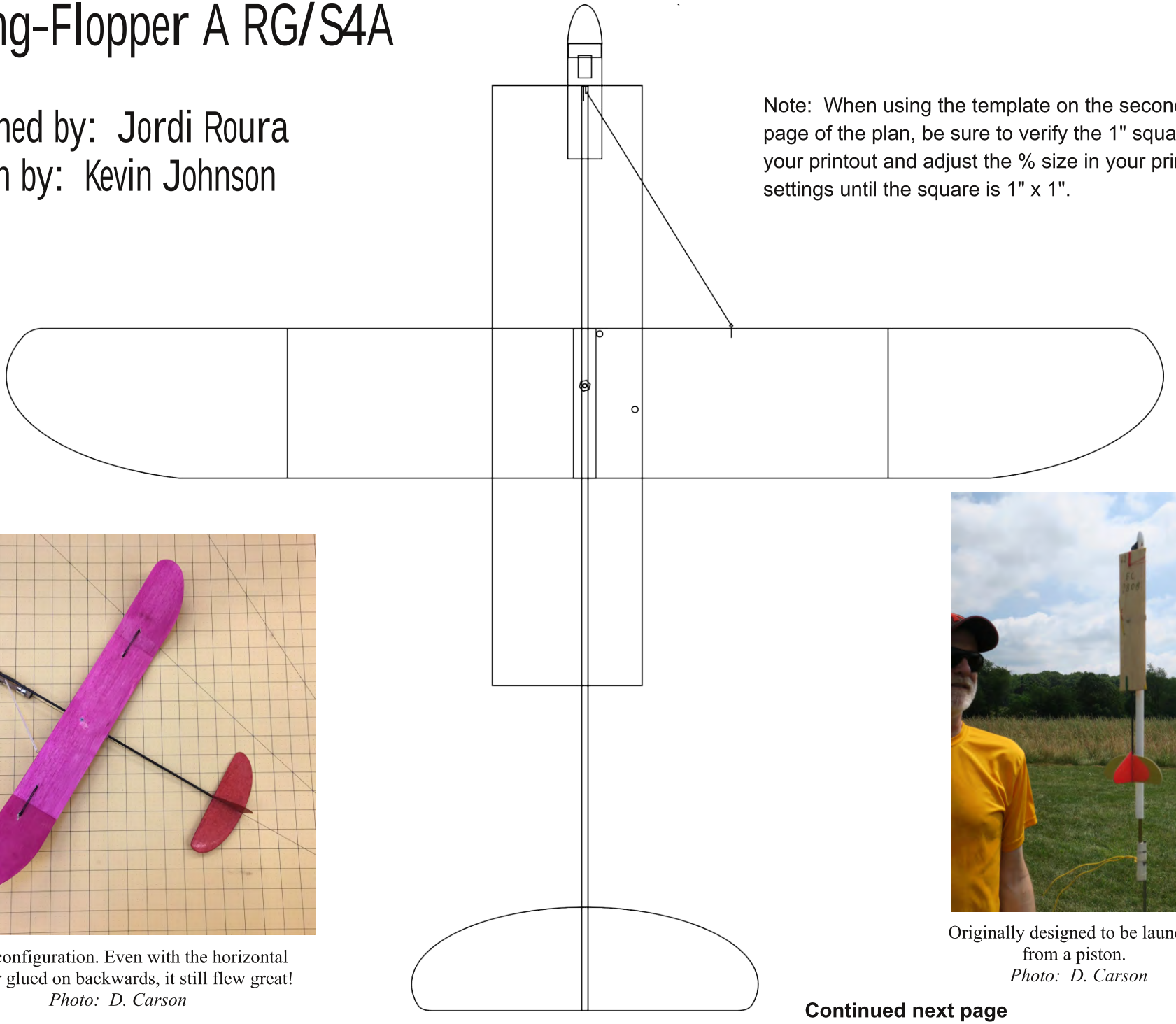
Swing-Flopper A RG/S4A

Designed by: Jordi Roura
Drawn by: Kevin Johnson

Note: When using the template on the second page of the plan, be sure to verify the 1" square on your printout and adjust the % size in your print settings until the square is 1" x 1".



