FL Bird Works “Wasabi” Total Aerobatics Glider

English Language Build Instructions

Photo courtesy SoaringUSA.com

Version 1.0 – February 8, 2008 by Steve “Surfimp” Lange

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Introduction

Congratulations on your purchase! The FL Bird Works "Wasabi" is one of the very best aerobatics gliders available today. If built with care, it will provide outstanding flight performance. Please do carefully read these instructions and make sure to understand every step before you begin construction.

This document has been distilled from "The Wasabi from FL Bird Works" thread on RCGroups.com. Take advantage of the thread to post any questions you have about building your Wasabi. The thread is located here: http://www.rcgroups.com/forums/showthread.php?t=710774

About the FL Bird Works "Wasabi"

The FL Bird Works "Wasabi" is an hollow-molded, composite glider designed to perform total aerobatics. It utilizes highly advanced symmetrical airfoils which, when combined with appropriate computer radio mixing, provide some of the most outstanding flight performance found on any aerobatics glider.

The Wasabi is not a beginner's glider. Building and flying the Wasabi requires intermediate and higher skill and experience. These instructions are written with the expectation that the builder has experience building and flying a hollow molded sailplane. However, anyone who has built a few gliders from kits should have no trouble with the Wasabi build, so long as they pay close attention and make sure to post any questions to the Wasabi thread mentioned above. As always, the old adage of "measure twice, cut once" applies. Take your time and get it right the first try!

Items Recommended to Complete the Build:

Build supplies:

Sandpaper (220, 400, 600 grit)

5 minute & 30 minute epoxy and related mixing materials (cups, stirring sticks, acid brushes, and vinyl gloves)

Thin & Thick CA

Hobby knife & blades

Dremel tool & related bits

Assorted jeweler's files

Razor saw

~5oz. fiberglass cloth

Microballoons

Denatured alcohol solvent

Pin vise

Dust mask & eye protection

Hardware:

8pcs of 2-56 clevises

2pcs of 2-56 rigging connectors

2pcs of 12" 2-56 threaded rod

10'+ of ~27lb. test nylon coated stainless steel fishing leader

Elevator pushrod material (4-6mm+ solid carbon fiber tube, or flexible pushrod and housing, builder's choice)

Miscellaneous servo installation screws, grommets & etc.

Wing retention materials (per builder's preference)

Lead trim weights for adjusting center of gravity

Radio gear:

Five channel or better transmitter with flaperon mixing, dual rates, end point adjustment, exponential, etc. on all channels

2 thin wing servos with maximum thickness of 0.50" / 13mm (i.e. Futaba 3150, Airtronics 94761Z, JR DS368, etc.)

1 mini-sized elevator servo (i.e. Futaba 3150, Airtronics 94761Z, JR DS368, etc.)

1 mini-sized rudder servo, the faster and higher torque the better. (i.e. Futaba 3155, Airtronics 94761Z, etc.)

Four channel+ receiver

Battery pack (6V recommended)

Wiring harnesses and servo extensions (per builder's preference)

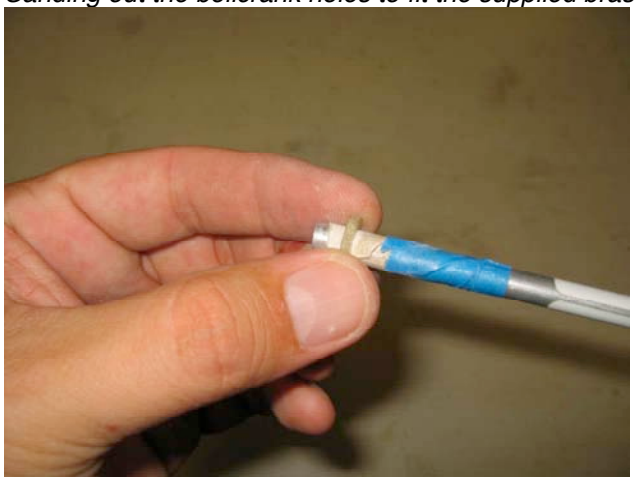
Switch (if used)

Build Instructions

Part 1 – The Fuselage

1. **Elevator Bellcrank Subassembly:** The holes in the bellcrank hardware are cut undersize for the supplied brass bellcrank sleeve and the smaller of the two bellcrank joiner rods (the metal one), so you'll have to *carefully* sand or drill them out to the proper sizes. This is important to get as slop-free as possible because it's your elevator linkage and it needs to be tight and non-binding. Start with 220 grit, then move to 400 and finally 600 to get a nice smooth surface for the bellcrank/sleeve interface. *Test fit often!*

   Sanding out the bellcrank holes to fit the supplied brass tubing

2. After that you glue the two small fiberglass washers to the sides of the bellcrank. I used thick CA, but you could use epoxy or Goop (those would give you more working time to get the parts perfectly lined up).

   Bellcrank subassembly ready for dry-fitting

3. With the bellcrank built, dry fit it and the servo tray into the fuse so you can do mockups of the elevator pushrod and make sure everything fits without binding. There's not much extra space in the fuselage, so you have to take care to make sure your servo tray is located low enough so your elevator and rudder controls will clear *underneath* the wing rod tubes, but not so low that the elevator pushrod binds on the floor of the tail boom when making the shot back to the tail.

4. Once you are happy with your bellcrank setup, set it aside. You will not permanently install it until later, after you've built your elevator pushrod and installed your servo tray.

5. **Elevator Pushrod Subassembly:** It's time to make an elevator pushrod. I recommend doing this *before* installing your servo tray or permanently mounting the elevator bellcrank, so that you can confirm the angles between the servo tray and the dry-fitted elevator bellcrank and make sure you have clearance beneath the wing joiner tubes, above the floor of the fuselage, and are sufficiently far away from the rudder pull-pull cable runs.

