

# USS PERMIT

## SSN- 594 CLASS

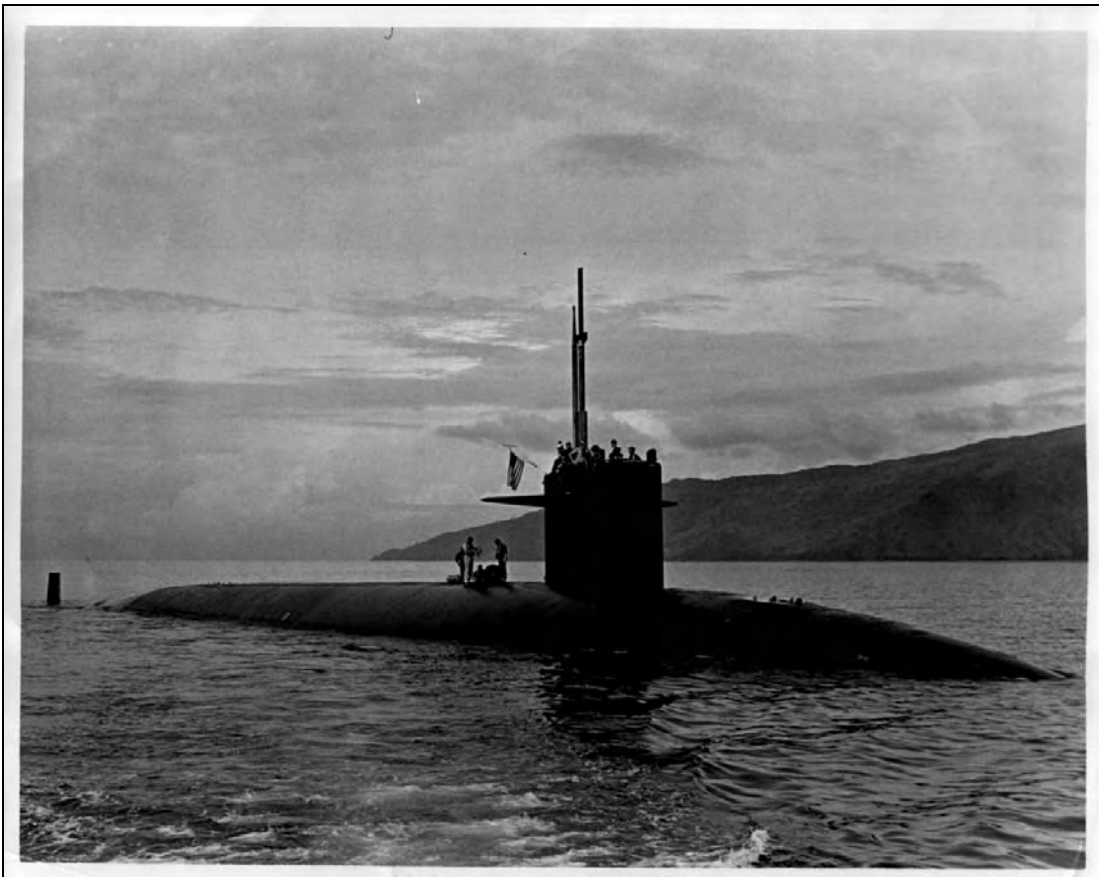
Model Submarine Hull Kit in 1:72 Scale  
Assembly Instruction  
Manual





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## 1. Introduction

Thanks for purchasing your new model Permit class attack submarine! Your new highly-detailed model is intended not only to provide many hours of quality RC running time in freshwater ponds, lakes or pools, but is meant to be a fun and good learning experience while building it as well. It can even serve as a fine static display model when not in the water. The whole concept behind the design of this project was to provide the modeler with a kit that requires very little, if any scratch building to complete it. In this way, even the more inexperienced of modelers should have little trouble in assembling this model submarine.



## 2. Background Information

The Permit class of nuclear attack submarines was the result of the US navy's need for a fast, efficient, deeper diving, and most of all, quieter anti-submarine warfare weapon platform over the previous Skipjack class. They were basically the prototype, which laid the foundation for all nuclear attack subs used to this day by the U.S. The main features in which define this "modern" attack submarine configuration are: The bow mounted sonar dome, which moved the torpedo shutters back to amidships to the first time in sub design history. Mechanical "rafting", a design technique utilizing rubber washers to isolate vibrating parts from the main hull drastically reducing the noise level produced from the boat. The whole package was wrapped up in the revolutionary hydrodynamic teardrop shape taken from the results of studies of whale's bodies, and so successfully incorporated into the Skipjack's hull.

The Permit's hulls were larger than the previous class, and used the same reactor and drive system, but didn't lose any speed due to better design application. They also used HY-80 (High Yield Strength - minimum 80 000 psi) for the first time resulting in deeper diving capability.

The first boat in the class was actually SSN-593 USS Thresher, and was lost in 1963 220 miles east of Cape Cod while conducting deep diving sea trials due to a pipe bursting and shorting out control systems. The result was a new program called "SUBSAFE" changing fabrication procedures and standards, thus ensuring that this kind of terrible incident would be very







unlikely to happen to any submarine after the loss. Although there were 14 boats altogether in the Permit class, very few of the boats, if any, were identical to each other. Some examples of this were: SSN-613 USS Flasher, SSN-614 USS Greenling, SSN-615 USS Gato all had 10' longer hulls and a longer sail for added SUBSAFE machinery, SSN-621 USS Haddock had a long sail but regular Permit hull, SSN-596 Barb was the only ship of the class with "puffer fins" added to the sides of the stern plane stabilizers, and probably the most noted of the class, SSN-605 USS Jack, is the only American nuclear submarine ever fitted with contra rotating propellers upon a single axial drive shaft. In the late 1970's and early 1980's the US navy added a towed sonar array to the all the boats requiring a fairing be added to the hull. A GNATS sonar jammer hump was added to stern as well as the sail was reconfigured to accept a improved BRD mast and an observation periscope. Even the added modifications were not built to a standard, and could be found to have variations from boat to boat.





### 3. Class Specifications:

- Displacement: Surfaced: 3,540 t., Submerged: 4,200 t.
- Length:
  - 278 feet
  - 297 feet SSN-605
  - 292 feet SSN-613-615
- Beam: 31' 8"
- Speed: Surfaced 15 knots, Submerged 28+ knots;
- Operating Depth: 400'
- Complement: 143
- Sensors:
  - Raytheon BQS-6A or -6B active/passive systems
  - BQQ-1 and the Edo BQR-7 passive, conformal array
  - TB-26 Towed Sonar Array
- Armament:
  - Four 21" torpedo tubes, forward
  - MK 48 torpedoes
  - UUM-44A SUBROC anti-submarine missiles
  - UGM-84A/C Harpoon anti-ship missiles
  - MK 57 deep water mines
  - Mk 60 CAPTOR mines
- Propulsion System: one S5W nuclear reactor, two Westinghouse steam turbines, one propeller 15,000 shp.
- Ship Builders:
  - 594, 595, Mare Island Naval Shipyard
  - 596, 607, 621, Ingalls Shipbuilding
  - 603, 604, 612, New York Shipbuilding
  - 593, 605, 606, Portsmouth Naval Shipyard
  - 613-615, General Dynamics' Electric Boat Division





## 4. Recommended tools

This list is a compilation of “recommended” tools only. By no means are you expected to go out to the store and buy everything you see listed here. There are always different ways and different tools used to accomplish a task. Rather, it would be a good idea to acquire tools you need only on an “as needed” basis

- Variable speed drill and assorted drill bits from 1/32” to 3/8”
- Rotary tool set with sanding disc, grinding attachments, and various other bits
- Small adjustable wrench
- Razor saw
- Airbrush
- Imperial Allen key set
- Hand clamps or spring clamps
- Phillips and flathead screwdrivers
- Exacto knife
- Utility knife
- Mini-file set
- Small hammer
- Bench vise
- Scissors
- Carpenter’s square
- Torpedo level
- Mini bubble level(s)
- Side cutters
- Tape measure
- Ruler or straightedge
- Face mask for paint and particulates

## 5. Recommended Electronics and WTC

These are the electronics and the “guts” that you will need to make you boat a fully functional RC model. Here are the websites of recommended vendors who carry these items. Most, if not all the required equipment can be sourced from these places:

[www.caswellplating.com](http://www.caswellplating.com)  
[www.mikessubworks.com](http://www.mikessubworks.com)