Glide configuration. Even with the horizontal stabilizer glued on backwards, it still flew great!
Photo: D. Carson

Originally designed to be launched from a piston.
Photo: D. Carson

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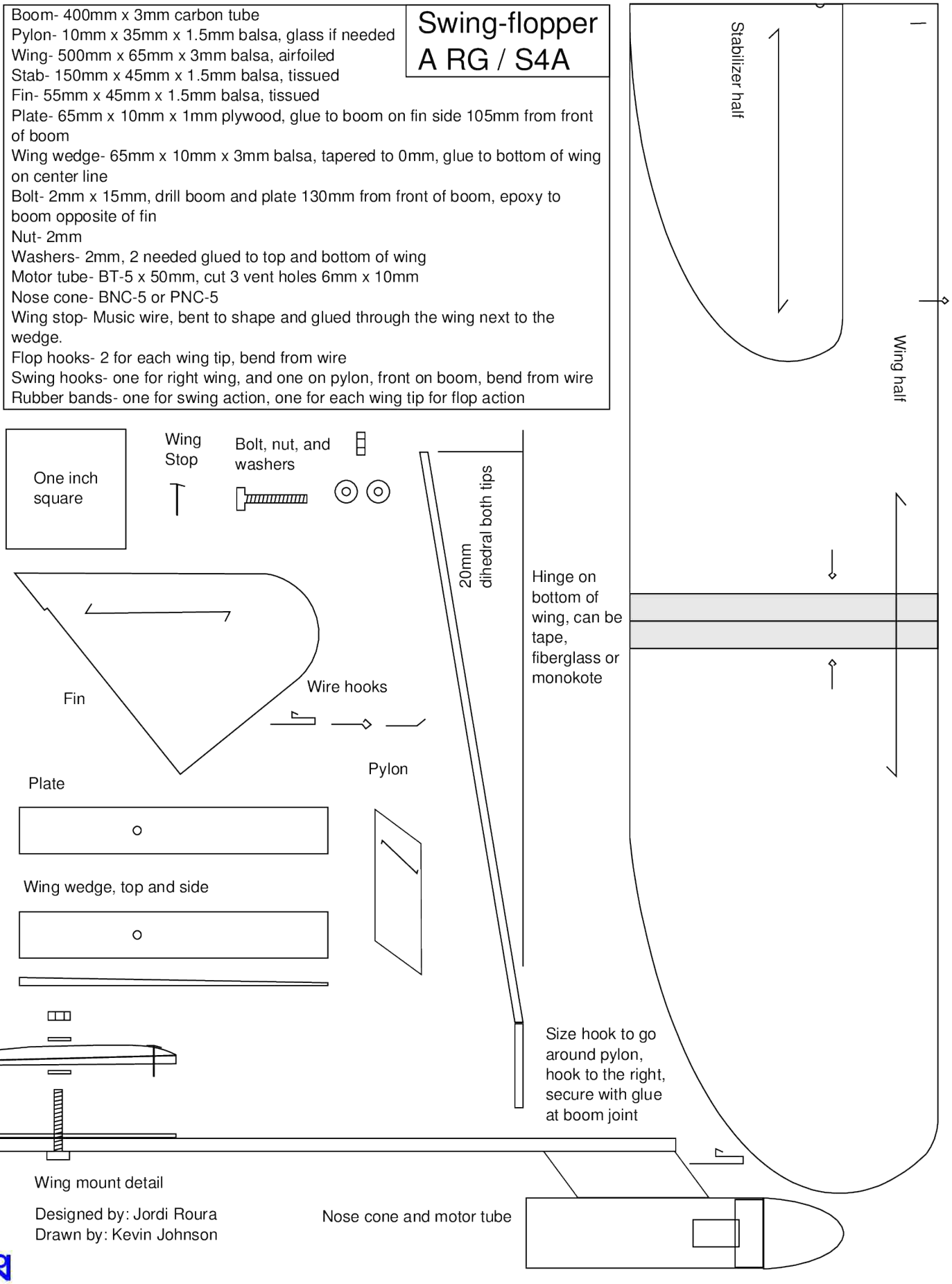
Swing-flopper
A RG / S4A

