SlowBoat

Flying off the water is always fun even with a sedate airplane like a J3 Cub, but when you have a seaplane with both good aerobatic performance and good water handling manners, the fun is multiplied. The SlowBoat fills this bill as an RC seaplane which emphasizes lightweight slow flight, quick but precise response, and 3D capability. The model has electric power, a 39" span, 15 oz. flying weight, and is built of 6mm Depron foam.

SlowBoat	
Wing Span:	39 in.
Wing Area:	383 sq. in.
Weight:	15 oz.
Motor:	Himax HC2812-0850, 150W
Battery:	Thunder Power 1350mA 3S LiPo
CG:	3.25" behind LE
Prop:	APC 10 x 4.7 SF electric
Servos:	4 Futaba S3114
Speed Control:	Castle Thunderbird 18
BEC:	Dimension Engineering ParkBEC 1.25A
Receiver:	Orange RX 8 chan (Futaba FASST compatible)

General Construction

The files to build the SlowBoat are available for free download on our club website at oconeeeagles.org. These files are:

SlowBoat plans.pdf – a construction drawing for printing on 8.5" x 11".
SlowBoat build notes.pdf – a construction article (this file).

The basic material is 6mm Depron foam. A standard 31¼” x 49” sheet provides enough material for the plane with a little left over for spare parts.

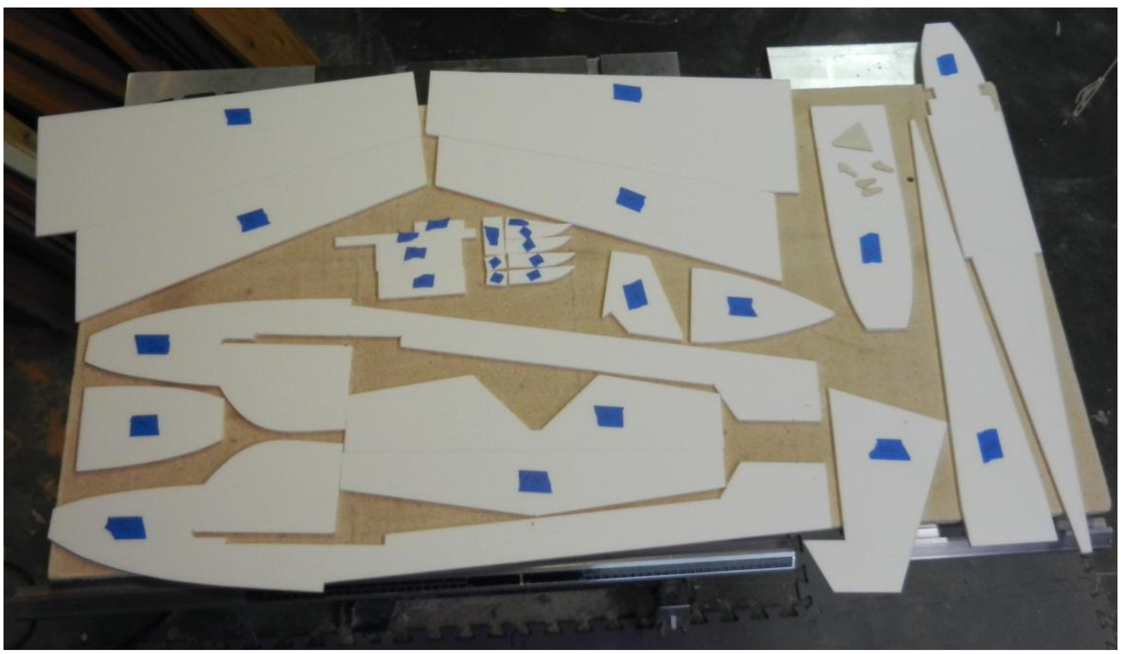
I use white Gorilla Glue (the kind labeled as “dries 2x faster”) with foam. With most glue joints you’ll need to wait 30 minutes before unclamping the joint. To insure water tightness, make sure your glue bead is continuous. Gorilla Glue expands considerably as it dries. This is good for water tightness, but if you want a clean joint, you’ll have to wipe it several times as the glue dries. Rubbing alcohol is good for removing Gorilla Glue (and epoxy) before it sets. It can be sanded after it sets, but the Gorilla Glue sands away slower than the surrounding foam.

Keep in mind that pin holes will leak water, so tape is preferred over pins to hold parts while the glue sets.

For hinge tape, I use 3/4” fiberglass reinforced strapping tape. The fiberglass reinforcement runs the wrong direction to do any good, but this is the stickiest tape I have found, including tape marketed as hinge tape. Don’t butt the hinged pieces tight together, but leave about an .020” gap for easier hinge movement. Run the hinge tape the full length of the joint. Don’t put the tape under tension as you stick it down so it doesn’t try to warp the foam. Press the tape down thoroughly by rubbing it in with a spoon shaped object.