- 3.5” WTC (D&E Miniatures 3.5 Subdriver recommended)
- 4-channel radio and receiver - It’s always a good idea to get larger capacity radio (6 or 8 channels) for extras that you might want to add to the model later. Retracting periscopes, dive planes and even torpedo systems are all examples of this. Polk’s Hobbies makes an excellent 8 channel setup for our purpose, for a very reasonable price.
- Electronic speed control
- Failsafe
- Pitch control module
- Rudder servo motor
- Stern plane servo motor
- Sail plane servo (optional)
- NiCad Rechargeable battery(s) and charger





## 6. Recommended Materials and Consumables

- Pencils
- Dishwashing abrasive pads
- Sharpie marker(s)
- Masking tape
- 1 hour setting epoxy adhesive (minimum)
- Thin Cyanoacrylate adhesive (CA) "superglue"
- Baking Soda
- Pink or blue foam
- Cardboard
- High quality filling and sanding primer (Dupont Nason Ful-Fil or Fill 'N' Sand acrylic lacquer)
- 100,220,400,600,800 grit wet and dry sandpaper
- Air dry glazing putty (Nitro-Stan or Evercoat)
- Polyester auto body filler (Evercoat with miracle sanding)
- Popsicle sticks or tongue depressors
- Paper Dixie cups for mixing
- 12" of 1/8" diameter brass rod or tube
- Abrasive dishwashing pads
- 'Woodland Scenics' Gothic 45 degree white small numbers
- 'Woodland Scenics' Gothic 45 degree white large numbers
- 'Woodland Scenics' Gothic 45 degree white small letters

## 7. Plastic Part Preparation

The first thing you'll want to do when you open the packaging for you new submarine is to look over all the parts to make sure they are all there as per the bill of materials that is included. You also want to inspect for any damages that might have occurred during the shipping of the package. Once you've looked over everything and are happy, the next step will be to clean off all the pieces in warm soap and water to remove any amine blushes or mold release and the bathtub is the perfect place for this. Keep in mind that the mold release (PVA) on the fiberglass parts has not been removed purposely to provide a little more protection to the surfaces for the shipping process. Gently scrub all the parts with your dishwashing abrasive pad and a little soap so that all the greenish PVA film comes off. It is important to get all of it off, as any coatings such as filler or paints will not adhere to the plastic. Also, give all the plastic parts a light scrubbing to clean off any impurities, which might affect paint or glue adhesion. Remove any seam lines and flashing from the plastic parts initially scraping it off with you Exacto knife and then cleaning it up with some 220 sandpaper. Finishing doesn't have to be perfect yet, but all seams and flashing that interfere with the fit of parts has to be removed. Final finishing and cosmetic filling should be left to when you are getting ready to paint the boat.





## 8. Marking Out Where Everything Goes

A good idea before you start cutting and drilling is to mark out where everything goes. You can start by taking your Sharpie marker and drawing in all the scribed details in the plastic. Doing this makes everything easier to see and work with. This will also be able to help prevent losing any detail in any later steps of your build. A good idea would be to take your machinist's scribe and deepen some of the scribe marks in the hull if you want them to stand out a little more.

## 9. Z-cut

The Z cut enables the two hull halves to be connected together in a simple, yet effective way. Two small machine screws are enough to hold the whole thing together!

- Begin by marking out on the bottom half of the hull 3" from the tip of the bow.
- Do the same with the top half but at 3.5" from the stern tip.
- Place the top half on the floor in a corner between two walls that you know is square in your house with the stern point firmly against one wall and the side of the firmly against the other.
- Take a block of wood with a hole centered at 3.5" from the bottom that is large enough to hold the Sharpie pen in place.
- With someone holding the hull firmly in place, carefully and slowly run your block of wood with marker in it along the wall marking out your cut line. Be careful not to get any ink on your wall or floor!





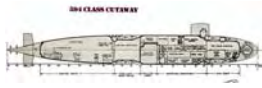


- Repeat this procedure for the top hull half at your 3" line. Carefully run your razor saw along the line making a groove or "path" that will allow easier cutting, giving the blade a path to follow when doing your main cut. This is essential to getting a clean line with the least amount of material being removed.



- Repeat for the other half of the hull you marked out. Sand about a ½" on the inside around where the pieces will be glued using 100 grit or lower sandpaper and then clean with lacquer thinner. This allows for proper bonding for your epoxy adhesive.
- With both cut off ends sanded, tape the cut pieces to the other hull half firmly.
- Put the hull halves together and "dry-fit" them to make sure everything fits well. You should only have a gap about the size of your razor saw between where you cut the pieces.
- Use a couple of small drops of medium or thin CA, then sprinkle a little baking soda to instantly catalyze the glue on the inside of the hull where the pieces meet. This will tack them together in preparation for the more permanent fiberglass tape and epoxy step coming up in a later step.





## 10. Registry Lips

This kit comes supplied with a bow, stern, port and starboard fiberglass registry lips that will help hold the two hull halves together tightly in conjunction with the provided carbon fiber spring clips.

- Start with the bow and stern lips and clamp them into place with  $\frac{1}{2}$ " protruding with a hand clamp.
- Mark the lines out on the lips where they sit and then remove and sand behind that line with 100-grit sandpaper and clean with lacquer thinner.



- Clamp back in place.



- Fit the starboard and port lips into place on the bottom half of the hull and check for fit. You want to see  $\frac{5}{8}$ " of the registry lip sticking up above the hull line and you don't want to see any gap between it and the hull.
- You might have to trim some length off each to achieve a good fit.



- Mark along the bottom of the lips along the length of the hull and then sand between them below that line and the hull edge with 100-grit sandpaper and then clean with lacquer thinner.



- Mask off all the surfaces that are not to be glued on the lips. It might be a good idea to mask off the outside of the hull as well

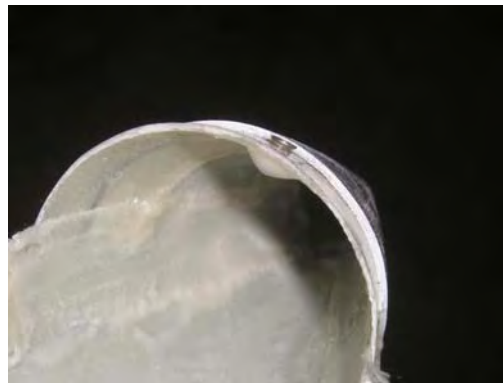
*Note: It is vitally important that you don't get any excess glue curing on those surfaces. If you have any squish out onto the tape, be sure to wipe it off.*

- You can now glue all the pieces into place using your epoxy adhesive and clamp into place with hand clamps.
- Once the epoxy is cured, you can now permanently adhere the bow and stern to their adjoining halves using fiberglass tape saturated with epoxy along the seam line inside the hull.
- Put the hull halves together ensuring that they fit well.
- On the bottom half put a mark  $\frac{1}{4}$ " back from the Z-cut edge
- On the top half mark a  $\frac{1}{4}$ " up from the stern Z cut edge. In this case you will not be able to center the mark exactly on top of the hull, as there is a MBT detail that lands too close. I recommend offsetting the mark so that when you mount the screw it will look similar to the finished MBT vent and could pass as it's twin
- With the hull halves still together in the exact position that they will be when finished, drill a  $\frac{3}{32}$ " hole where you marked both halves through both the hull and index lip





- Disassemble the hull halves
- Hacksaw some grooves and scour the surface of the provided 4-40 stainless nuts
- Grease the two 4-40 by 1/4" long machine screws provided with Vaseline
- Tighten the nuts (on the insides of the bow and stern lips) through the lips to their screws and epoxy the nuts in place. Try to cover the nuts with filled epoxy so that you don't see any steel showing through



- After the Epoxy has cured, remove the screws from the lips.
- Countersink the upper hull holes with a 1/4" drill bit. Do not go too deep as you just want the top of the screw head to be flush with the hull surface
- Fit the hull halves back together and you now will be able to fasten them together by threading the machine screws into the now stationary nuts

## 11. Registry Spring Clips

Enclosed with the kit comes 10 carbon fiber spring clips. The purpose of these is to hold the bottom registry clips tight against the upper hull for a tight, clean fit between the halves.