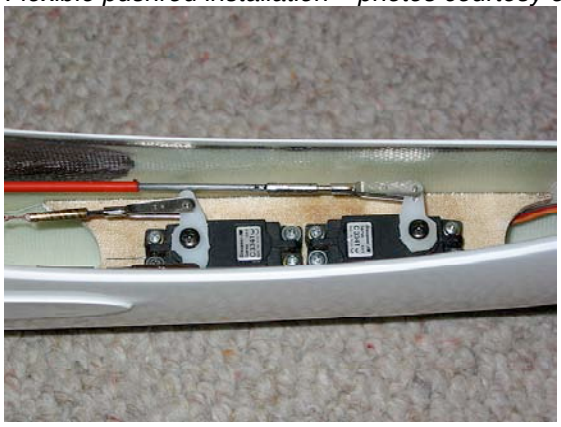
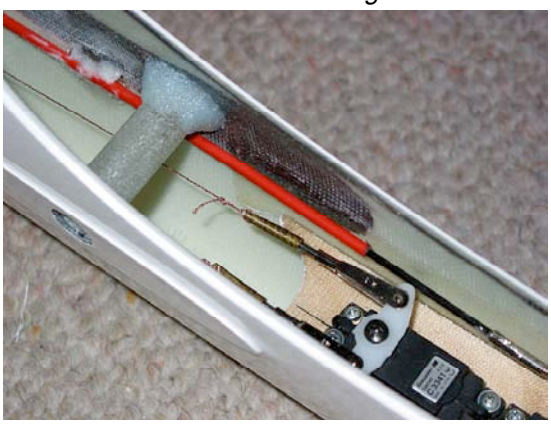
   Elevator pushrod build options:

   a. Solid Pushrod: I used from some suitably sized carbon fiber tube leftover from another project. I had previously used epoxy thickened with microballoons to glue threaded rod in one end, and then wrapped that with Kevlar thread CA'ed in place to prevent splitting. For the other end, I glued a threaded rod end onto a smaller piece of scrap CF rod with thickened epoxy, then glued the CF rod into the larger CF tube, also with thickened epoxy.

      Solid elevator pushrod made from carbon fiber tube, threaded rod and Kevlar thread


   b. Flexible Pushrod: Alternatively, you can use a flexible pushrod and housing for the elevator pushrod. To install the pushrod housing, insert a length of music wire into the house and then use rare earth magnets (placed on the outside of the fuselage) to hold the pushrod housing in place while the glue (epoxy or Goop) used to glue in the pushrod housing sets. After the glue cures, remove the music wire pushrod and install the normal elevator pushrod that came with the pushrod housing.

      Flexible pushrod installation – photos courtesy of Pierre Rondel's Planet-Soaring.com

6. **Servo tray:** Sand the inside of the fuse in preparation for glassing in the servo tray. Use 220 grit and then wipe it down afterwards with denatured alcohol to get the dust out.

Sanding the inside of the fuselage in preparation for gluing in the servo tray

7. Dry fit the servo tray in the fuselage. The rear "legs" of the tray should be about 5mm ahead of the main wing joiner tube. I lined up the rearmost part of the back servo cutout with the leading edge of the wing, which seemed perfect. Make sure to provide enough clearance for your servos above the floor of the fuselage!

   Tip: Once you have confirmed the servo tray is level from front-to-back and side-to-side, use a Sharpie felt tip market to trace the edges of the tray. You will later use these marks to position the tray when you glass it in place.

Dry fit the servo tray in the fuselage – the rear legs should be ~5mm ahead of the main wing joiner tube.

8. Glass in the servo tray using some ~5oz. glass and epoxy resin, making sure it was aligned with marks made in the previous step indicating the "perfect" location for the tray.

A piece of ~5oz. glass for glassing in the servo tray – apply across the top of the servo tray and about 1/2" up each side of the fuselage. Make sure to wet the cloth out completely, but do not use excessive resin.

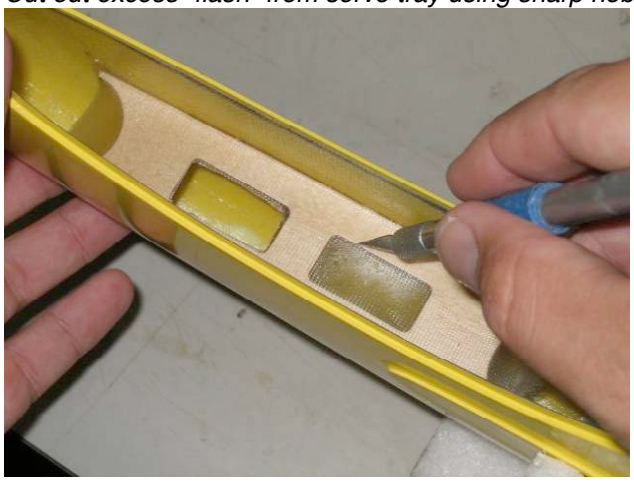
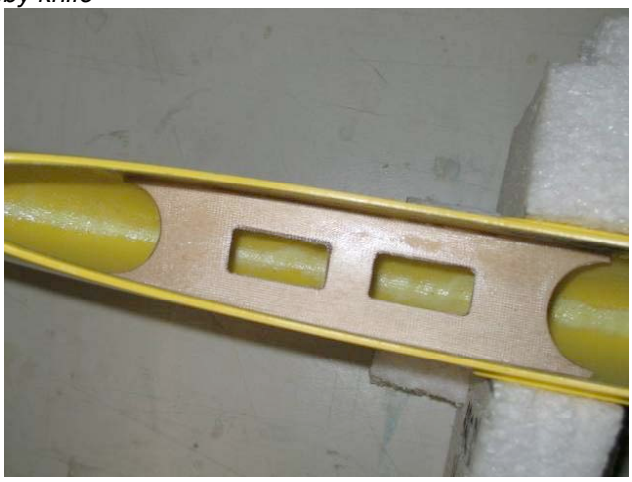

Servo tray build options:

a. You could instead use Goop or aquarium silicone to install the servo tray, but one advantage of glassing the tray in place is that you effectively "lock" the two sides of the fuse together with a material bridge, which should help durability of both the fuselage and the servo tray.

b. As desired, prior to glassing in the servo tray you can lay extra reinforcement in the fuselage, depending on what you feel your flying location and landing abilities require. One or two layers of ~5oz. cloth laid inside the fuselage from the nose back to about 2-3" past the trailing edge of the wing would make for an extremely durable fuselage, though it would potentially increase the aircraft's all up weight somewhat. As with everything, there are compromises to be considered.