Let’s Cut Foam

Cut out the foam parts. Page 2 of the drawing shows the parts with dimensions. Page 3 shows a possible cut pattern if you start with a standard 31¼” x 49” Depron sheet. I lay out a part using the dimensioned drawing and a ruler and T-square, then cut the part with a sharp X-acto against a straightedge.



A Homemade Kit

For the parts with curves, print out the full size curve templates (Pages 3 – 6 of the drawing) and cut the printout to the outline with scissors. The nose template of the side piece wouldn’t fit on a single sheet, so tape the two parts of the template together. Then use the template to draw the curve on the foam and freehand cut the foam to the drawn curve.

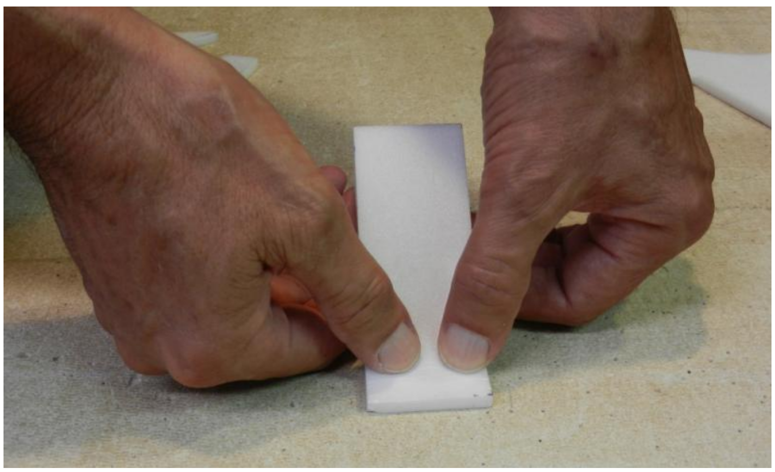
I put little colored labels on the parts as I cut them out so I can identify them later and keep them right side up.

On the parts that have a left and right pair, I prefer to make a left and right part instead of making two the same and flipping one over. On the wings especially, I think this will build a straighter flying model.

Rout slots for .157” carbon fiber (CF) tubes in the bottoms of the wings and elevator. I used a 5/32” drill bit in a drill press as a router, with a piece of wood clamped to the drill press table as a fence. The CF tube shouldn’t fit too tight in the slot or it will tend to warp the wing. The slots are only .125 deep, which leaves some of the CF tube sticking up above the foam surface, but doesn’t weaken the foam as much as a full depth slot would.

Pontoons

Start by building up the pontoons to get a feel for working with foam. Bend the pontoon bottom to fit the sides. The foam will break if you just bend it, but will bend OK if you indent the inside of the bend by pressing the foam between your thumbs and workbench while bending.



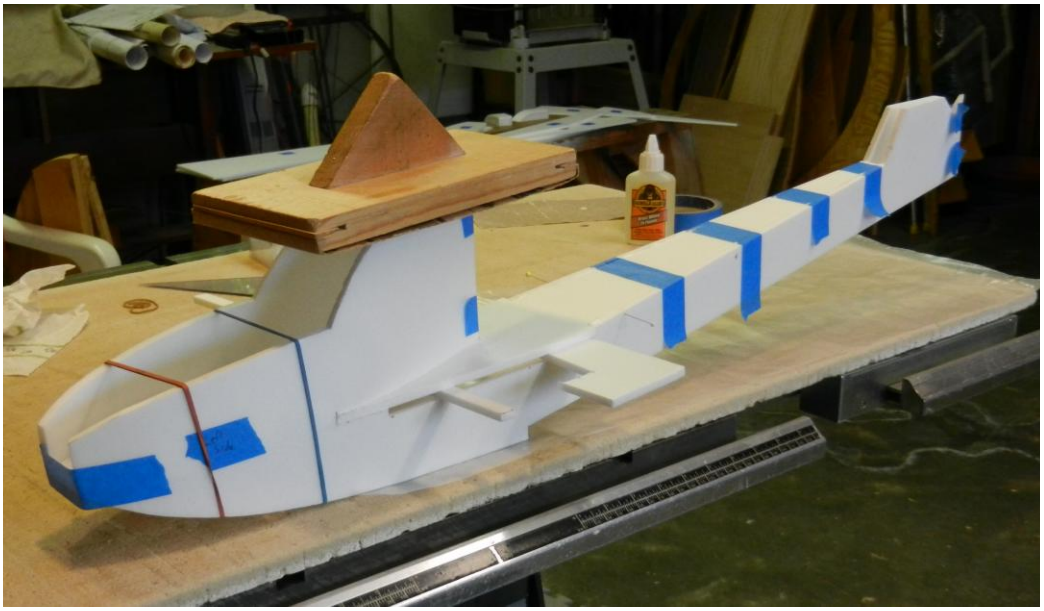
Bending Foam

Glue the pontoon sides, rear, and bottom together. The bottom glues to the bottom edge of the sides and end; the end goes between the sides. Let the extra material of the bottom stick up in front of the pontoon, then after the glue dries sand off the extra bottom material and sand the top of the pontoon flat.