- To begin, start by marking lines on the upper hull 3" from the stern cut-off and the bow part that was glued on.
- Between those marks you can then mark out 4 evenly divided spaces.
- On these marks you can use your rotary tool to rough up the fiberglass in about 1 square inch patches about 1" from the edge of the hull lip.
- Rough up the back of the contact surface with your tool or sandpaper and clean all the surfaces to be glued with lacquer thinner.
- You can now epoxy the clips into place and hold them there temporarily with masking tape. When looking from the side of the hull you will want to see about 1/4" of the clip protruding past the edge







- Once cured, you can now fit the two hull halves together and check for fit



## 12. Drive Train Installation

The drive train includes mounting the included forward bearing supporting bulkhead and an aft 3/16" Oilite bearing that supports the drive shaft and lubricate it as well. These are not your typical bearings as they sintered bronze bushing impregnated with oil, a far more "maintenance friendly" configuration than ball bearings, but could use a drop or two of oil before every run.

The propeller comes provided with a stainless steel setscrew that should be sufficient on it's own when tightened, to hold the propeller in place when running the boat. However, this part is definitely something you don't want to take chances with slipping off when in the middle of a pond or lake. Some precautions you can take is to notch the drive shaft where the setscrew contacts to make a ridge that the screw fits into that will prevent the propeller from sliding off if the screw loosens. Another precaution would be to scour the shaft where it contacts the propeller hub and then use small amount of epoxy to create a permanent mechanical bond between the prop shaft and propeller. You can even use a combination of the all the above procedures.

- Ensure that the prop hub fits properly on the stern of the hull by loosely putting it into place. If the hub is slightly larger than the hull at that point then you can block sand the taper down a little. Don't take much off, maybe a 1/32" at a time until the prop hub and the hull match exactly.
- Gouge the 3/16 I.D. flanged Oilite bearing in x-type patterns around the outside diameter of it using a triangle shaped file. Because the bearing is impregnated with oil, we have to put these gouges in to give us a surface that can be bonded to with epoxy in a mechanical fashion
- Place the bearing bulkhead as far to the rear in the bottom half of the hull as you can. You want this part to be in just snug and not prone to moving. Don't put it in so that it is too tight that it starts to bow the hull out in any way. You might have to also trim a little of the plastic to get it to fit around the hull index lips that were glued on earlier
- Grease the 3/16" stainless shaft provided with the kit with Vaseline

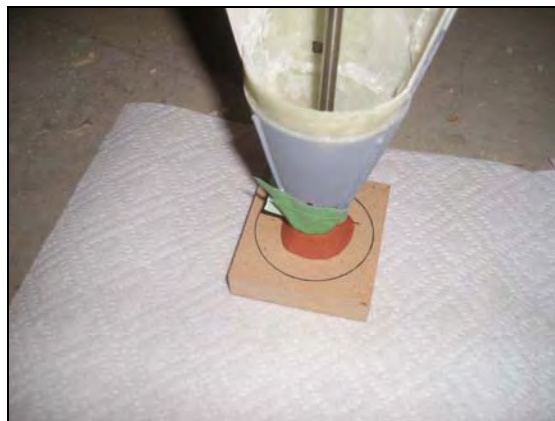




- Slide an Oilite bearing flush with one end over the shaft and place the other end of the shaft through the back of the boat so that it slides through the 3/16" bearing that is cast into the bearing bulkhead

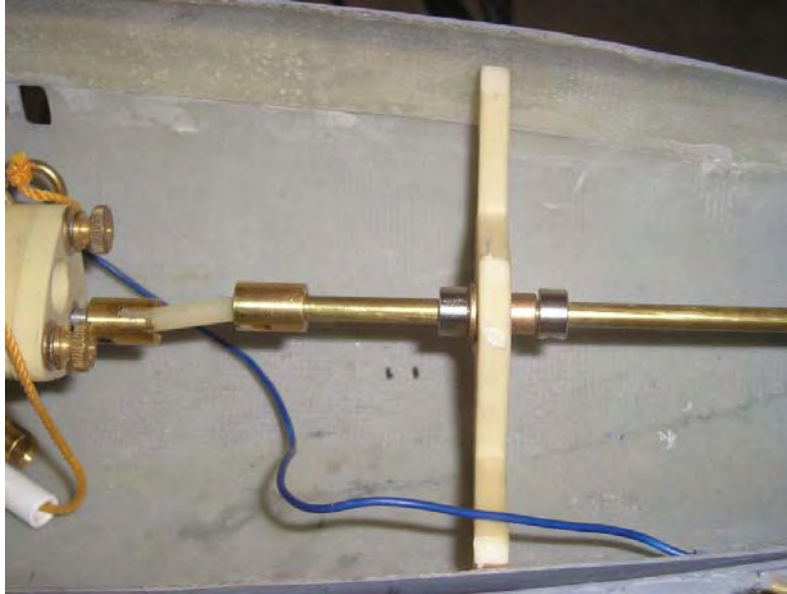


- Fit the flanged end of the bearing so that it is flush, or even sticking out about 1/32" from the stern taper end
- When centered exactly, place a small drop of CA on the bearing and catalyze with baking soda to tack into place.
- When the bearing is centered where you want it in the hull taper you can put a larger drop of CA between the hull and bearing. It should wick around the diameter of the bearing and you can fill with baking soda to make a seal.
- Tape the bottom of the bearing (with the greased shaft still flush in place and wrap it up around the hull, sealing any gaps that might still be there. Keep in mind this has to hold curing epoxy from leaking out
- Cut a hole in the tape to allow the drive shaft to go through
- With the shaft inserted, tape it to the bottom of the taper as well so no epoxy can come out
- Measure from the back of the taper 1/2" in the middle of the bottom of the hull and drill a 5/32" hole on this mark





- Lay wax paper on the floor and suspend the hull upright over the paper so that the stern is pointing straight down. You can clamp or tape the boat in place if you're able to, so that it doesn't fall over. Use modeling clay around the base of the taper where it touches the ground to help seal in any epoxy that might try leaking. For further piece of mind, put the taper in a small disposable cup and rest on the ground to catch any leaking epoxy
- Mix and pour unfilled epoxy down the inside of the stern, you will know when to stop pouring when the epoxy starts dripping out of the 5/32 hole. Let cure fully before going to the next step.



- After the poured epoxy has cured, mark out a line where the bearing bulkhead meets with the hull and remove the bulkhead.
- Scour the surface where you traced the line about half an inch on each side with your rotary tool or heavy sandpaper and then clean with lacquer thinner
- Slide the bulkhead back into position, tack with CA in place and then put a nice 1/4" fillet of filled epoxy around the joint and let cure.

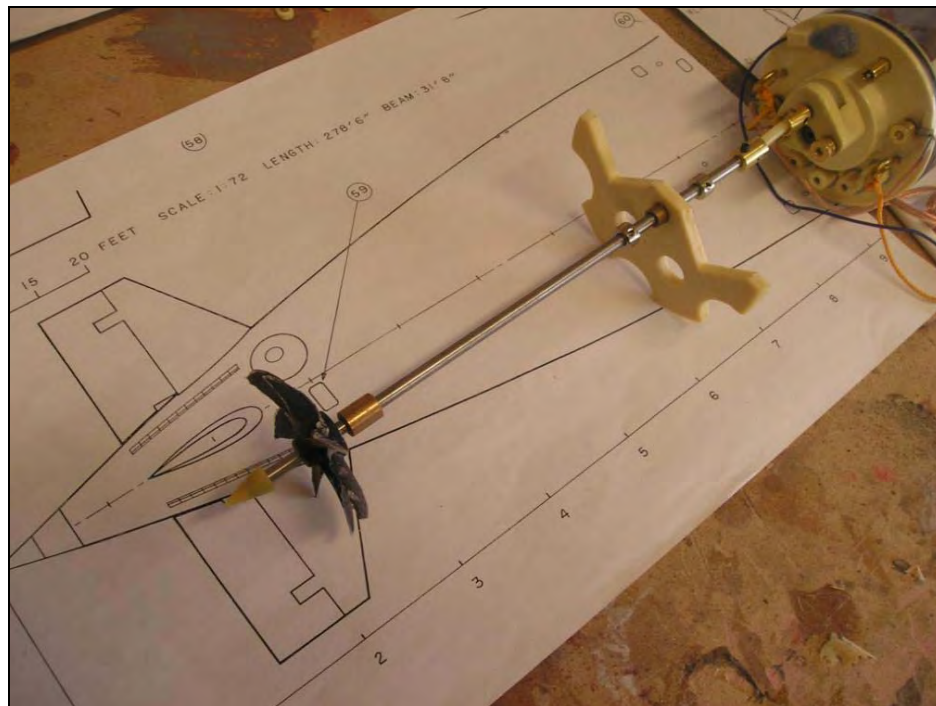
*Important note: When you are tacking the part down, be sure to not put any stress on the shaft whatsoever. The purpose here is when the epoxy has cured the shaft should not bind and be very easy to rotate. Any hindrance in movement can cause overworking of the motor and cause excessive battery drainage and bearing wear.*



### 13. Installing Hull Formers (WTC Saddles)

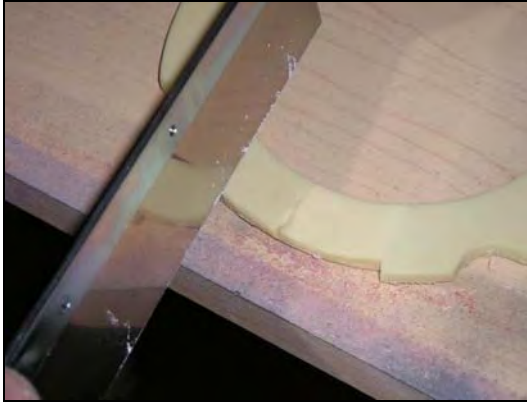
Hull formers, or otherwise known as WTC saddles, pretty much do as their name implies. They are basically a bulkhead that adds strength and rigidity to the light fiberglass hull shell, and provide a way to mount your watertight container inside the boat in perfect axial orientation.