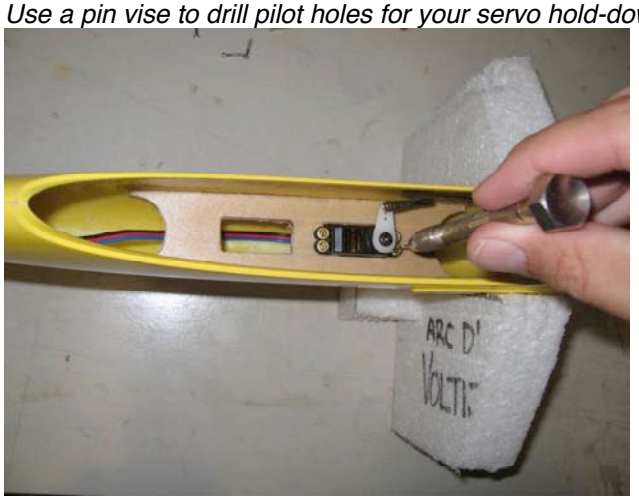
9. Once the epoxy cures, use a fresh hobby knife blade to cut out the flash covering the servo wells and remove the flash from the front and rear portions of the tray.

Cut out excess "flash" from servo tray using sharp hobby knife

10. Now make sure everything works as anticipated. To do that, install the elevator servo. It's best to drill pilot holes first with a drill or pin vise, then install the servo hold-down screws. The wood tends to split a less that way.

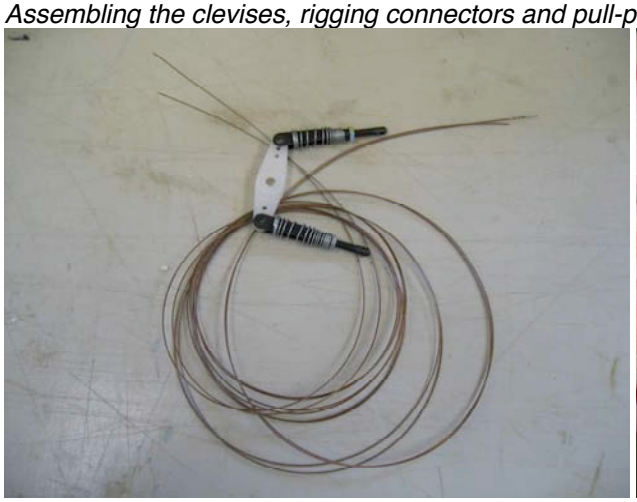
Use a pin vise to drill pilot holes for your servo hold-down screws



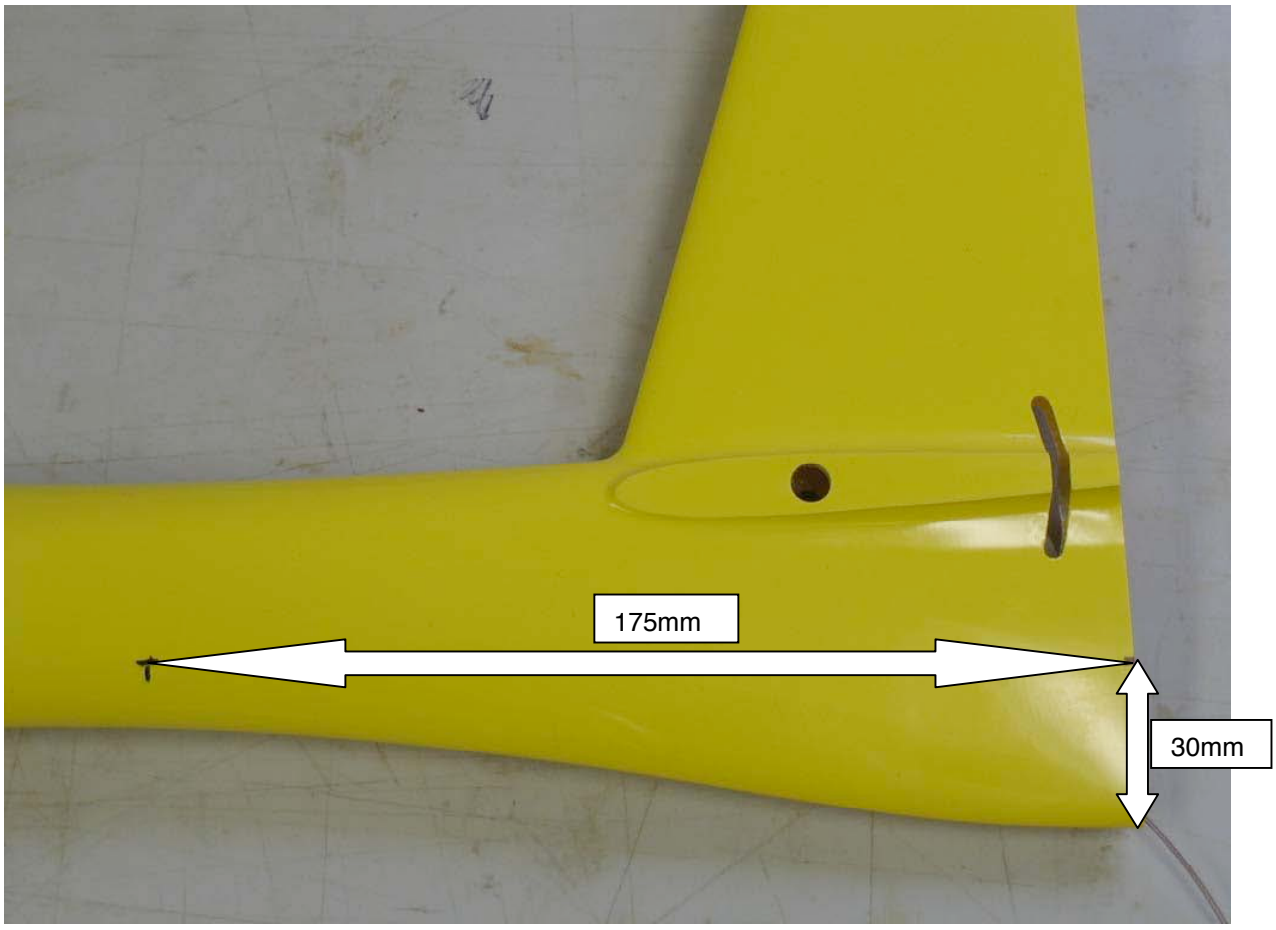
NOTE: I ended up having to put small 1/8" x 1/4" hardwood shims underneath the elevator servo in order to lift it high enough for the rudder pull-pull cables to pass without binding (see steps regarding rudder cable installation below). Whether or not you need to do this will depend on whether you choose to do the flexible elevator pushrod or not (and if so, whether you place the elevator servo in front or behind the rudder servo), as well as the size of your servos and the location of your servo tray in the vertical dimension. Again, take your time here and make sure that nothing binds. If it does, pull it out and make it right before proceeding. You will thank yourself later!!