Sides and Middeck

Sand a taper on the inside of the sides at the tail so the thickness of the two sides together at the rear of the fuselage matches the thickness of the rudder. Bend the front of the sides to match the curve of the middeck. Bend the sides at the rear of the cabin area to meet each other on the centerline, and sand a taper on the insides of this joint as you did for the rear of the fuselage.

Test fit the sides and the middeck. The shoulders of the middeck go in the upper portion of the slot in the sides. The rear portion of the middeck goes between the sides. The sides have a bit of extra material at the front (like the pontoon bottom did); we’ll sand the nose square after the other parts are glued on. When all fits well, run a bead of glue everywhere the parts meet and glue the sides and the middeck together. Place some scrap material in the lower slot as the glue dries so this slot won’t close up.



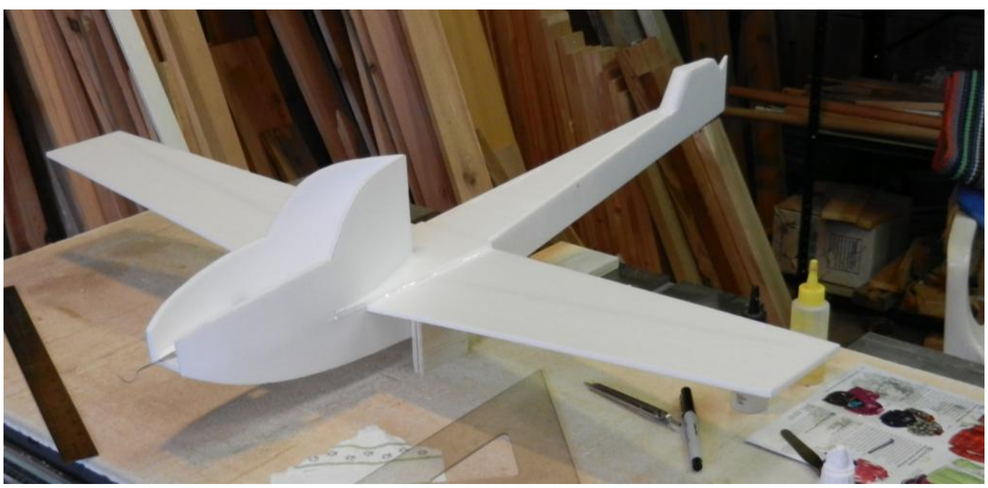
Gluing the Sides and Middeck

Wings

Cut two pieces of .157” CF tube 18” long. Cut two pieces of 3/16” aluminum tubing 1” long, and epoxy these over one end of each of the CF tubes for reinforcement. This reinforcement is necessary because CF tube is amazingly weak when something like the dihedral brace pushes on it from the inside. Gorilla Glue the CF tubing into the slot in the wings with the reinforced end toward the center of the wing.

Sand the bottom front of the ailerons to a 45° angle for throw clearance. Hinge the ailerons to the wings with hinge tape.

Build a dihedral brace from a piece of steel wire which just fits into the hole in your CF tubing. I used a piece of 10 penny finishing nail (0.12” diameter), but a different wall thickness of your CF tube may want a different wire diameter. Bend the wire to match the dihedral angle of the wing (check it over the drawing), and cut it to a total length of 1.5” with the bend in its center.



Gluing the Wings

Test fit the wings into the slot in the sides. Insert the dihedral brace into the CF tube at the center of the wings. Sand the wing joiner thinner to fit and with a taper to match the dihedral. Place the wing joiner between the wings and the middeck. The dihedral is specified as 2” per wing, but it is more important to just make sure both wings match.

Glue the wings, the wing joiner, and the dihedral brace in place. Use epoxy to glue the steel dihedral brace. Square the wings with the fuselage, and make sure the wings both have the same dihedral.

Insure the ailerons have full throw.