Boom- 400mm x 3mm carbon tube
Pylon- 10mm x 35mm x 1.5mm balsa, glass if needed
Wing- 500mm x 65mm x 3mm balsa, airfoiled
Stab- 150mm x 45mm x 1.5mm balsa, tissued
Fin- 55mm x 45mm x 1.5mm balsa, tissued
Plate- 65mm x 10mm x 1mm plywood, glue to boom on fin side 105mm from front of boom
Wing wedge- 65mm x 10mm x 3mm balsa, tapered to 0mm, glue to bottom of wing on center line
Bolt- 2mm x 15mm, drill boom and plate 130mm from front of boom, epoxy to boom opposite of fin
Nut- 2mm
Washers- 2mm, 2 needed glued to top and bottom of wing
Motor tube- BT-5 x 50mm, cut 3 vent holes 6mm x 10mm
Nose cone- BNC-5 or PNC-5
Wing stop- Music wire, bent to shape and glued through the wing next to the wedge.
Flop hooks- 2 for each wing tip, bend from wire
Swing hooks- one for right wing, and one on pylon, front on boom, bend from wire
Rubber bands- one for swing action, one for each wing tip for flop action



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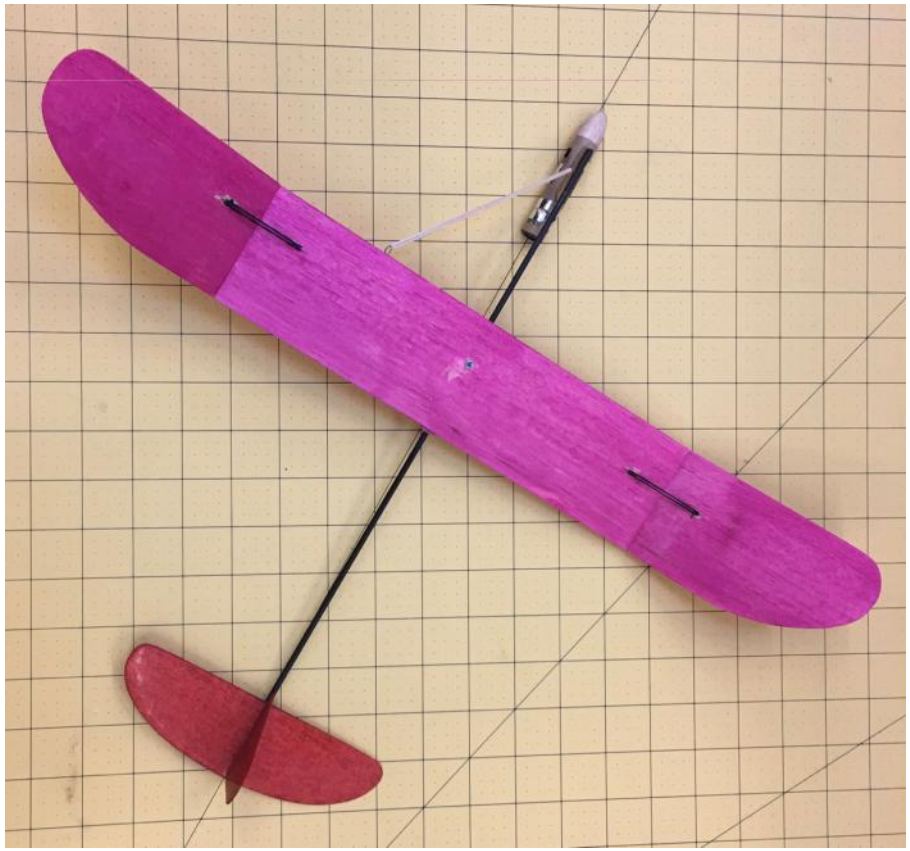
Building the Jourdi Roura S4A Swing Flop Wing

By Don Carson

Photos: D. Carson



Glide configuration, note rubber bands that deploy the flop wings.

Two Roura models.