11. **Rudder Pull-Pull Cables:** Assemble two clevises on the two rigging connectors, cut two generously long lengths of leader (approximately 1.5 times the length of the fuselage), and tie the leader cables to the rigging connectors using a Duncan knot or similar.

Assembling the clevises, rigging connectors and pull-pull cables



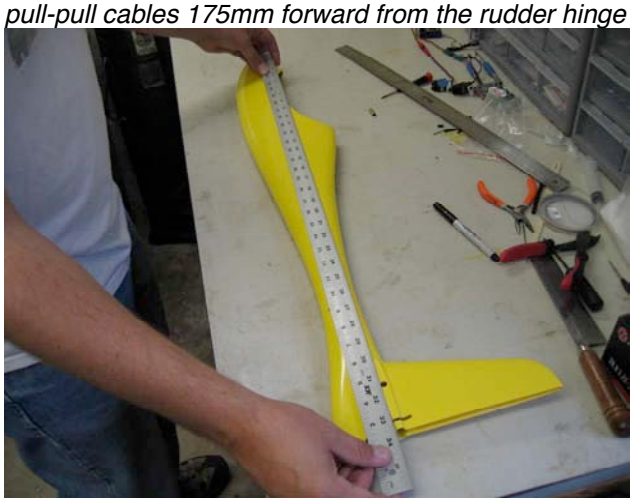
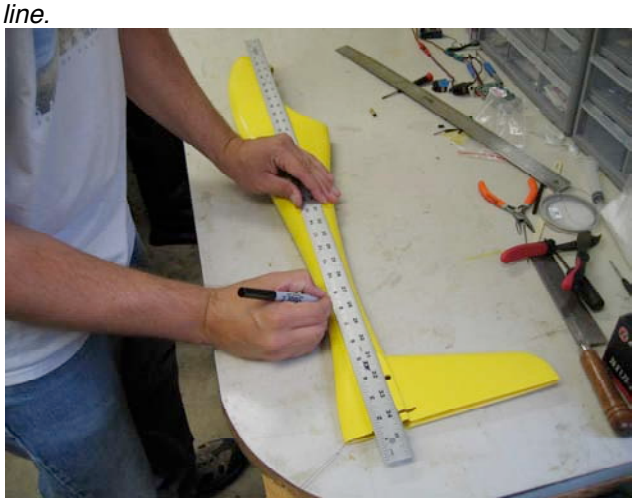
12. On the rudder, mark the intended location for the rudder control horn (30mm up from the bottom of the fuselage) and the exit location for the rudder cables (175mm ahead of the rudder hinge line).



Tip #1: Measure the location of the rudder's servo arm & clevis and mark it on the outside of the fuse (I use a Sharpie felt marker for this, it wipes off easily with a bit of denatured alcohol solvent on a rag or towel). Then use a long straightedge and mark the precise exit location on the rudder pull-pull cables on the side of the fuse.

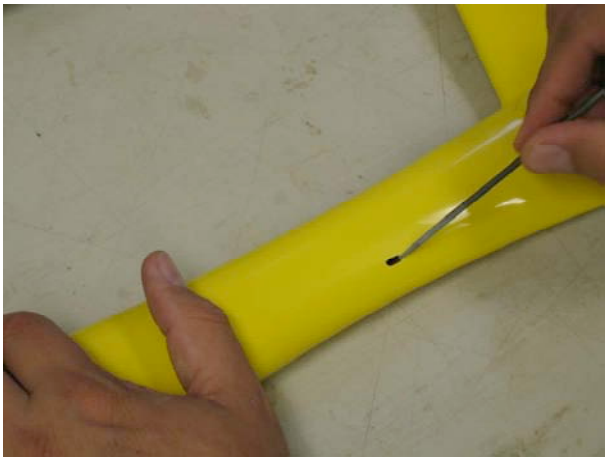
Measure and then mark location of the rudder servo arm on the outside of the fuselage

Use a straightedge running between your rudder servo arm mark and the rudder control horn mark to simulate the straight cable run from the servo arm to the control horn. Mark the precise outlet points for the pull-pull cables 175mm forward from the rudder hinge line.

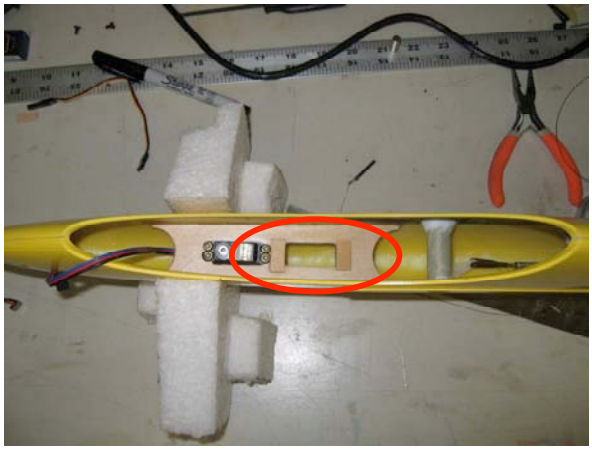
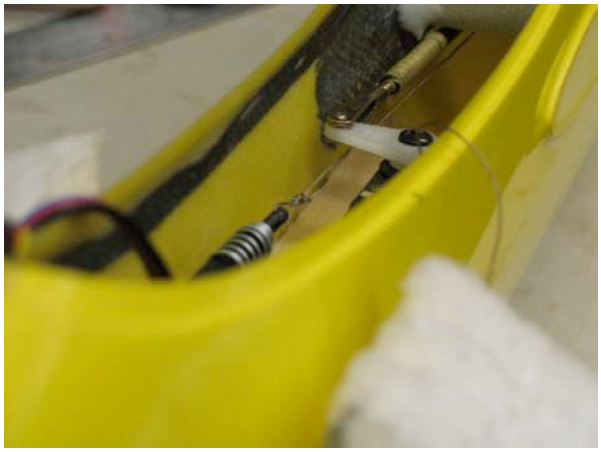
13. Use your Dremel tool to cut the rudder cable outlets. Use a round needle file to clean up the holes.