Tail

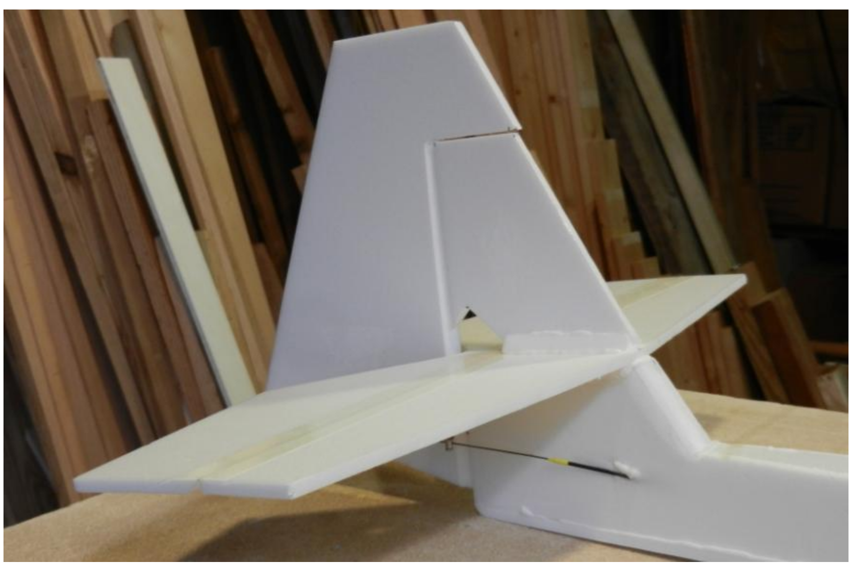
Glue the little Tail C and Tail B pieces between the sides. Make sure there are no holes between pieces in this area to let water in. Glue the Tail A piece to the front of the lower vertical tail. When the glue dries sand an aerodynamic curve on the front of the lower vertical tail.

Glue a 12” piece of .157” CF tube into the slot in the elevator. Sand the bottom front of the elevator to a 45° angle for throw clearance. Hinge the elevator to the horizontal stab with hinge tape.

Test fit the horizontal stab to the top of the lower vertical tail, and sand the top of the lower vertical tail to make the horizontal stab perpendicular to the lower vertical tail. If the horizontal stab is not level with respect to the wing, we’ll fix this later when we glue on the aft hull bottom. Lightly sand the top and bottom of the horizontal stab to break the surface glaze in the glue area for better glue adhesion.

Cut some scrap foam into 45° triangle stock. Glue on the horizontal stab, making sure it is perpendicular to the centerline of the fuselage, centered left to right, and as far forward as it will go and still give full elevator deflection. Glue the 45° triangle stock along the joint line as reinforcement.

Glue on the vertical stab, making sure it is perpendicular to the horizontal stab, that it is aligned with the centerline of the fuselage, and that the rear of the fuselage and the rear of the vertical stab are aligned. Glue more 45° triangle stock along the joint line as reinforcement.

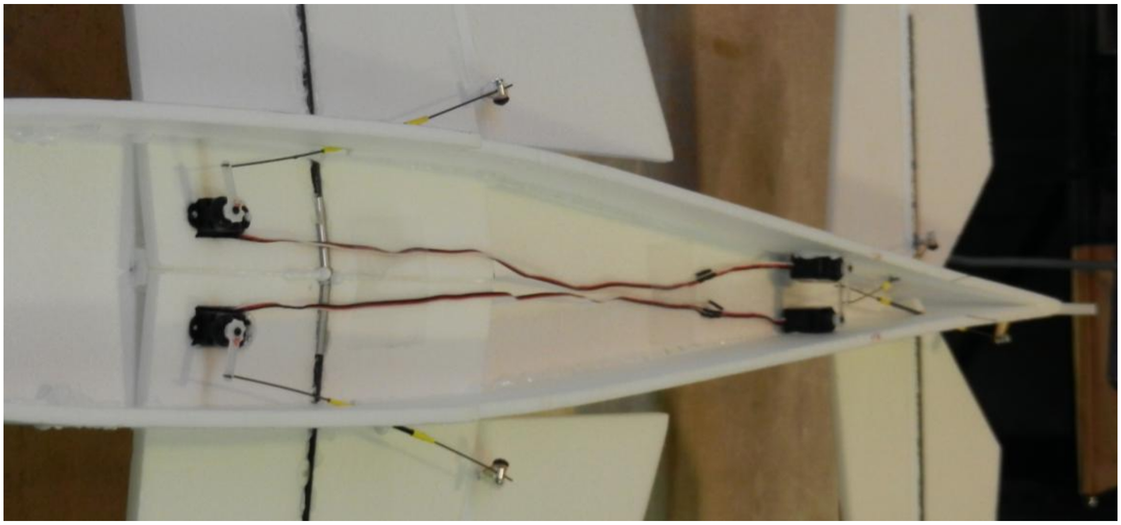


Finished Tail

Sand the right front of the rudder to a 45° angle for throw clearance. Hinge the rudder to the vertical stab and to the fuselage with separate pieces of hinge tape.