- To locate and install where the WTC will go, your drive train should be installed. This means the rear bearing has been suspended in cured epoxy and the bearing bulkhead should be in place.
- Install the drive shaft with all its components: propeller and dunce cap should be on with setscrew tightened. The shaft should be slipped through its bearings, with the propeller flush to the hull taper end



- On each side of the bearing bulkhead should be a tightened 3/16" ID ring collar that will allow approximately 1/32" of play if you try moving the shaft back and forth
- At the end of the shaft is the universal joint coupling with its setscrew tightened





- Cut the hull formers at the designated cut lines (It's possible this might already be done). The bottom formers are designated by the little wart located on the side



- Place the WTC with the nylon dog bone connector in place in both the drive shaft universal socket and the WTC universal socket. You should allow a little play in the shaft so that the dog bone will be able to move freely.
- When you have the WTC in position, slide two bottom saddles under the WTC roughly an inch away from each end and mark. The middle saddle will be mounted when it's time to install the WTC.

*Note: Keep away from spring clips you installed earlier. You might have to trim some of the formers to accommodate the registry strips that you installed earlier in your build.*

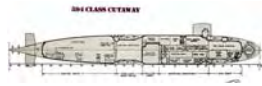


- Take the WTC out and draw lines where you want your formers to go, around the whole half of the hull inside
- Take the formers out and grind and scruff the area that the formers will be bonded to. A half an inch on each side of the line is more than sufficient.

***Important Note: Be careful not to scuff too deep so that you grind through the hull itself!***

- Scuff the hull formers where they will connect to the hull and clean both surface with lacquer thinner
- Tack the formers into place with small drops of CA in strategic places, just enough to hold the former in place
- After the CA has dried, you can now apply a thickened epoxy paste (I recommend West system 401 Adhesive filler) In a nice filleted bead around the edges of the hull and the former that are in contact with each other
- You can now install all three of the top halves' formers in the same way at even spaces, but be sure to stagger them so as they don't interfere with the bottom formers as this will create problems with final hull fit
- To lock the positioning of the WTC in place first start by locating the 1/8" registry hole (provided on the Subdriver 3.5 by D&E miniatures) on the bottom of the ballast tank section.
- Insert the brass pin extruding from the registry part into the WTC hole and then fit its female part to the corresponding male wart on the remaining bottom saddle. Be sure to dry fit first to ensure fit
- Wick CA in the joint to adhere
- With the saddle taped in position on the wtc, fit the drive socket back onto the dogbane shaft and put in place once again, marking out where the saddle ends up on the hull
- Remove the WTC, scuff the area where the saddle will go and clean with lacquer thinner
- Tack the saddle in place with a few drops of wicked CA and let dry
- Remove the WTC and epoxy fillets around the base of the saddle and let cure. This should give a perfect fitting WTC every time you take it out for maintenance and put it back in





- To hold the WTC in place, there is no limit to the options that one can take. Some have used Velcro glued to the hull and had Velcro belts hold the WTC down. You can drill holes in the top of the bottom cradles, thread bolts in and run an elastic or small bungee hanging on the bolts cord across to the other side of the cradle.



*Note: You can always drill more holes in these formers to allow for water and air flow passage later for better performance. When doing so, be sure not too drill too big or too close to the inside edge, thereby weakening the bulkhead*





## 14. Cutting Out Vent And Drainage Holes

Holes need to be cut out on the hull to allow for air to escape out the top and water to flow in and out of the bottom for RC operation. This probably is the right time to do this, as there are no appendages to get in the way of turning your hull to proper position to cut the holes out. It is also a good idea to add another couple rows of flood holes in the bottom of the hull where the WTC ballast tank holes are located. See the picture for a recommended flood hole pattern. This pattern isn't set in stone, as you can choose however you would like it to look. The objective is to allow easier water flow for better response from your boat.

- Mark out all the applicable flood holes on the bottom of the hull with your sharpie marker



- Drill out the middle of each marked flood hole with a 3/16 drill bit
- Machine out the holes with your rotary tool using a grinding bit to get as close to the line as you feel comfortable with. You don't want to grind outside the lines
- You can then finish up the holes by using different shaped mini files to clean up the edges.
- For the top half of the hull we have to drill 1/8 holes in the middle of the ballast tank vents if you are not going to apply the photo-etch details over top. If you do plan on installing these details you can go a little larger with the hole you drill, say up to 3/16. Do not apply the photo etch details yet though, as you should wait until after paint to do this







## 15. Stern Planes

It's time now to start installing the fins, and we'll start with the stern plane assemblies. The proper installation of these is critical for having everything line up cosmetically, and for proper function of the boat. The line where you glued the stern piece onto the bottom hull half is your middle reference point where the center of the stern planes should be mounted directly on.

- Begin by referencing your plans that came included with the kit by placing the loosely assembled fins exactly where they are drawn out. You can use a 1/8" solid shaft connecting the stern planes for help if you wish.
- The hull should have some light dimples cast into it where the shaft holes will have to be drilled. Make some measurements to confirm exactly where the shaft hole will be.
- Using a 5/64" drill bit, bore out both sides where the shaft markers are, then rough up the area 1/8" around the hole with a file or your rotary tool



- Clean with lacquer thinner
- Assemble the stern assemblies with the 2 small bearing bosses fit over the shaft and placed through the 5/64" holes.

*Note: The Circa '79 add-on kit necessitates that the port stern plane stabilizer is replaced with the special modified stabilizer that comes with that kit. The procedure for installation of this piece is exactly the same as the base port stabilizer. The only exception to this is the USS Barb, where the towed array extraction fits on top of its already existent puffer fin rendering the add-on kits' extraction tube unusable*

- Eyeball the orientation to make sure everything looks true, and when you are happy with the fit, use a drop of CA on each bearing boss where touching the hull to tack in place firmly.
- With the bearing bosses in place, you can now hold the model with the nose pointing at the floor. Mark the middle of the stern plane stabilizer to the mid point of the hull and then trace a black line around the shape of the part.
- Remove the plane assemblies from both sides and then rough up the areas inside the lines you traced out. You can even grind out some "X's" in the roughed areas to help parts adhere to the hull



- Using some epoxy filled with adhesive filler (mixed to a peanut butter consistency), assemble the planes on the 1/8" shaft once again and glue into place. The key here is to use just enough adhesive to glue the parts on and fill all the voids. You don't want to get extra epoxy getting out over the hull
- Clamp the stern planes in position with their stabilizers using hand clamps and small blocks of wood. This will keep the stabilizers true while the epoxy sets



- Fillet any adhesive that does come out around the stabilizer and the hull to around a 1/8" radius and let the epoxy fully cure before installing the rudder bearings
- With the epoxy cured, assemble the stern planes with the cap screws on the outside threaded and the 1/8" shaft on the inside put into place.
- Cut a strip of 150 grit sandpaper the length of the sheet and the width the distance between the inside of the hull and the stabilizer arm
- Flip the plane up just enough to be able to feed the sandpaper strip so you can grab it from the other side



- Hold the plane down with slight pressure and pull the sandpaper through at the same time. Repeat a couple of times with the sandpaper facing in, and then flip over for a couple of passes on the plane itself. The plane should be able to move completely without binding on the stabilizer





## 16. Rudders

Before you begin to actually install the rudders, a good idea would be to make an alignment jig out of clear plastic so you can ease the installation of the parts and ensure that they are perfectly perpendicular to the stern planes.