Cut the outlet holes using a Dremel, then clean up with a round needle file

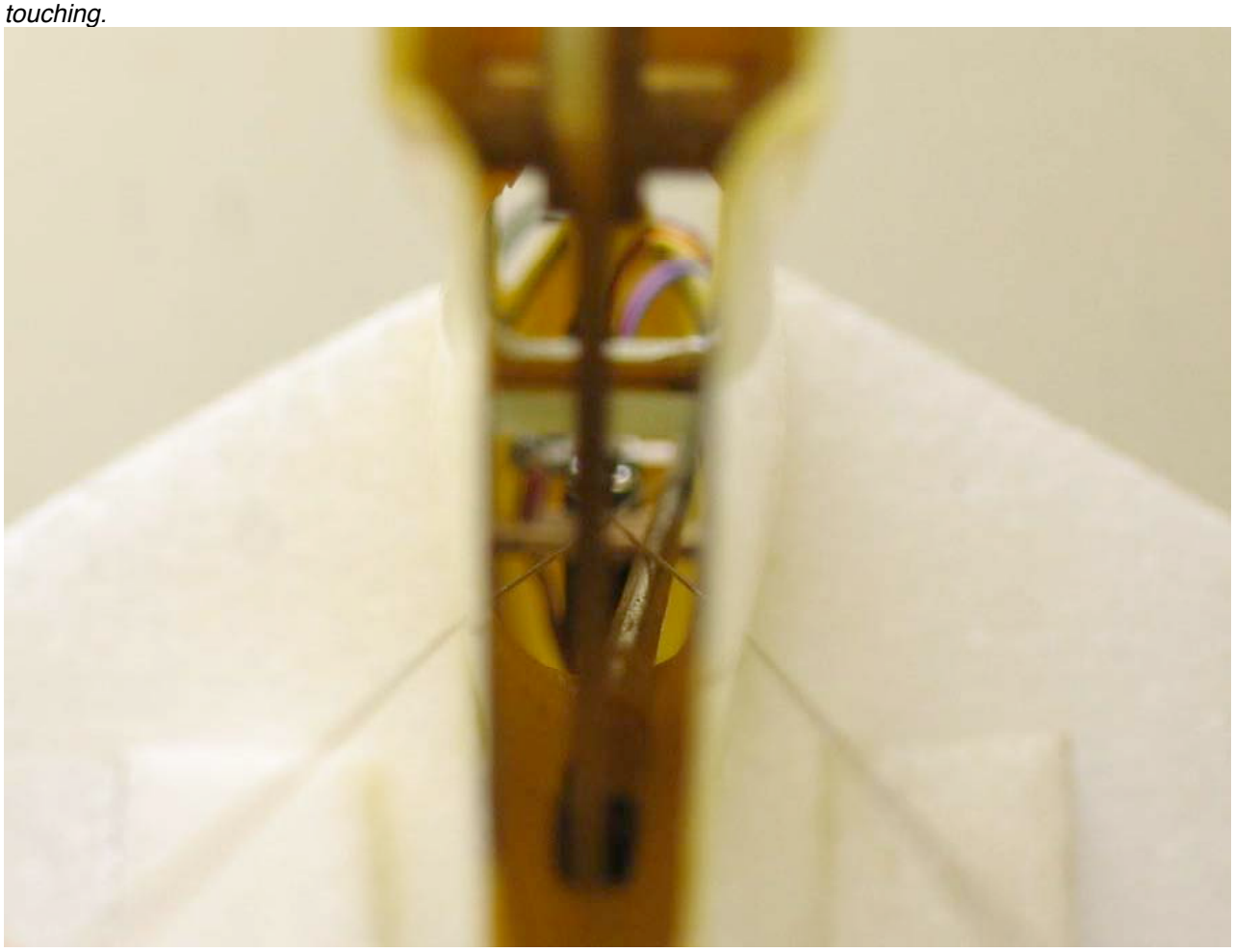



14. Test fit the elevator pushrod and rudder pull-pull cables to confirm non-binding, full range of motion for each. You may need to use hardwood blocks to shim up the elevator servo so it clears the rudder cables.

Hardwood shims for elevator servo

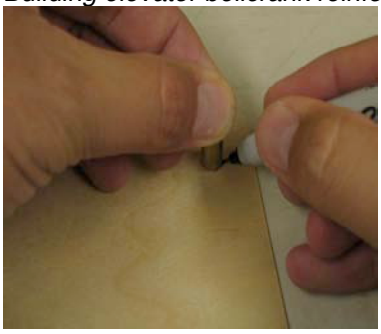
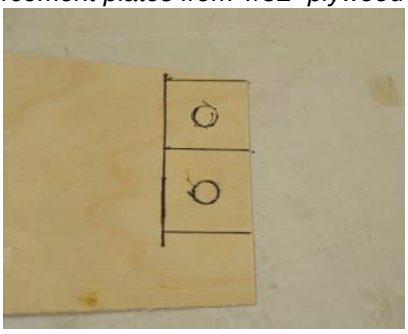
Example elevator pushrod and rudder cable fitment. While tolerances are close, there is no binding or touching.



15. **Elevator Bellcrank Installation:** Now the elevator pushrod can be hooked up and the elevator bellcrank permanently installed. While the bellcrank can be installed without reinforcement if desired to reduce weight as much as possible, adding reinforcement is relatively easy and recommended for long term durability.

    a. To reinforce elevator bellcrank installation: Start by cutting two squares of 1/32" plywood with holes in the center that snugly fit the elevator bellcrank joiner tube.

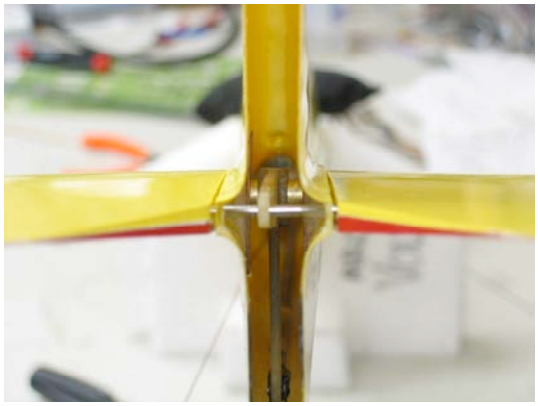
Building elevator bellcrank reinforcement plates from 1/32" plywood


b. Test fit, then when satisfied glue in place, *making sure not to accidentally get glue in the bellcrank.*

TIP: Put Vaseline or oil on the bellcrank tube to prevent glue from penetrating and causing the bellcrank to become permanently immobilized.