Insure the elevator and rudder have full throw.

Servos and Linkages



Servos and Linkages

Print the four control horn patterns and attach the printout to 1/16" plywood with double stick tape. Drill 1/16" holes in the position shown and saw and sand the horns to the shape of the pattern. Paint the horns so they won't soak up water.

Use the longest servo arms which come with the Futaba S3114 servos (0.6" pivot to outer hole).

Make four pushrod sleeves from .078" CF tubing. Two of these are 2" long (ailerons), one is 4" long (elevator), and one is 5" long (rudder). Using the smallest diameter heat shrink which will fit over the CF, place a 1/2" long piece of the heat shrink over the end of the CF tube with about half of the heat shrink exposed past the end of the CF tube. Place a piece of .031" music wire through the tubes and shrink the heat shrink with a heat gun. When this cools, the music wire should have a mostly watertight fit but still slide smoothly through the sleeve. Repeat this for both ends of all four sleeves. Squirt some grease into each sleeve for lubrication and water tightness.

Cut holes in the wings and middeck for the aileron servos. Make sure the holes come out inside the cabin. Leave extra width in these holes to feed through the servo connectors from the tail servos. Glue the aileron servos into the holes, with the servo arms at the bottom as shown on the drawing.

Drill holes through the sides for the pushrod sleeves. These holes should be positioned and angled so the pushrods are straight. Install the sleeves in the holes, but don't glue the sleeves to the sides yet.

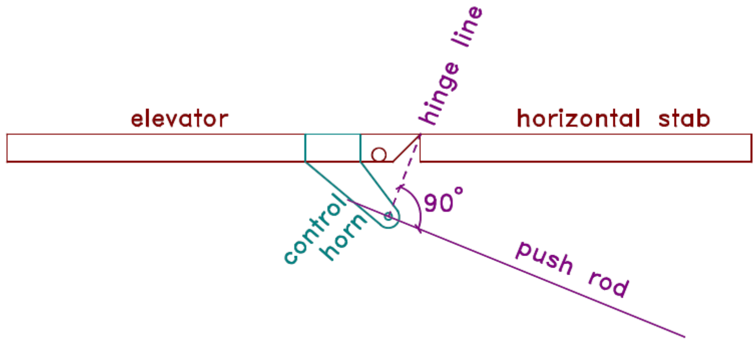
Cut slots in the ailerons for the control horns. The hole in the horn should be directly below the hinge line. Install Dubro Mini E-Z connectors on the horns, oriented so the screws in the E-Z connectors are accessible, and glue the horns to the ailerons.

Make pushrods from .031" music wire. Make a Z-bend in one end of the pushrod. Install the Z-bend through the outer hole of a servo horn, slip the pushrod through the sleeve and into the E-Z connector, and mount the servo horn.

Install servo extensions on the tail servos. I prefer soldered extensions instead of connectors. If you use connectors, consider some type of waterproofing such as non-corrosive RTV over the connector housing.

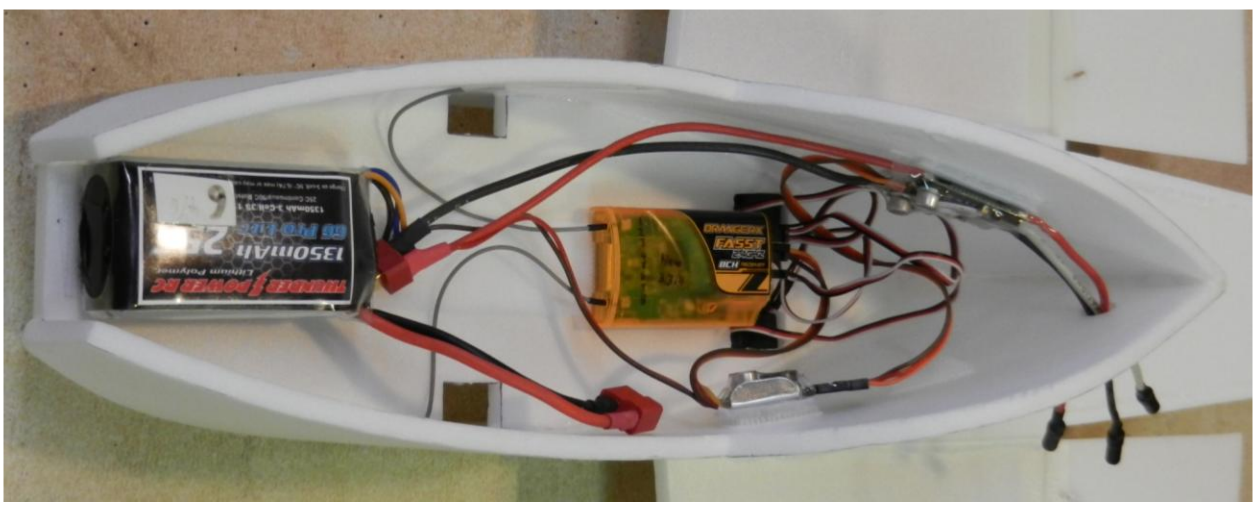
Glue the tail servos to the fuselage sides. Again the servo arms are at the bottom but angle the servos to line up with the pushrods. Locate the servos as far back as you can in the tapered fuselage and still give them clearance to each other. The elevator servo is offset a bit below the rudder servo so the servo arms don't collide. Make sure the servo arms won't hit the hull bottom when the arm swings through its range.