The drawings for this design were published in the September/October 2017 issue of the Zog-43 and is available here (http://narhams.org/zog-43/v39/zog43_v39n05_201710.pdf) or on the NAR FAI page, as the FAI S4A Rocket Glider - Spanish Design, here (http://www.nar.org/wp-content/uploads/2018/08/FAI-S4A-Rocket-Glider-2018.pdf).

This design is one that has evolved over the years. Jourdi modified the design he got from the Moscow Institute of Aviation and has graciously shared it with us. I have made some changes, as well. In some cases, the changes are to improve reliability. In some cases they are intended to improve aerodynamics.

Along the line, there are substitutions that have been made to improve competitiveness but may involve materials that are more expensive or difficult to obtain. There is no reason to use those materials when learning how to build and fly this type of model. For beginners, I recommend starting with the cheaper, easier to get materials until the model works right for you. Then introduce changes, as you desire, for competition models. I think the basic model makes a perfectly fine contest model on its own.

One thing I am careful with is trying to improve the alignment of the various components as they get assembled.

I sparingly use a small amount of epoxy in the construction. Many would disagree with this on a glider, but it has worked for me. When called for, use very little, the stuff is heavy.

Tools

Wil-Kro razor plane.

There are a number of optional things that can help you build gliders faster or more accurately.

Razor plane to shape the wing faster and wth less dust, strictly optional.

Sanding block, 150 and 220, use self adhesive sand paper. Block can be a shop made wooden block (8-12” long) or an aluminum Great Planes block. You should use one for any glider build.

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Swing Flop, Continued

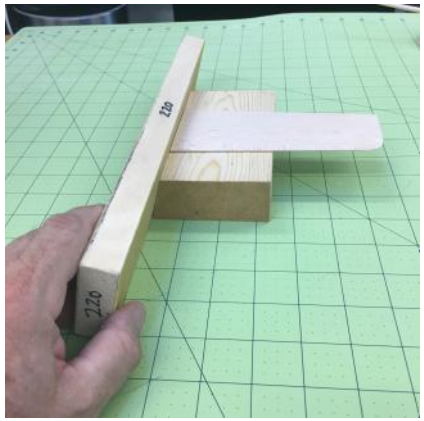
Bevel jig for dihedral and squaring up flop wing joints. Can be made by many wood workers.

Cutting mat with grid pattern for aligning and gluing the fuse/stab/plate

1”x2”x3” steel block and small button magnet — optional but helps glue the vertical fin on perpendicular to Stab.

Box fan and filter set up by your bench to suck away the sanding dust.

Wire cutter (hardened for music wire) and pliers to bend and form all the fiddly bits.



Homemade sanding block and bevel jig. Jig is simply a pine block cut with an 8 or 10º angle on one face.

Materials

- 1/8” x 3’ x 36” balsa for the wing (for contests, I use C-grain, Contest balsa. Don’t bother for practice gliders)
- 0.125” Carbon Fiber (CF) tube, not solid rod. Hobby shop or online
- BT5 Body tube and nose cones — online or maybe in hobby stores
- 1/8” x 3/8” x 12” or 36” long Basswood - Hobby store or online
-1/16” x 2” x 36 inch balsa 9 light weight C-grain is best)
- Straight pins
- 1/8” dowel
- Hairbands for deploying the wings (if not using music wire springs)
- Rubber bands or dental owner chain for caisson deploy.
- Cotton thread (get spec)
- Masking tape and/or Mylar tape.
- Launch lug, if launching on a launch rod
- Modeling clay for trimming the assembled model to glide correctly
- 0.040” drill for fuse and wind pivot
- 3 mm or Imperial equivalent bolt/nut/washer
- Cyanoacrylate super glue (CA), 20 or 30 minute epoxy
- Small amount of fiberglass cloth
- Tyvec tape for hinges — (not cheap, there are other options, read some of the other material on wing hinges)

Advance Materials

- 0.098” CF fuselage
- G10 plate and wedge liner (https://www.asp-rocketry.com/ecommerce/G-10-Fiberglass-Sheet.cfm?cat_id=67)
- 1/32” Japanese tissued epoxy vac bagged tail surfaces
- 0.015” music wire - Hobby store or online. (alternate .014” SS fishing line)
- Piston launcher for best performance

Build order:

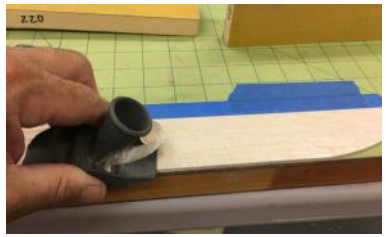
You will want to scuff the CF boom wherever you will be gluing to it.