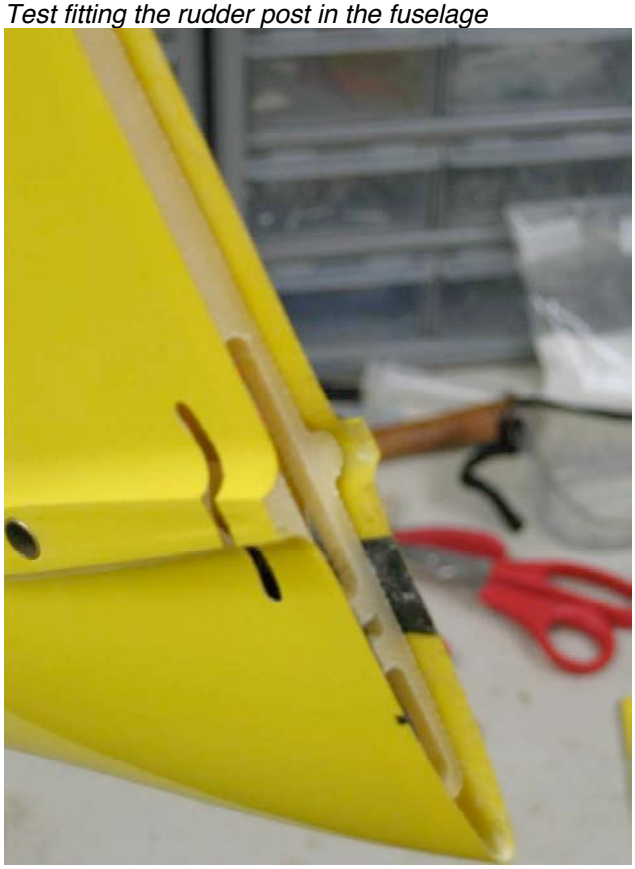
Plywood bellcrank reinforcement plates installed



16. **Rudder Installation:** Once the elevator bellcrank is installed, test fit the rudder post in the fuselage. If necessary, use sandpaper to smooth the edges of the rudder post to fit the fuselage closely.

Note: When test fitting and sanding the rudder post, care must be taken that the rudder post doesn't slightly deform the stabilizer root fairings. It is almost always the case and it creates friction between the elevators and the fin behind the "smile" shaped cuts.

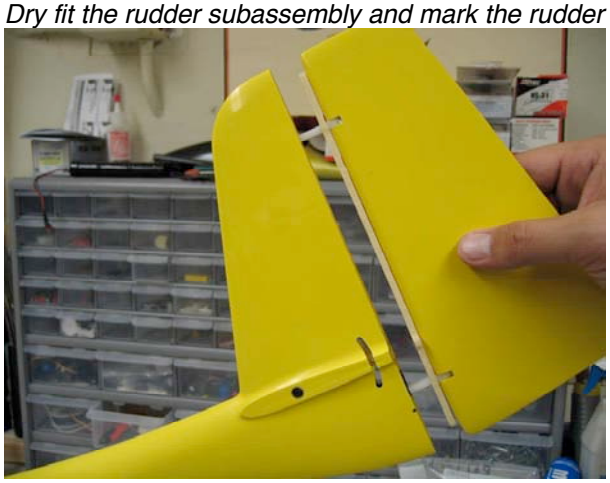
Test fitting the rudder post in the fuselage



17. Dry-fit the rudder post on the rudder hinge pins and test fit the rudder subassembly in the fuselage. Mark the rudder control horn location using the marks made previously when installing the rudder pull-pull cables.

    Note: You may need to sand down the top rudder hinge pin so it will fit the rudder post. Be careful not to damage the rudder post when dry fitting the rudder.

    Dry fit the rudder subassembly and mark the rudder control horn location



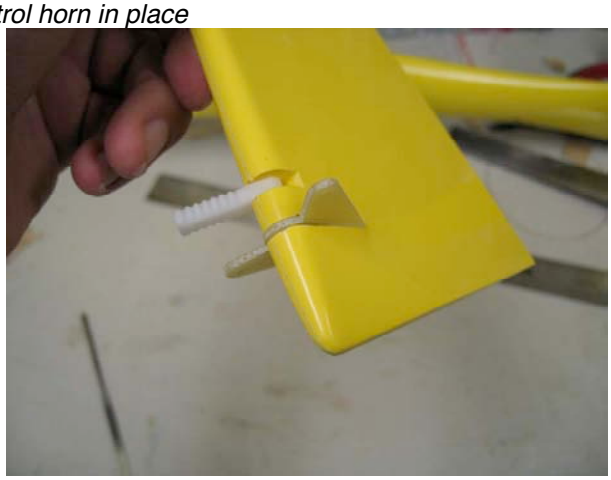

18. Using a razor saw or Dremel cutoff wheel, cut a slot in the rudder to capture the rudder control horn.

    Note: The rudder only needs to be slotted about 1/2 the depth of the rudder control horn – the "legs" of the horn are meant to be bonded on the outside of the rudder skin.

    Measure and then cut a slot for the rudder control horn in the rudder


19. When satisfied with the fit of the control horn (make sure both holes in the control horn are equidistant from the center of the hinge), glue it into the rudder using thin CA or epoxy.

Use a flat file to clean up the slot, then glue the control horn in place

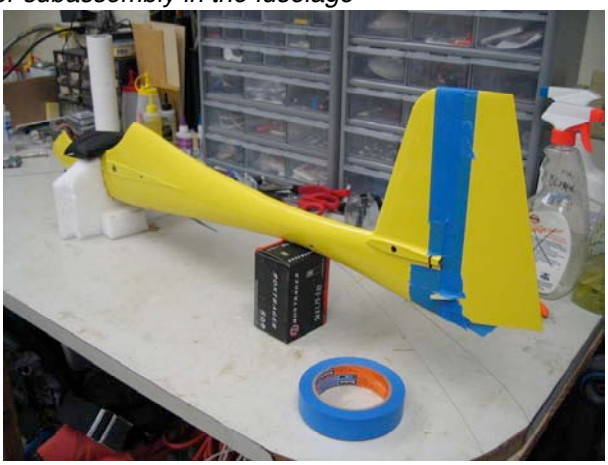
20. Glue the rudder post to the rudder using Goop, epoxy or CA. Then install the rudder subassembly in the fuselage using Goop, epoxy or CA.