Mount pushrod sleeves, control horns, and pushrods like we did for the ailerons. Mount the control horn on the elevator farther from the hinge line to make up for the angle of the pushrod; the hole in the control horn should form a 90° angle between the pushrod and the hinge line as shown below.



As much as possible, center all 4 pushrod sleeves fore and aft on their respective pushrods, and glue the sleeves to the fuselage sides.

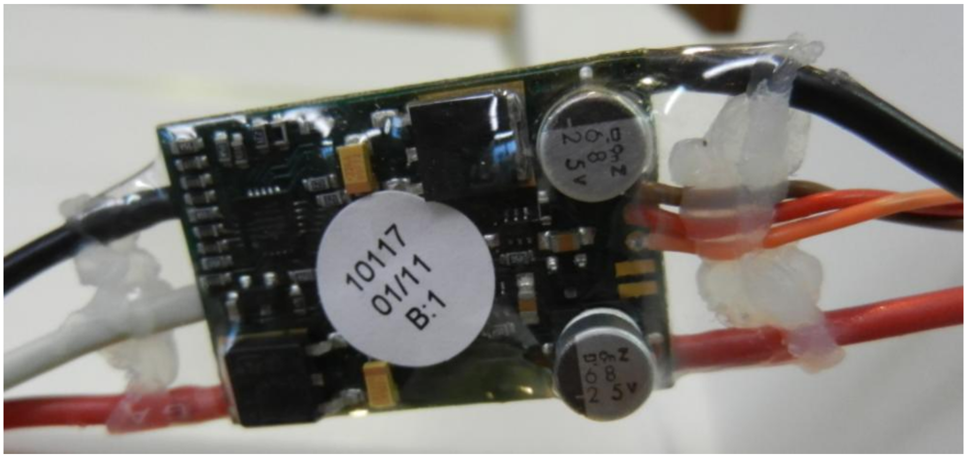
Radio and Speed Control



Radio and Speed Control

Mount the receiver and battery to the middeck using Velcro. The battery will probably go all the way forward against the nose cone, but leave room to shift the battery back to adjust the CG.

Waterproof the speed control by sealing the ends of the speed control module where the wires exit the heat shrink covering. I used a few pinches of the waxy type silicone ear plugs from the drugstore. If you use RTV, use non-corrosive RTV.



Speed Control Waterproofing

Mount the speed control to the side of the cockpit using Velcro.

Heat buildup is an issue inside our flying styrofoam beer cooler. Without addressing this, the speed control will overheat and shut down to protect itself. I know of three ways to fix this:

1. Cut ventilation holes in the front of the cowl and the rear of the cabin area. This solves the heat issue, but defeats our carefully built water tightness.
2. Use an external heat sink on the speed control. This works well (I use this on my Model Aero Polaris) but requires that you use a speed control which has provision for a heat sink, and it needs a bit of tricky mounting to have the speed control waterproof on the inside with the heat sink exposed to air on the outside.
3. Use a standalone battery eliminator circuit (BEC) instead of the one built into the speed control. This removes the heat of the BEC from the speed control, and the switching BEC specified will generate less total heat. This is the method I chose.

No matter which method you choose, it's a good idea to let the model cool for a few minutes with the hatch open between flights.

Mount the BEC to the side of the cockpit using Velcro.

Cut a hole in the side of the cockpit for the motor wires.

Finish the Hull

Glue the aft hull bottom to the bottom of the sides. Make sure the horizontal tail is level with respect to the wing; adjust this by adding twist to the fuselage as you are taping it together for the glue to set.