- Repeat the measuring process for the rudder shaft holes as you did with the stern planes. Remember that the dimples represented on the hull are only guidelines, so the holes might have to move a little for adjustment
- Take a firm piece of clear plastic. An old compact disc case cover that you have lying around is absolutely perfect for our task
- Use your carpenter's speed square to draw a "crosshair" directly in the middle of the plastic cover
- Use a protractor to draw a circle 1 3/4" diameter in the middle of the crosshair. If you have a hole saw kit for your drill you can use a 1 3/4" saw for cutting the hole out. If not you can carefully use a sharp utility knife to remove the hole. In either case the plastic should be clamped to a piece of wood that's roughly the same size as it for backing and give stability when cutting so as not to damage it.
- When your hole is cut out, file out notches to allow slipping the plastic jig over the two stern plane-bearing bosses. Your black line should hit exactly in the middle of the bearing holes and you can now reference the perpendicular line on the clear plastic to get your rudder marks in alignment
- Drill out the holes with the 5/64" drill bit and scour the surface for 1/8" around the hole.



- Put the bosses in place in their respective holes and slip a greased 1/8" brass rod through both the planes and the bosses
- Slide your clear alignment jig over the stern as shown in the picture above and line up the shaft.
- Once it is true with the stern plane and looks perpendicular when looking at from the side you can now tack the bosses in place





- Put all the planes in place in their bearings and take a good look at how it all looks together set up. This will be the only convenient time you will have to be able to reposition the bosses if so needed. If you do, pry the bosses up with a flathead screwdriver and begin the alignment process over. When you are happy with their locations, you can then glue the gaps with small amounts of CA and baking soda, building up the gaps in small layers.
- From the inside of the hull, fillet filled epoxy around the bearings (be sure to clean any grease off first with lacquer thinner) where they protrude into the hull. This will give the bearings the added support that they will need for supporting the planes.

## 17. Assembly Of The Sail

The Permit class of submarine's sail was a major part of designer's attempt in the way to improve the boats' hydrodynamic properties. It was extremely small compared to the predecessor class of nuclear submarine, the Skipjack. The model's sail comes with a choice of two caps. One has nearly all the mast holes started for mounting all the masts and the other is solid for those who don't want extra complexity when running the RC model. Because the small proportionate size of the sail, (both in the real boat and this scale representation) it has been designed for removal from the hull at will to allow easier access to the mechanical parts inside it. It is not recommended that the sail itself be permanently mounted to the hull

*Note: The Circa '79 add on kit necessitates that you use one of the provided modified sail caps that come with that kit. This cap has a mini sail and a reconfigured mast/scope layout that is more representative of the boat in this time period*

- Dry fit the two sail halves together. Make sure there is no gaps or burrs between where they fit. If they don't, lightly run the edges over some 220-grit sandpaper that is held flat on a table. *Be careful not to take much material off*
- Tape the halves together ensuring that they fit perfectly with no overhangs anywhere



- Drop a few drops of CA down each crease to tack the halves together, and sprinkle some baking soda to cure it instantly
- Place the sail in its designated hull marks and check for alignment compared to the rudders and stern planes. If the sail deviates in any way you can hold down some sandpaper tightly on the hull with your hand where the sail goes, and with your



other hand drag the sail over the sandpaper removing material from whichever side needs it. It takes very little sanding to move the sail a few degrees one way or the other!

- Tack the mounting assemblies in place with a little CA. The shorter, fatter one goes in the front, and the longer, sharper one is for the rear of the sail
- Once these have cured solidly in place, line up the sail on it's side where it would go on the hull and mark the holes where the threaded shafts will go through
- Drill out 1/8" holes on the hull where these marks are, and then check for fit. You should see the scribed outline of where the sail should go on the hull outline the sail when you put it on
- The hole for the sail can also be cut out now. Be sure to stay well away from the inside sail marking line and keep away from the bolt holes so as to not weaken them.



- You can now bolt the sail to hull using the 6-32 stainless nuts and washers that are provided
- While you still have access from the top of the sail, take this opportunity to epoxy all joints from inside

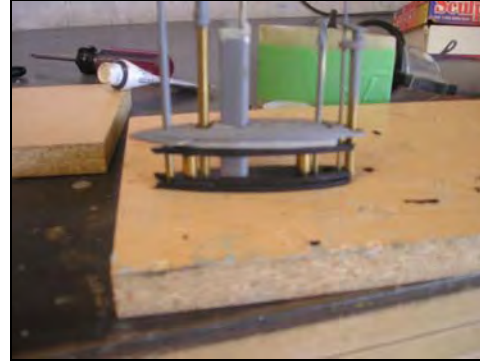
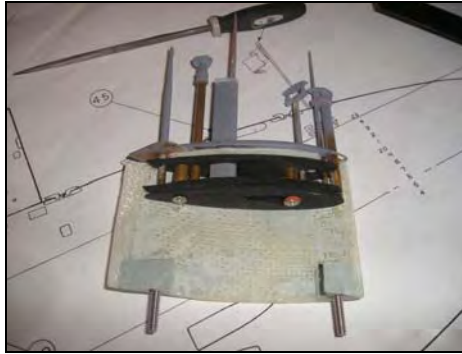


- You now have to choose between the two sail caps - the open version or the closed version. If you choose the closed version, you have to at least open one or two holes of your choice to let air escape while your model is diving.



- For the open version, file all the holes so that they accept the appropriate mast and periscope in a manner that provides easy install and removal and that the scopes are supported straight up and down.

*Note: Do not glue the scopes into place, as they have to be able to be removed*



*Note: the following scope rack assembly is designed to align and hold the masts and scopes straight up and down and from side to side and should provide a loose fit that provides easy install and removal. However, this assembly can be challenging for the modeler just starting out. An option is to skip the rack assembly altogether and simply "friction fit" the masts to their holes by removing less material around the holes when them*

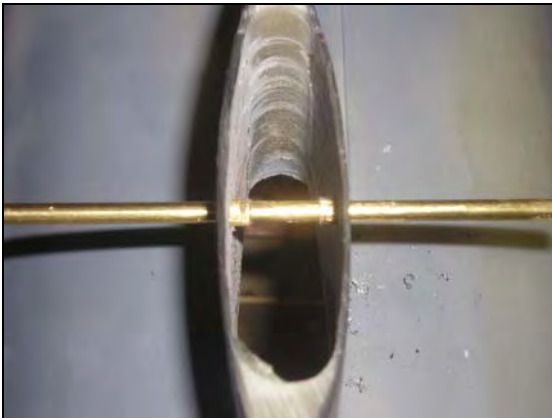
- Fit together the three racks and pillars that compose the scope rack as shown in the pictures above and below
- Check the scopes and masts for fit in the rack. You might have to do a bit of filing and sanding to clean up extra flashing from the molding process.
- When all the scopes and masts fit straight up and down, you can now glue together the scope rack using CA
- Glue the scope rack to the bottom of the sail cap that you wish to use using CA. Do this with the sail cap and scopes in place and aligned straight on the sail with the rack, pressed up from the bottom with a finger
- You can now glue the back end of the sail cap onto the sail itself, hold until the glue dries and then glue the front down. Keep pressure on until the glue has dried
- Once tacked, you can wick in CA all along the seam of the cap to permanently adhere the cap to the sail and fill with baking soda



## 18. Installing the Sailplanes

The sailplanes provide your boat with the ability to control its depth, just like on the real boat. You have the option to glue the sailplanes directly to the sail, but they have been designed to function, as they have brass collars and setscrews molded right into them for attaching to a rotating 1/8" shaft.