Tip #1: Tape off the face of the rudder to avoid getting glue in the rudder hinges or on the rudder itself.

Tip #2: *(from Francois)* I recommend gluing the rudder post first inside the fin. The positioning is not extremely critical. When the glue has set, I glue the hinges inside the rudder post slots and by moving the rudder full deflection on each side of the fin, I make sure the hinges slide at the correct location before the glue sets so that full movement is available. I then tape the fin at neutral position while the glue sets.

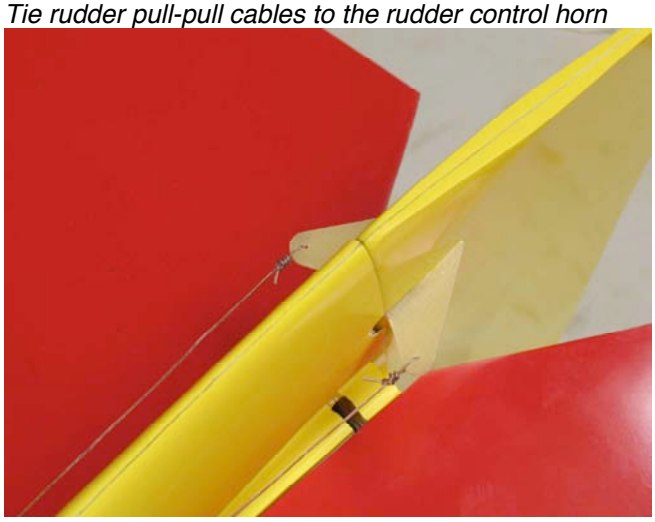
This method helps you position the hinge line where it needs to be to allow full deflection of the rudder but it also prevents damage to the very brittle rudder post. If the rudder post is already glued inside the fin when fitting the hinges, the fin skins will prevent it from splitting while if you work on the rudder post itself you are almost certain to brake the upper slot that has very little material left and thus very little strength.

Tape off the face of the rudder, then install the rudder subassembly in the fuselage

21. Connect the pull-pull cables to the rudder control horn using a knot of your choice.

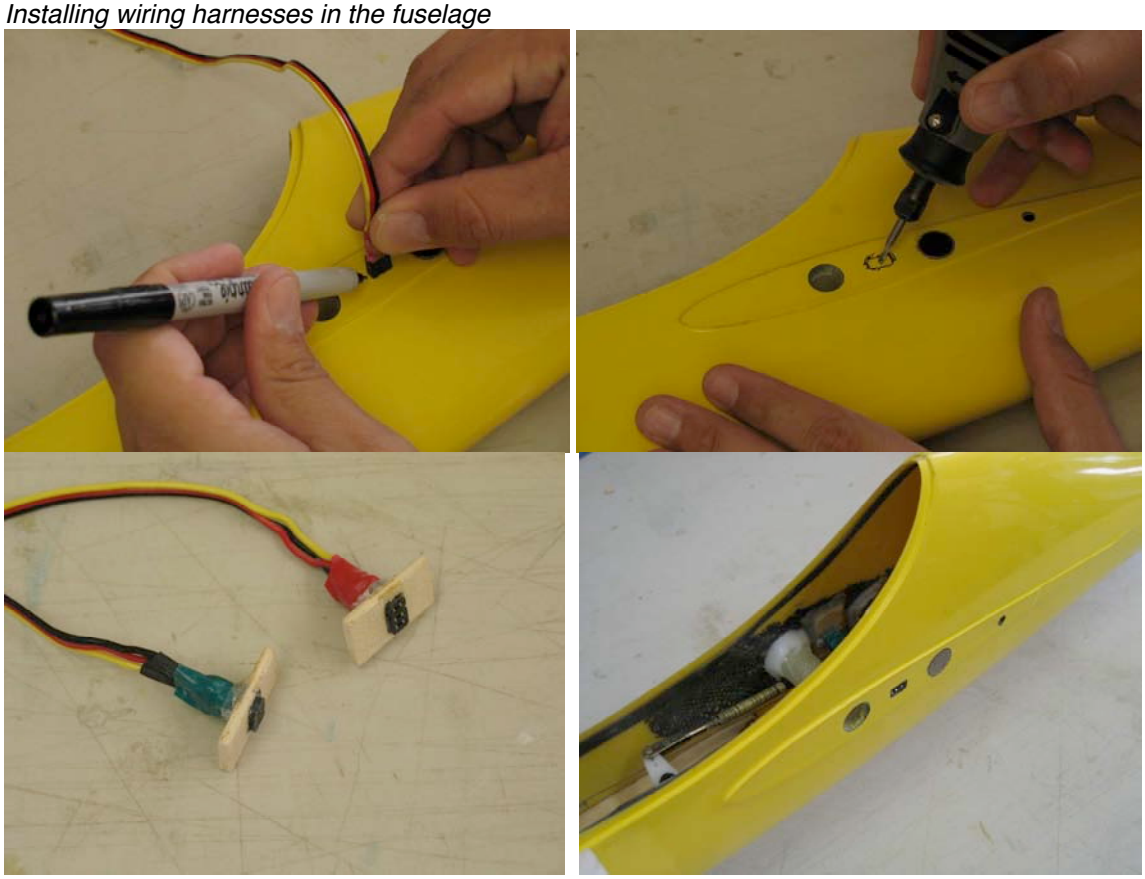
Tie rudder pull-pull cables to the rudder control horn



Part II – The Wings

22. Assemble and install the wiring harnesses for your wing servos following the method of your choice. I used Deans 3 pin connectors, but there are many options.

