The true transom is the one that supports the motor. (see building notes for complete text). The foam for the false transom will be applied to a full transom mold, not to slats. Dimensions for that false transom mold are given on the plans. We also show dimensions for a spacer that will give the correct transom angle.

# PH15 Building Method



Cover your vacuum-bagging table with a thick sheet of polyethylene before securing the molds to the table.
To reduce the risk of leaks, use as few fasteners as possible to secure the molds to the table. Molds can be secured with a mailer (2x4?) between the mold and the table. Install the bow mold. Plank the molds with the slats. Important: proceed symmetrically. One batten on the port side followed by one batten on the starboard side, otherwise, the jig will twist. Do not over tighten the screws that hold the battens. They should make contact but not be pulled flat.



The exact location of the slats is unimportant but there should not be more than a 4" gap between them. At the bow, they may end before the bow mold. We expect them to bend under the foam.

**Plank the jig with foam.**
The plans give the exact dimensions for all the foam panels: no need to take them from the jig. There will be a gap where the tunnel goes and in the opening in the transom. We will use plain Styrofoam to fill those gaps. Use cheap blue insulation thick.

**Inserts for tru-hulls.**
Tru-hulls or hardware can be installed in a cored hull or deck after the building, but it is easier to plan the installation at this stage. In such a small boat, you may very well not install any tru-hulls but if you do, they will require some attention. See the plans for a typical tru-hull installation drawing using a higher density foam.

Cover the jig with the foam. The foam is fastened to the slats with drywall screws. Use as few screws as possible.
Close to the bow, the foam will be too stiff to take a proper shape. Cut slits in the foam along lines perpendicular to the curvature. (see building notes for complete text) In areas of high curvature, you can cut slits in two directions in the style of scored core foam.
To keep the hull fair, do not cut more slits than necessary. After all the foam panels are installed, build putty fillets at all seams. The putty should be made of . . . (see building notes for complete text) Remove the screws from the foam. The foam may pull back a little bit from the jig, but the vacuum will take care of that. If you can push the foam in shape with one or two fingers, the vacuum bag will also pull it since it will create a pressure of around 6 psi. Beware of . . . (see building notes for complete text) Prepare the foam for the outside laminate: Round all corners except the edges along the sheer to a radius. Fill gaps with micro balloons putty if necessary. Grind the foam down 1/8" all around the tunnel location, up to 6" away from the future tunnel cut. This is done because later, we will add fiberglass tape all around the outside edge of the tunnel. (the plans show the exact location of that step). That extra fiberglass would create and extra thickness difficult to fair. The little dip in the outside skin is just what we need to obtain a fair hull surface after tabbing the tunnel in the hull. Grind the foam same way all around the sheer but only 3" down. Later, we will bond the deck to the hull, inside and outside, with fiberglass tape. That little step will absorb the extra thickness of the tape and produce a fair outside hull. Cut all the fiberglass layers for the outside skin as specified in the lamination schedule. Pay attention to the overlaps and stagger the edges.

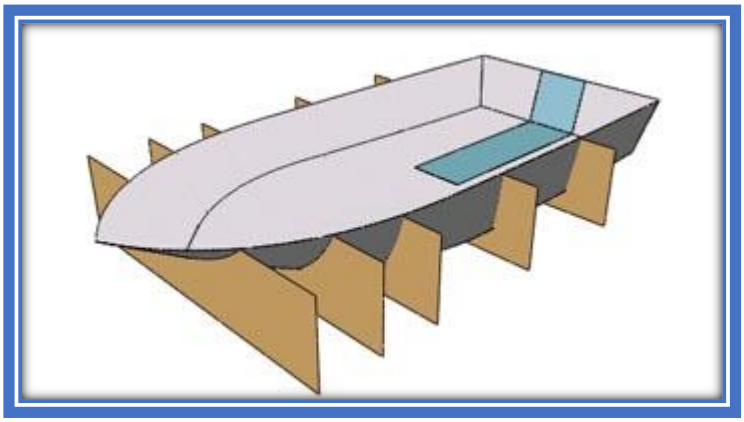
# PH15 Building Method

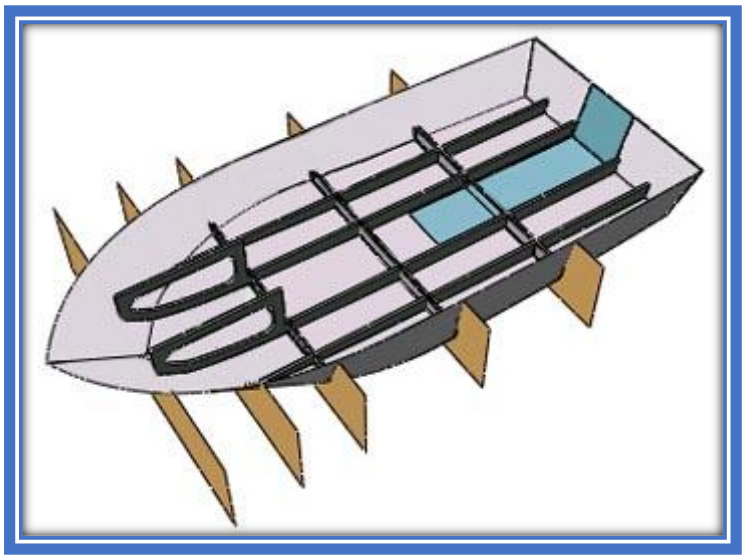
Build the outside skin either by simple vacuum bagging, resin infusion or open mold layup. Wait for complete cure. Note that there is no need to cover the Styrofoam parts with fiberglass since we will cut those pieces out. Extend the glass just a few inches over the Styrofoam inserts.