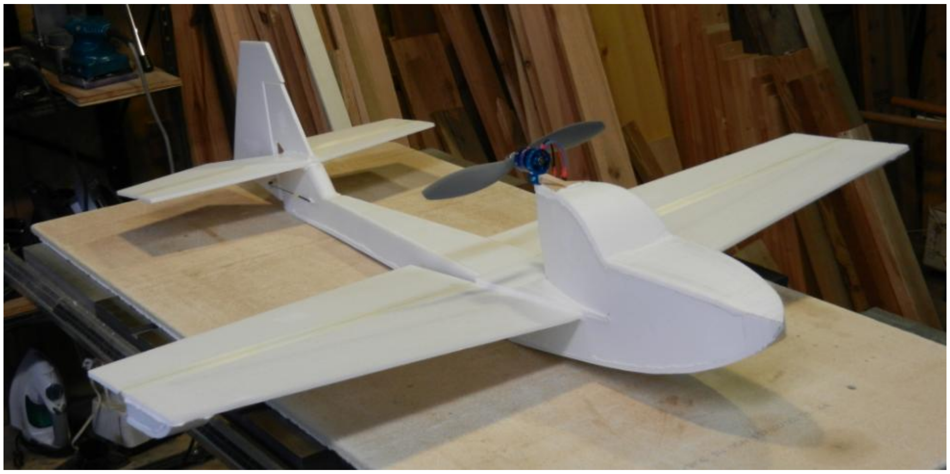
Glue the step spacer to the aft hull bottom. Sand a taper on the step spacer so the fore hull bottom fits. Prebend and glue the fore hull bottom to the bottom of the sides.

Prebend and glue the windshield and the cowl to the top of the sides.

Sand the nose square. Glue a stack of 4 pieces of foam to the nose. Saw and sand the nose cone (nose pyramid?) to shape.

Glue the pontoons to the bottom of the wings.

Sand the glued edges for appearance if desired. Leave a square edge on the hull bottom to reduce spray.



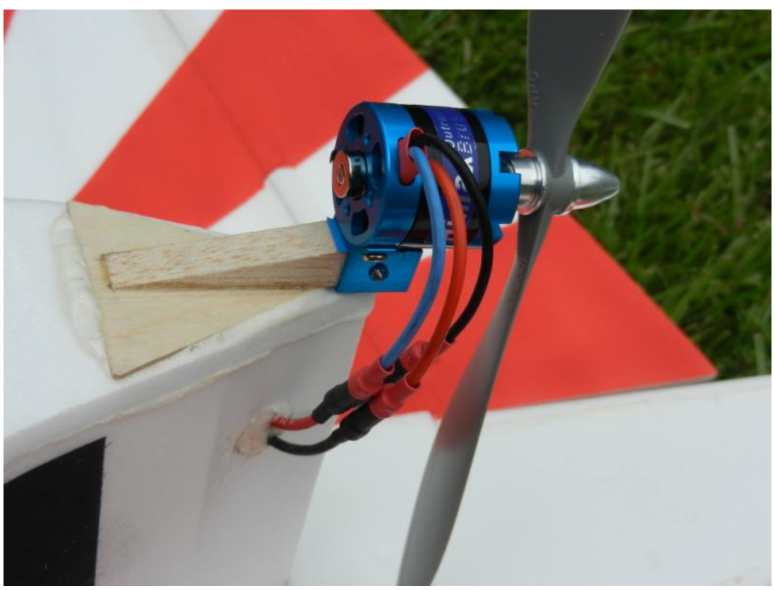
Finished Hull

Add a layer of thin packing tape to the bottom of both fore and aft hulls and to the bottom of the pontoons. This reduces friction and adds scuff resistance.

Cut a battery hatch in the cowl. Make this hatch as large as possible while still leaving enough margin to tape the hatch all around. Glue some bits of balsa or foam to the inside bottom of the cowl to form a seat for the hatch.

Motor

I used the Himax motor in a stick mount configuration. The motor will mount neater if it is changed so the shaft comes out the end opposite the stick mount. To do this, loosen the two setscrews on the motor shaft and press the shaft through until it protrudes out the other end of the motor, and then tighten the setscrews. This takes a pretty firm push—I press the shaft with a (not running) drill press.



Motor and Mount

Cut the motor mount from 1/16" plywood to the shape in the pattern. Make a short stick mount from 3/8" square hard balsa. Epoxy the stick to the motor mount. Drill the stick to accept a screw to hold the motor. Paint the motor mount assembly to waterproof it.

Glue the motor mount assembly to the top of the windshield. Turn this 3° to the right to set the right thrust angle. The 4° upthrust angle was already built into the fuselage sides.

Install the motor, connect the motor to the speed control, and get it rotating the right way. Glue the motor leads for water tightness where they pass through the fuselage side. Make sure the leads are short enough that they stay out of the prop.