Warning - use a mask and vacuum whenever cutting, sanding and drilling Carbon Fiber materials. The dust is bad stuff, you don’t want to be breathing it.

Parallel Activities - you can make these parts in any order you wish

Wing - 1/8” x 3” stock

1. Cut wing sheet to the cord width.
2. Sand top and bottom smooth.
3. Mark tips, cut out, sand smooth.
4. Mark hinge and center lines.
5. Mark high point 5/8” from the Leading Edge (LE).



A razor plane makes quick work of roughing out the airfoil.

6. Airfoil the whole wing. Re-mark hinge lines(top), not centerline (or you will mistakenly cut there, sooner or later, don’t ask me how I know).
7. **Optional** - Dye wings, or color with permanent marker
8. Cut hinge lines with a square. True up 90 degrees, if necessary.
9. Bevel one side of each hinge joint 8 or 10 degrees.
10. Use thin CA to harden hinge area, being careful not to glue the wing open or closed.

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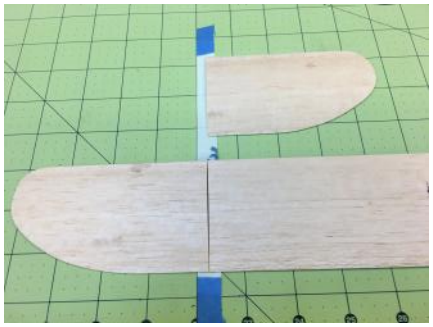
Swing Flop, Continued



Installing the hinges.

11. Cut hinge tape strips and attach tips to center section of wing.
12. **Optional**, if using torsion springs to deploy flop wings, install the spring retaining loops.
13. Find center of middle panel, draw center line top and bottom
14. **Optional** - CA a 1/4" square fiberglass pad on top of the wing where the pivot hole will be for wing washer to bear on.
15. Sand wedge 1/8", glue to centerline bottom of wing
16. **Optional** - glue a thin G10 plate to the wedge to provide a smooth pivot surface.
17. Drill hole for pivot from bottom side (centering the hole in wedge), as shown on the drawing. Reinforce the area with thin CA. Re-drill the hole after CA cures.
18. Paint wings with 2 coats of butyrate dope thinned 50%

Tail - Cut out tail surfaces, sand. Mark CL perpendicular to LE on both sides. Optional - you can use 1/32" vacuum tissued balsa.

Boom - cut to length - 15"

Power pod - cut out pylon (basswood, 3/8" tall for 13 mm motors, 1/2" tall for 10.5mm motors, ~1"long), tube, coupler reinforcement if used. Glue pylon to tube. Leave aft of tube overhang 1/4" to allow for taping the motor in place, CA aft of the tube exterior so repeated removal of tape won't damage tube.

Fiddly Bits - Wedge, plywood plate, wire bits - cut and form per the drawing.

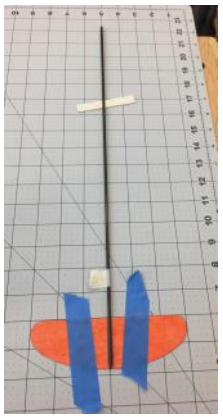
Torsion Spring Details.

Fashion springs — make 2" long C shaped springs from 0.015" music wire.

Use a sewing needle to pass thread from top to the bottom side and back up to the top to form a loop on the bottom. Pull tight and CA the thread.

When forming the thread loop, use a larger wire (~0.022") so there is some clearance. You can see where fiberglass reinforcement has been CA'ed where the "legs" of the spring will rest.

Assembly - it is helpful to use a flat surface with a grid pattern on it (like a cutting mat) to help with aligning and squaring up parts.