**Vacuum bag outside skin:**

Flip over; remove jig, and secure hull: Flip the whole assembly over and support the hull before removing the jig. If you used particleboard to make the molds, use the leftovers as support, they have the perfect shape.

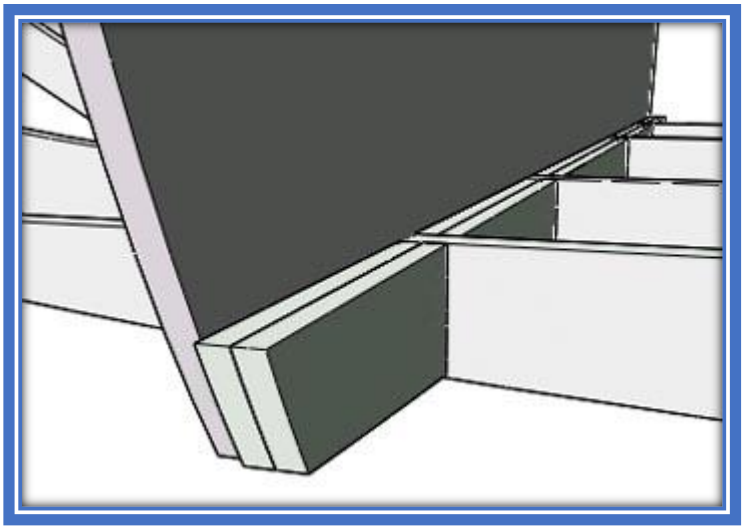
Build the inside skin without any floor frames or stringers. Use putty fillets where needed: all seams should have a radius. Use . . . (see building notes for complete text) Now, you have a complete foam sandwich hull shell.





Install stringers and floor frames Install the stringers and floor frames in the hull shell. This can be done in one or two steps depending on your vacuum bagging skills and equipment. If you proceed in two steps, install the stringers first. The stringers must be in one piece with the floor frames between them. The stringers are capped with carbon fiber. See the lamination drawing for specifications and stack order.

The lamination drawings show how to tab those parts to the hull. We use trapezoidal foam wedges between the framing and the hull. Note how the frames and bulkheads blend in the floor frames. The easiest procedure is to install bulkheads like A and B after the floor frames. Let's look at B for example. . . (see building notes for complete text)



With the stringers and floor frames cured, proceed with the installation of the tunnel. The tunnel fits between the stringers. (see building notes for complete text) With the tunnel in place, we install the true transom (motor mount), motor mount sides and sponsoon sides. The true transom and sides do not sit on a foam pad. Build a ?" fillet at the seams with structural putty. Keep in mind that we will cut the tunnel and false transom openings later. There is no tabbing or fillet where we cut.

The construction drawing shows the sponsion sides butted against the outside face of the stringers and the motor mount sides on the inside edge of the stringers.

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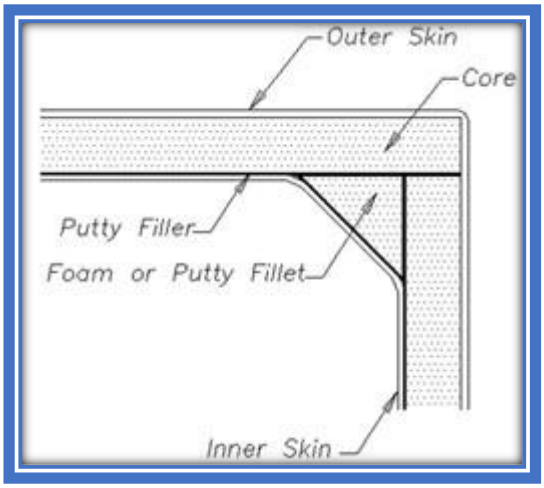


The construction drawing clearly shows how those parts fit together. The transom is made of high-density transom foam. Install frame A, bulkhead B and the sole. The sole . . . (see building notes for complete text) The space under the sole can be filled with two-part foam before sole installation. Chase tubes for steering, controls etc. as well as the drain pipes for the scuppers must be installed before the sole. We recommend running the electrical wiring under the gunwale. Fuel tank shelf: if you plan to install a fixed fuel tank, it should be located under the casting deck. Install a tank shelf made of the same material than the sole under the casting deck. Install the other frames above the sole. Install all hull hardware with appropriate backing plates or extra laminations: bow eyes, trailer U-bolts, trim tabs etc. Install the deck. The deck is glued to the sheer with epoxy putty and tabbed all around inside and outside. The finish and fairing are done the same way than on any other fiberglass boat. A glued vinyl rubrail is appropriate for this boat. The topside foam will take the screws until the epoxy glue cures. The same applies to other small parts like a toe rail.