- Drill out the dimples on the sail that represent the where the shaft goes with a 5/16" drill bit.
- Assemble the two 5/16" brass bearings on the greased 1/8" brass shaft and then slide the sailplanes on the shaft and tighten the setscrews. This will tell you if you have any minor adjustments to make to the holes to get everything lined up properly. A good thing to do is look at the sail from every possible angle, from the top, front and back and with the sail tightened to the hull so you can compare it to the rudders and stern planes to check for alignment.
- When you are satisfied with the alignment of the sail planes you can then tack the bearings to the inside of the sail with CA and baking soda
- Epoxy the bearings in place, making sure that you don't get any on the shaft or inside the bearings



- Install the sailplane swing arm assembly that fits inside the hull, below where the sail goes.
- Assemble the swing arm bridge mechanism, including the two V-brackets, 1 stainless steel socket cap screw and the hollow 1/8 shaft that slides over top of it along with a control horn that tightens upon the hollow shaft
- Position the assembly so the shaft holes will line up with the shaft from the sail
- Mark where the swing-arm assembly contacts the hull and remove the assembly
- Roughen up the surface with your rotary tool where the marks are, and clean with lacquer thinner
- Using epoxy filled with adhesive filler mixed to a mayonnaise consistency, glue the assembly in place putting a nice fillet around the base of the V-braces
- When cured, you can unthread the stainless steel socket headed cap screw and remove the shaft and control horn with the provided Allen key





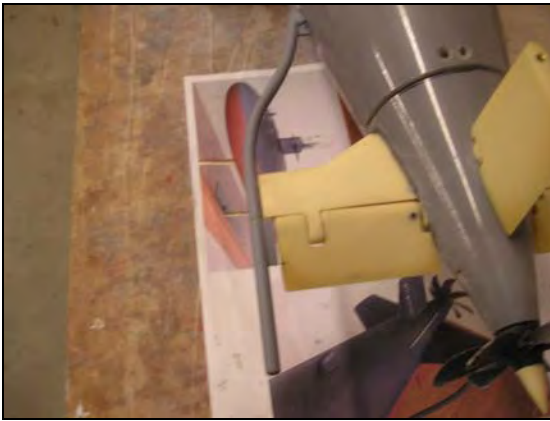


## 19. Circa '79 Towed Array Fairing And Extraction Tube

The circa '79 add-on kit (ordered separate from the base kit) comes with a solid resin towed array fairing, it's accompanying extraction tube and a GNATS sonar jammer hump, all of which have to be adhered to the hull and are not represented on the Circa 1961 drawings that are provided with the kit. These parts can be added to any submarine in the Permit class that has the base length hull (Except for USS Barb). Here is the recommended procedure for installing these extra parts on your model:



- Fit the bottom hull part (the part that contains the forward piece of the extraction tube) so that the back edge of the tube is flush with the back of the stern plane stabilizer. The forward piece where the tube flows into should be flush with the edge of the bottom hull half.
- Holding the part with your hand, mark out on the hull where the fairing fits



- Remove the part and scour the surface where you marked and clean with lacquer thinner
- Use filled epoxy to adhere the part in place and use masking tape to hold it in place while curing
- Join the top half of the hull to the bottom and tighten hull screws
- Cut the bottom edge off the towed array fairing off with your razor saw. Refer to the above picture for exact location of the cut
- Place the top part of the towed array fairing (the largest part) so that the part you just cut off is flush with the top of the part you just glued onto the bottom hull half
- The fairing should look uniformly straight looking down from the front of your model. Tape in place and mark on the hull the location of where the fairing fits
- Remove the fairing and scour the hull inside the markings you just made and the underside of the fairing that will contact the hull.
- Clean with lacquer thinner and epoxy the fairing in place and let cure.
- To complete the assembly, you simply have to slide the aft part of the extraction tube into the corresponding hole on the fore part. File any flash off the insertion tube to acquire a nice firm fit

*Note: It is not recommended to glue the aft part of the tube in place, as you will need to access the stern plane shaft screw. You can use a small amount of RTV adhesive silicone to hold the part in place*



- For installing the GNATS sonar jammer begin by finding the centerline on the top of the top hull half. This can be achieved by running a flexible straightedge between the middle of the aft escape hatch and the upper rudder mid-point
- Measure 0" from the edge of the rear Z-cut. This will be where the aft point of the sonar jammer hump will be located
- Mark out the outline of the sonar jammer hump
- Scour inside the markings, and clean with lacquer thinner
- Use filled epoxy to secure the part in place. Ensure that it is mounted upright by using the rudder and the sail as a reference.







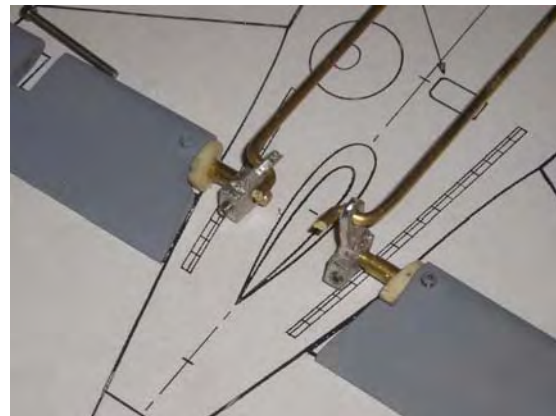
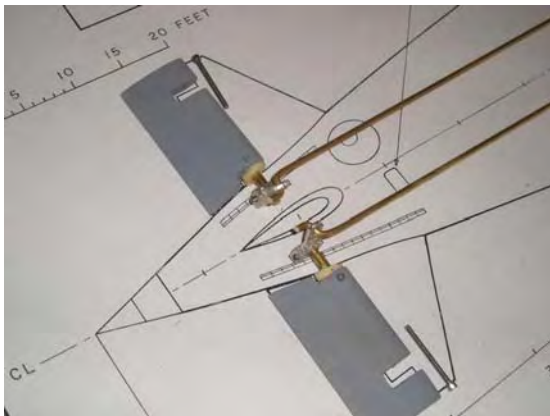
## 20. Mechanical Linkages

This part can be a little tricky, but all one really needs is a steady hand and a good pair of needle nose pliers. I recommend fish hook removal pliers, as the nose on these are extra skinny and are designed to get a good grasp on things. For the white metal control horns that come provided with the kit, be sure that the shafts holes fit over their respective shafts. You might have to chase out the holes with a 1/8" drill bit. Also ensure that the setscrews thread properly by threading them in and out a few times using the provided Allen key. For connecting the control surfaces' push rods with the WTC control rods there are several ways to do this. I would recommend using a magnet-to-magnet system that some vendors offer. You can also insert your solid rods into the hollow ones provided by the WTC manufacturer, and then hold them tightly together with a collar and setscrew that pinches the tube tight to the rod. This allows for easy adjustment. At any length, if you do not have your WTC yet, then I recommend leaving your push rods long and then trimming them to length later.

- Begin by assembling the stern planes to their stabilizers. Push the provided greased 1" long by 1/8" shaft from the outside of the bearing boss until flush with the outside edge
- Put the stern plane in place and tighten the stainless steel socket headed shaft screw from the end of the plane. If the screw feels like has too much resistance screwing in, check to ensure that the screw has a clean path through the bearing.
- From the inside of the hull, use your pliers to force the shaft into the stern plane. Tap on the end of the shaft with you pliers if it needs a little more force
- Bend the end of a 1/16" or 3/32" brass rod into a "S-bend" configuration and fit it through the horns' control hole. Also, you can bend the metal arm of the control horn down around 30 to 45 degrees so as to allow free movement in the hull
- Holding the control horn with the needle nose pliers, slide over the stern plane and tighten setscrew and repeat the previous steps for the other stern plane

*Note: When tightening the setscrew on the plane or controls horns with setscrews, you might want to groove the shaft that they are connected to by using a file. This gives the setscrew a better surface to bite into a provide a tighter connection*

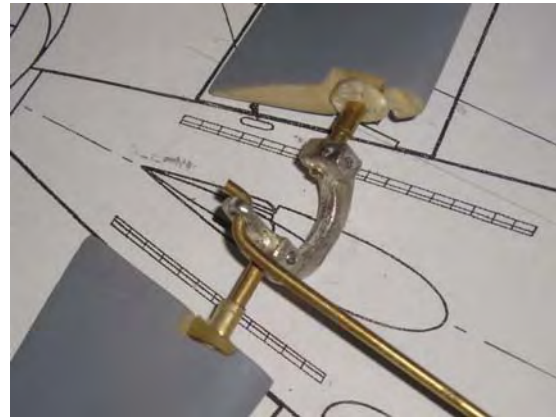
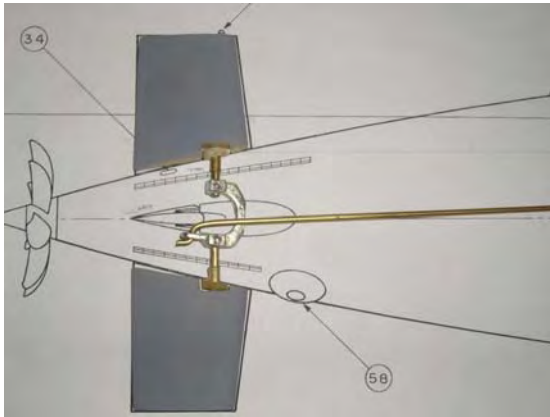
- Repeat this process for the other stern plane