Install the prop. A pusher prop is not needed because we can make the motor run either way. It does require a little thought to get the prop mounted frontward when the motor is backward. Props mounted backward are not very efficient (don't ask how I know this).

CG & Control Throws

Shift the battery to set the CG to 3.25" behind the leading edge, which is on the wing spar. If you are a bit tail heavy even with the battery all the way forward, add nose weight for your first flights. After it is trimmed out and you have a little experience with it, the CG can be pushed back a bit.

Set the control throws to 45° each way for each surface, or all you can get. I set up exponential on all surfaces so that the first half of the stick throw gives the first quarter of the control surface deflection, while of course the second half of the stick throw gives the last three quarters of control surface deflection. If your radio allows you can set up flaperons; this is not necessary but about 10° of down aileron on each side will allow slower flight without pitching up the nose.

Preflight

Install the battery and tape the hatch closed. Use hinge tape on the front of the hatch, and use plain old frosty Scotch Tape to seal the rest of the hatch. Folding under part of the tape to make a pull tab will make the hatch easier to open.

Flying

Water takeoffs are easy and can be done slow and graceful at gentle throttle or wild at full throttle as the mood strikes. A full throttle takeoff takes about 1 plane length. Water landings also are easy and can best be done as stall landings in the three point landing attitude. It helps to carry a bit of throttle to keep the glide slope from being too steep. Or you can get it going slow at a high angle of attack and let it plop down tail first into the water.

Landings (almost) always remain upright. The exceptions are when I am pushing my personal envelope and fall out of a low hover or something equally brilliant. If you find yourself up-side down in the water, it is possible to slowly motor, still up-side down, back to shore, with the prop saying sploosh-sploosh-sploosh. Keep the throttle low if you do this so you don't pull too much current.

There is plenty of power for unlimited vertical. The plane can be sitting at a full stop, do a takeoff, a loop, then land and come back to a stop in about 3 seconds.

Flight times on a 1350mA battery are about 20 minutes.


Loops and rolls are quick or slow, at the pilot's discretion. Unexpected pitch changes due to the high thrust line are not an issue, but it is harder to hover than a traditional tractor motor 3D foamie. Knife edge, while possible, is also a bit awkward. Inverted flight is easy and there is no obvious self-righting tendency due to the dihedral.

Slow flight feels very connected and precise. It is impressive to fly slow circles or figure 8's while dragging a wingtip in the water, or to fly low and slow down a grass runway and hear the bottom of the hull brushing the tips of the grass as it flies past. The slow flight precision, coupled with the light weight and no propeller on the front, make it fun to fly slowly past my valued self.

High speed flight is, uh, none. Full throttle level flight is a bit twitchy with the big control throws, and it's still not that fast. No doubt dual rates would help, but I haven't pursued this.

Slow or fast water taxiing are a piece of cake. Rudder turns are effective, or the ailerons can be used to plant a pontoon and spin around on it. Directional control in the wind is not an issue, and there is no need for a water rudder. The limit on how much wind it will accept is that a strong enough crosswind can blow it over during slow taxi.

Operations from grass are not significantly different from water. My usual method of putting the plane in the water is to drop it on the grass at my feet, blip the throttle for a grass takeoff, and land in the lake. Then at the end of the flight, I land on the grass back at my feet. I do this at one flying site on a 10' x 15' wooden dock instead of the grass.

Postflight

Seaplanes in general take more postflight cleanup than land planes, but the SlowBoat is better than most.

At the end of a flight, dry the hatch area and then pull the hatch open with the tape still attached to the hatch. If the sticky part is kept dry, the same tape can be used for several flights. Leave the hatch hinged at the front.

The plane typically stays bone dry inside, but it's good practice to check for water. Store the plane with the hatch open to encourage it to dry out.

If there is more than a few drops of water, pour out what you can and pour water out of the bilge (the area below the middeck) through the opening in the middeck. Cut a vent hole in the middeck behind the tail servos to get circulation going, and leave a fan blowing on the open hatch overnight. Tape over the vent hole before your next flight.

All the electronics are mounted so that it would take quite a bit of water inside the plane to do more than splash the cases. A splash probably won't hurt anything except the speed control, and we took steps to waterproof that before it was installed.

If the plane had been up-side down in the water, leave the fan blowing overnight on the motor to dry it out. Water doesn't seem to affect brushless motors, but long term water exposure will cause any exposed copper to corrode.

The servos can be reached for maintenance by cutting an access hatch in the bottom of the plane. This should not be a big deal, just glue the hatch back in place when done and seal it with fresh packing tape on the bottom of the hull.

I would like to hear from anyone who builds the model or has feedback on the plans.

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