1. Glue stab to aft end of boom using tiny amount of 20 minute epoxy. Put a shim of the same thickness as the stab under the forward part of the boom to keep the boom level.
2. Lay the boom/stab assembly on a flat surface, stab side down. Epoxy Mount plate to the boom per plan, same side as the stab. Use only a small bead of epoxy.
3. Locate the pivot bolt hole per plan.
4. Drill hole for pivot screw in fuselage/mount plate. **Tip** - I file a small flat on the CF boom. Then I drill with a tiny drill and follow that up with an 0.039" or 0.040" dia. bit. It helps to keep the hole centered in the CF boom. If you go off center, don't worry, the plate will maintain the strength of the fuselage.

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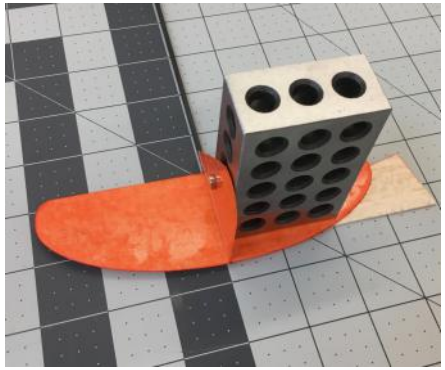
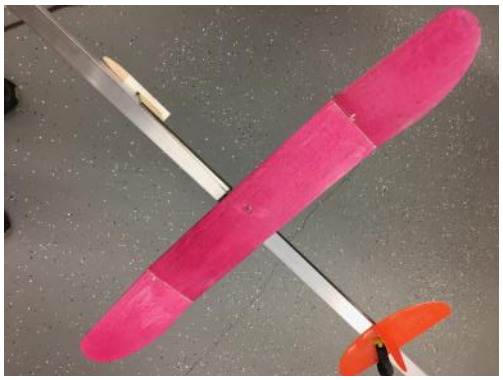
Swing Flop, Continued

5. Glue the fin on top of stab. Tack with thin CA, lightly fillet with epoxy
6. Insert the bolt from the boom side up through the plate. This is easy to get reversed, check the drawing. Apply a small amount of epoxy around the head of bolt.
7. Assemble wing on boom.
8. Add wire bits, see the drawing and photos. The plan shows a dowel glued in a hole in the wing to limit the swing of the wing to 90 degrees. **Optional** - glue the swing limiter into the wedge so that it hits the plate, see photo to the right.
9. Glue Power Pod to front end, opposite side of fin, this too, is easy to get reversed. Reinforce with pylon/boom joint with a small wrap of fiberglass/CA. **Tip** - you can use a length of aluminum angle to align the pylon perpendicular with the tail, see photo.



Using a square block and a small button magnet to align the fin for gluing.



Aluminum angle clamped to the tail can align the power pod pylon during assembly.

Pre-Flight

1. Verify the angle for each tip panel and adjust if necessary. Tip - I use this $5 (sometimes less) Multipurpose Angle Finder from Harbor Freight, works great. https://www.harborfreight.com/multipurpose-angle-finder-1028.html.

2. Hook up all springs and/or rubber bands.
3. Trim the model for a nice glide with a burnt out motor casing in the power pod.
4. Fold the tip panels and rotate the wing 90 degrees to the launch configuration.
5. Holding the wing in launch position, loop a burn thread through the vent ports, around the pylon, to the wing hook and back the same path. Pull tight against the fuselage. Pull the thread tight and secure with tape. If the wing pulls away from the fuselage, remove the tape, pull tight and re-tape.

Two side views of the burn thread routing. The thread is taped on the body tube in a "U" so that it won't slip.

Launch - Unfortunately, the selection of US motors for S4A is not so good. An A3-4T works but is really too long of a delay, you will lose some altitude before deployment. I have flown them on the A10-3T, which is a better delay, but they have a pretty high initial thrust spike. I have never had one fail with either motor. I always launch with a piston, which helps with the long delays. You can also fly these with a 1/2A3-2T.

Launch and glide configurations of a torsion spring variant of Jourdi's design.