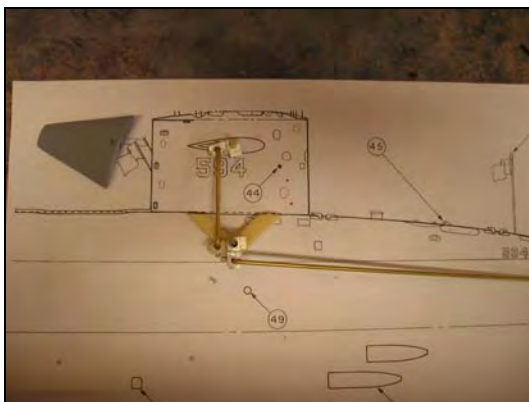




- Turn the boat onto its side and slide the rudders into their respective bearings
- Holding the rudder U-shaft link with your needle nose pliers, push a rudder shaft through the bearing and then through one of the u-shafts holes, repeat for the other rudder.
- Center the U-shaft link on the rudder shafts around where the drive shaft would rotate and then tighten its setscrews on the rudder shafts



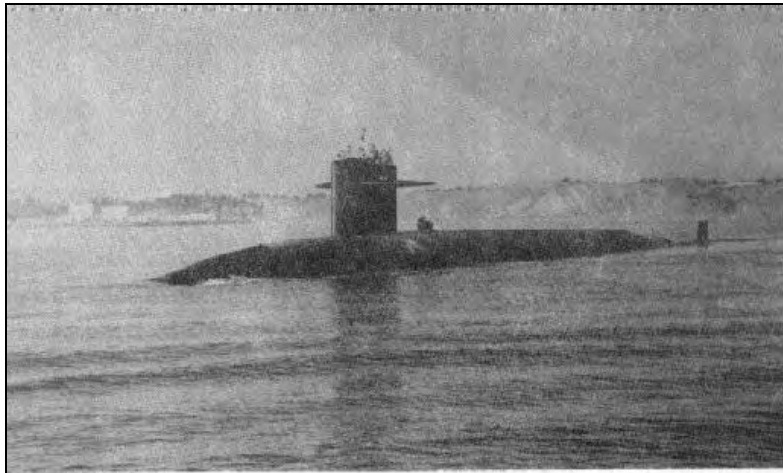
- For the sail planes' control linkages, remove the sail from the hull and remove both planes and 1/8" shaft.
- Create a shaft using 1/16" or 3/32" rod with S-bends starting at the middle points of where the sail shaft goes and the pivot arm mounted on the bottom side of the hull where the sail is mounted (see picture below)
- Slide the rods' S bends into the holes on their control horns. ***This has to be done before the horn is installed in the sail***
- Hold the control horn with your needle nose pliers and place in position in the sail (***Ensure that the setscrew points down so you can access it from the bottom of the sail***)
- Slide the 1/8" shaft through the sail bearing, through the control horn and then out through the other bearing.
- Tighten the set screw when the shaft is centered in the sail
- Slide the pivot arm shaft through the control horn. Slide a second control horn as well. This second horn will accept a push rod from your choice of activation, whether it be from the WTC itself or a forward mounted waterproof servo motor
- Tighten the setscrews for the control horns. You can position the second horn perpendicular to the sail control horn for optimum location.





- You can now install the sailplanes ensuring that they line up perfectly and have a small gap between them and the sail. You can even put a small stainless steel or Teflon (size #6) washer in between the planes and the sail to maintain that gap. You can now tighten their set screws when you are happy with the placement

*Note: All the planes should move freely without binding, as any hindrance in movement can cause overworking of motors causing excessive battery drainage and put undo strain on bearings and shafts! If there are any clearance issues in the rear cone concerning the linkages, try swapping the rudder U link to control the stern planes and use the separate control horns on the rudders.*



## 21. Pre-paint Preparation

Pre paint preparation is actually the most important part of the paint job. How this step is carried out vastly determines how the final paint job on your submarine will look. Also, the quality of materials you choose will affect outcome as well. Basically, like everything in life, you usually get what you pay for, and painting and prepping products are of no exception to this rule. Higher quality primers (not the ones you buy in the spray cans) are used not only to prep the surface for accepting paint, but are used to help visually point out flaws and scratches, and can actually be used as a minor scratch filler in itself. The 2-part polyester filler that you should choose should have properties that allows easy sanding when cured and won't be prone to cracking when submitted to temperature changes. Finally, the red air-dry putty should be one that dries fairly fast and won't crack. Products that are recommended for these tasks are listed in the "Recommended Materials and Consumables" list.

When wet sanding, use a bucket of warm water with a few drops of dish soap mixed in for to cleaning the sandpaper with. The soap helps in preventing clogging of the paper. Also, when changing to a finer coarse sand paper, be sure to change the water out in the bucket every time you do so. By doing this, you eliminate any particulate captured in the water which could scratch your finish

Wash the parts with clean water between every step in sanding



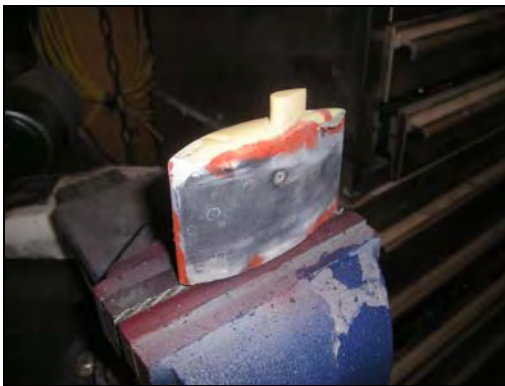


**Note:** A good idea is if you are not familiar with using any of these types of products, would be to practice using small amounts of them on a scrap piece of wood or plastic. This way you can become familiar with the application, curing and sanding properties of each product and not have to worry about wrecking anything on your model

- Right now would be a good time to install appendages like the mushroom anchor either CA or filled epoxy so it can be blended to the hull
- Using 400-grit sandpaper, wet sand the entire hull and its parts and pieces so that the glossy finish is now dulled. Primer will adhere better to the dull surface than to a glossy one
- Take a good look at your model as it now stands. It should be 100% assembled, but it will have scratches and dings from the construction process that need to be filled, and joints that need to be blended together to create a "seamless" look. Mark or circle any areas that need attention with a Sharpie marker.

**Important Note:** If you plan on using hobby paints and primers use a pencil and not a Sharpie marker for this task as the black ink will show through the final finish

- Fill in any gaps or large scratches with the two part polyester filler mixed per the manufacture's directions. You do not need a lot of filler, just enough to fill what needs to be filled. You can mask off parts nearby where you filling with masking tape to prevent extra filler from adhering to where you don't want it to.
- Once cured, sand with 220-grit sandpaper to smooth out the filled sections and remove extra filler



- Fill small scratches or pin holes found in the hull finish or from the last step of filling with the air-dry putty. Again, use only enough to fill the blemish. Too much



filler material takes too long to dry, adds more sanding, and could possibly crack with temperature changes

- Wet sand with 400-grit sandpaper
- Spot prime all the surfaces that had blemishes and let dry. (*The high quality primers dry faster than the spray balm stuff*) This will let you see if any blemishes remain or if more sanding is needed. You can repeat this step for as many times as is required until you get the surface quality that you desire. Also, be aware of any surface details that might get filled in; be sure to use your scribe to remove any excess fillers or primer.
- Wipe the parts down with a moist cloth, removing any dust or contaminants from the surface.
- Apply a coat of primer to the entire surface of the boat and re-scribe out the details
- Wet sand the entire surface with 600 grit wet sandpaper.
- Repeat the last three steps going up with 800, and then finally 1000 grit wet sandpaper

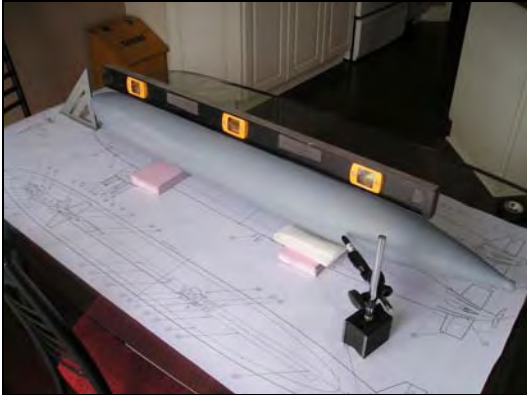
*Your model should be ready for paint!*

## 22. Paint

- A few things you might want to consider before you paint your model. First, you might want to trim your boat first, just in case you get any scratches or dings in it from that process. Second, be sure of what details you want to go on (like photo-etch hatches and such) that you want the same color as the hull are put on and primed. Third, read the paint manufacture's application instructions carefully so you know what to expect in terms of how many coats to apply and how long you have to wait before applying additional coats. To keep the natural metal look of the MBT vents you want to put them on after you have painted, but before the final clear coat is installed. Here are a few tips that will help you achieve a stellar paint job!
- The best method of paint application is to use an airbrush or automotive type of paint gun. If you don't have these, then spray balm from the can is your next option
- Try to avoid using a brush altogether to avoid getting streaks or imperfections in the paint.
- Pour your paint through a strainer when loading your gun or airbrush to remove solid contaminants that could ruin a paint job.
- When spraying, always hold the gun or spray can perpendicular to the surface you are painting.
- Go with multiple light coats as opposed to heavy coats to eliminate runs.
- Overlap each pass by about a quarter of the width of each pass.
- Don't stop at the end of the pass, but spray past the end without letting your finger off the trigger and then come back preventing unwanted, uneven paint build up.