Installing wiring harnesses in the fuselage

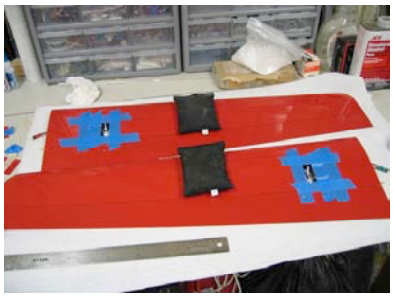


23. Assemble and install the wing retention method of your choice. I use rare earth magnets for wing retention, but as with wiring harnesses there are many options and preferences. For complete details on how to perform the rare earth magnet installation, see the build thread on RCGroups: http://www.rcgroups.com/forums/showthread.php?t=710774&page=17

24. Install the wing servos following the method of your choice. I used 5 minute epoxy mixed with microballoons "spooge" to install mine, after wrapping the servos with electrical tape and lightly sanding the inside of the wing. *Make sure to center your servos and attach servo arms before you install them!*

Wing Servo Installation

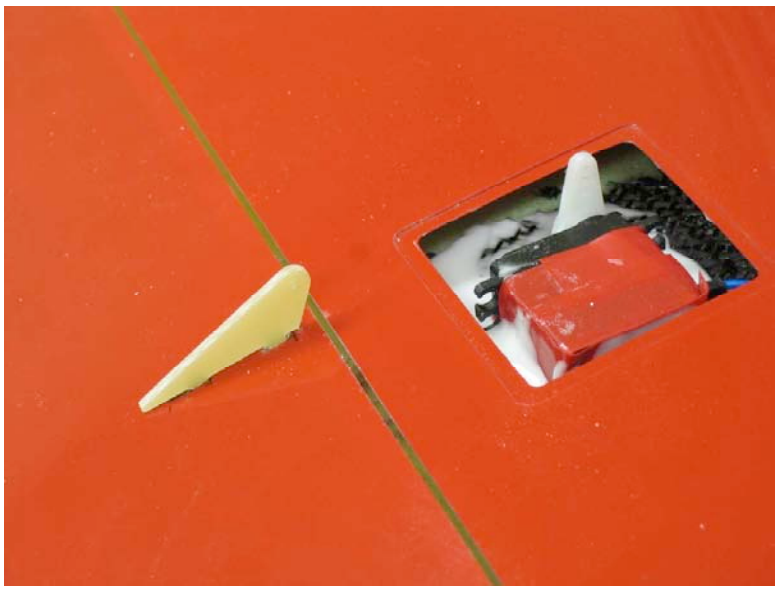




25. Locate and install the flaperon control horns using thick CA, epoxy or Goop. Note that it is very important to get the pivot hole in the horn as close to centered over the hinge line as possible. However, do not position the horn so far forward that you have to slot the wing skin to allow full flaperon movement. Those two constraints should help position the horn relative to the hinge line.

Flaperon control horn installation



26. Build the flaperon pushrods from threaded rod and 2-56 clevises.

27. Carefully drill out the holes in the flaperon control horns to accept your clevises.

Drill out the control horns to accept the clevises

28. Connect the flaperon pushrods between servo and control horn.

29. Install your receiver and battery pack in the fuselage if you have not already done so, then fully assemble and **balance the plane with the center of gravity measured at 88mm from the leading edge of the wing as measured at the wing root.**

30. Setup the control surface throws as shown below. Exponential is used to make the controls softer around center.

Decalage: 0* (wing & stab at exact same angle of attack relative to fuse)

Elevator
Low rate: +/- 10mm
High rate: +/- 15mm
Expo: -30%

Rudder
Single rate: +/- 50mm
Expo: -80%

Flaperons
Aileron low rate: +/- 15mm
Aileron high rate: +/- 20mm
Aileron expo: -60%

Snapflap
Elevator low rate: +/- 5mm
Elevator high rate: +/- 12mm

Camber/Reflex (on left stick for landing / 4-axis): +/- 30mm

Wasabi Setup & Flight Tips by Francois Lorrain

Setting up Camber:

* Best acceleration camber is 0°
* Best lift to drag camber is 4°
* Best sink rate camber is 8°

In general, a pilot will transit at a higher speed then best lift to drag speed which means for an efficient transition he will need less camber. The same is true for low sink speed. So if you have to chose fixed camber settings, I'd chose something like 3mm for cruise and 6mm for slow speed or slermalling. If you chose to use the camber on your throttle stick, you could have 0° with forward stick and +8° with aft throttle stick.

When launching the plane into the breeze for the first time, make sure you have at least 2 to 4° of camber.

For landing, the flaps may be lowered down by 30°. The aileron horns have actually be sized so that they will allow +-30° deflection just for this purpose.

The flaps down at 30°, the Wasabi will land easily at your feet even with gale winds. In order to retain good roll control, you'll need to program a virtual dual rate switch with your landing flap setting so that aileron throws goes to max when the flaps go beyond 20°

Snapflaps

Then you have to consider snapflap setting and that makes things a bit more complicated because the idea is to never exceed 8° of camber in order to avoid creating drag while not improving lift.

The Wasabi likes snapflaps but if you've followed me from the start the ideal snapflap curve would be to have +-8° when general camber is at Zero and +-0° when general camber is 8°. So if you can create a snapflap curve in your transmitter then it could be interesting to play with it along these guidelines. I personally haven't played with a snapflap curve but I've chosen to have snapflap mix on a switch so I can remove it when I cruise with a lot of camber or for some snap rolled and stalled stunts. Therefore I have the snap setting at +-5°. A lot of care must be taken that your flaps go down by the exact same amount otherwise your loops will twist.

Center of Gravity

The CG for the first flight should be set at 88mm and then tuned to your taste.
With 88mm the Wasabi will need just a _very_ light forward pressure to fly level inverted.

Rudder

Rudder deflection needs to be set as high as possible and the use of a fast servo is preferred. You will notice that for some reason the rudder has a bit less authority then the Voltij rudder.

Slowing for Landing

Don't forget to explore the low speed limit with some camber (6mm-->8mm) and you'll be surprised. This will also help you to free your mind about the landing and avoid landing too fast.

I've noticed that most pilots are reluctant to slow the Wasabi and they tend to land much too fast. You have to force yourself to slow it down much beyond what you feel you should.

Also in strong winds, don't hesitate to drop the flaps all the way down to 30° (you have to mix an auto revert to high throws beyond 15° of Flaps) and this will allow you to parachute with zero ground speed. I think it is likely that you wouldn't damage the plane even when landing in rocky slopes if you use this high drag low speed configuration.