## 23. Detailing

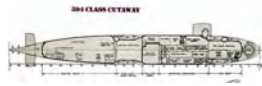
Here is where you add those finishing touches that add so much to the look of your model. You can add stainless steel MBT vents and grating to the sail and hull using the provided photo-etched detail sheet. Numerical and letter markings can be applied to the model using dry transfer decals. And, for the more advanced of modelers, weathering can be added as well. All of this should be done after the paint job has been done, but before the clear coat(s). Here are a few notes on installing some of the details

- When installing your photo etch metal pieces it is a good idea to scour the back of the metal photo etch sheet with 120 grit sanding block (not with enough pressure that you disconnect the pieces from the sheet). Also scour the surface that is being glued to. A proper sized diameter drill bit work great for this task, especially for the MBT vents and capstan tops



- When installing the metal flag masts, drill a hole through the hull where the mast is supposed to go that is just large enough for the mast to pass through. Grease the mast and put it through the hole. Use epoxy clay or putty to hold the mast in position and to create a mast mount that adheres fast with the hull. You can now put the mast in place or remove as you wish
- Dry transfer decals really make the boat stand out. Your plans show exact location on the boat where the decals go. However, in the real world numbers like those on the sail weren't even permanent as they were held on when in port with magnets and taken off when on patrol. A good idea for draft marks is





to make a jig like that shown below and use masking tape as a way to temporarily mark out their locations.



- White metal pieces such as cleats and capstans should have their bonding surface roughed up with sandpaper, or ultimately if you want to paint the parts as well, given a short dip in Ferric Chloride (acquired at Radio Shack or The Source By Circuit City) to chemically create porosity in the surface to better accept glue or paint. Of course, the surface being glued to should be scoured as well.
- Zincs can be installed as well after the paint job, be sure they are painted and have the bonding surfaces scoured first before doing so. CA is sufficient to adhere these to the hull



## 24. Trimming the Model

Trimming your model is the process in which you add a combination of weight and buoyant material to it to achieve a scale waterline when your boat is surfaced and a very slight buoyant condition when in submerged mode. To achieve this, you must first acquire around 16 ounces of lead weight or more and some pink or blue closed cell foam. The lead weight can be found in all sorts of places like hunting and fishing supply stores in the form of buckshot or pre-measured tackle weights. Tire shops carry lead weights for balancing tires, but probably the most convenient forms can be found at the hobby stores as it comes in pre-measured weights and comes in various sizes. Appropriate foam for this task can be picked up at any home renovation store or construction supply yards. The stuff we need for our task is the pink or blue closed cell variety. The white open cell Styrofoam won't work too well for what we have to do in this application. It is used mainly as a supplemental insulation material in home building and is relatively cheap as well. There are several methods that can be used to adhere these materials to the inside of the boat. These can include using Velcro strips, adhesive silicone, or two-sided "outdoors industrial" adhesive tape - the same stuff used to bond plastic moldings to metal body parts on cars. Trimming can be carried out anywhere you have a convenient body of water that is large enough to hold the model and is deep enough to submerge it properly, most likely, your bathtub might be the optimum place for this if it is long enough.

- Begin trimming by attaching your lead weight below the ballast tank inside the hull. You will want to locate it as low in the hull and centered to the middle as possible, while avoiding covering the drainage holes
- Attach strips of foam on the inside of the top hull section, but only up to, and not over the designed water line



- Let the adhesives dry if they have to before going on to the next step. *Keep in mind when placing the foam of where all the components like WTC cradles, registry clips etc. are placed so that the foam doesn't interfere with the fit of the hull halves*
- Every bit of weight counts towards the trim of the boat (or lack thereof), so you want it as close as possible to actual running weight. Assemble everything in the model as if you were going to run it. This includes the WTC with all it's servos electronics blow tank filled with airbrush propellant, control linkages, and battery. I recommend using maybe one or two masts installed in the sail for running and for location purposes on the pond. Perhaps the functioning hollow-tube snorkel if you are running an air pump (snorkel system) and the





attack periscope. Leave the rest of the holes open so that air trapped in the sail can be released when submerging.

- Slide elastic bands on the outside of the hull over the bow, stern, and over where the ballast tank is



- Attach a small level to the top of the model right at the mid-point line. This small level is used to tell you if the boat is orientated properly in the water. You can permanently mount this level on the inside of the hull later as it will come in handy when setting up your pitch controller. This also alleviates the need to compensate for weight if removing the level. These little levels can be acquired at hardware stores in the tool section probably labeled as "line levels"
- Put your boat in the water and turn it over.
- Gently rock it back and forth to let all the air out of the ballast tank along with any other nooks and crannies that could trap air in the submarine. Wipe off any tiny bubbles that have formed on the hull surface as well
- Turn back over so that the boat is in its natural orientation.

*Note: The goal here is to basically only have the cap part of the sail sticking out above the water. This means you have slightly positive buoyancy allowing the boat to eventually surface if you run into trouble in the real world.*

- Add strips of foam under the elastic bands in the stern and the bow as high in the boat as possible (not over the designed water line) to level the boat out. If the model is sitting too high in the water add weight to the elastic bands below the ballast tank. If you think that you already have enough weight, you can try re-orientating the foam's position. The farther it is located to the outer extremes of the boat, the more of a buoyant reaction you will get from the same amount of foam. If you have more foam than you need, you can break off small chunks of foam at a time to achieve the proper level. This stage is also crucial to how straight the boat actually sits in the water.



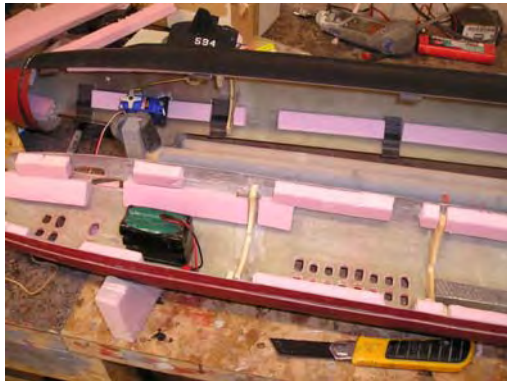




- Command a blow from the wtc from your radio and see where the water line ends up on the boat. If you are close to where the designed water line should be then your boat is good to go. If it is sitting too high in the water you will have to add neutrally buoyant material to the ballast tank to adjust for this and then go through the trimming procedure all over again.

*Note: When the boat is in transit in the water you will not be able to tell where the line is, the extra trouble of going through and trying to get a perfect waterline might not be worth it*

- When the boat is trimmed out remove from the water and keep a mental note of where the foam and weights are located, or better yet, take a picture with a digital camera of the locations
- Remove all the foam and weight and let dry out along with the hull
- Attach all the foam and weight inside the hull where it was located on the outside held by the elastic bands. The boat should almost be trimmed. You might need to add a little weight or foam here and there to make up for the weight of the adhesives used to tweak things up a bit.



*Note: All bodies of water have compositions that differ slightly from each other. The water in your bathtub will have less dissolved solids but more chlorine than say your local pond, thereby causing slight density changes. Your model will most likely require small modifications from location to location.*



## 25. References and Credits

- Plans by Greg Sharpe at [www.deepseadesigns.net](http://www.deepseadesigns.net)
- Ideas, inspiration and support at:
  - [www.subpirates.com](http://www.subpirates.com)
  - [www.subcommittee.com](http://www.subcommittee.com)
- Picture usage and facts from the horses' mouths:
  - [www.uss-jack.org](http://www.uss-jack.org) - webmaster: Robert Mitchell
  - [www.usspermit.com](http://www.usspermit.com) - webmaster: Dave Stoops
  - [www.navsource.org](http://www.navsource.org)
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