DuskStik Builder's Manual

Thank you for purchasing the DuskStik. The DuskStik has been designed to be easy to build, easy to fly, and strong enough to withstand the abuse of a beginner pilot. The plans have been written for the first time builder. Take your time and enjoy building this plane. It is a great, well-behaved flyer. I have had many wonderful hours flying it and hope you will too.

Doug

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Required Equipment

To build:

- Xacto with #11 blades
- Thin and Thick CA – Cyanoacrylate glue (Super Glue)
- Sanding block with 200 grit sandpaper
- Smooth, flat work table
- Wax paper to protect plans
- Needle nose pliers
- Wire cutters
- Hobby Iron for applying covering – also called a sealing iron

To fly:

- Three channel radio (The FMA Extreme 5 is highly recommended, second is the GWS-R4P micro receiver. The Hitec Feather with the Laser 4 transmitter provides a low cost solution for a first time radio, however, the Feather receiver has a reputation for glitching easily. In my opinion, if you can afford it, you are much better off starting with a good radio such as the Hitec Flash 5 G with HS55 servos substituted for the HS80s that normally come with it.)
- Two micro servos: Hitec HS50s, HS55s, or GWS Pico servos recommended
- GWS A motor with 1047 propeller
- Motor Speed Control: GWS ICS50 or GS100 suggested
- Battery pack: 7 cell 300mAH Nickel Metal Hydride recommended.

Parts List

1 ea – 1/32” laser cut balsa spar webbing sheet
1 ea – 3/32” laser cut balsa sheet
1 ea – 1/16” laser cut balsa rib sheet
1 ea – 1/32” laser cut plywood sheet
4 ea – 1/8”x1/4”x36” balsa spars
2 ea – 1/8”x36” hardwood dowel leading edge
1 ea – 1/16”x3/4”x5” plywood battery holder
4 ea – 3/16”x5/16”x2 ¾” balsa breakaway motor mount (3 spares)
1 ea – .085”x3/8”x2 1/8” solid wood servo mount spacer
1 ea – 1/4" carbon fiber fuselage tube
2 ea – .050” carbon fiber pushrods
2 ea – 1/4"x7” carbon fiber spar reinforcement tape
1 ea – 1/16” landing gear wire
1 ea – 14” thin music wire for tail skid and pushrod ends
1 ea – Heat shrink tubing for pushrods and wheel retainers
1 ea – Velcro strip for mounting the battery
1 ea – Kevlar thread for attaching landing gear and skid to fuselage
1 ea – Wire tie pushrod retainer
1 ea – Tire Rubber
2 ea – 1/2” long aluminum tube wheel axle bearings
1 ea – Roll of covering material

Notes and Hints

- The plywood built up parts should be assembled with thick CA or white glue. Thin CA sets up too fast to allow you to align the parts.
- The DuskStik has been designed with weight in mind. Parts and reinforcements were chosen so as to keep the plane light. Special care must be taken when making glue joints to ensure that the DuskStik can survive rough landings.
- There is very little that is critical when building the DuskStik. The only thing that requires special attention is to make sure the wings are not twisted. If the wings are straight, the DuskStik should fly hands-off without any trim.
- Heat shrink can be heated with a hairdryer, a soldering iron, or, if you dare, with a lighter. Pay close attention to what is near the heat shrink when you are heating it.
- You really need the sealing iron. You will find putting on the covering so much easier. They are reasonably inexpensive and invaluable

DuskStik Assembly

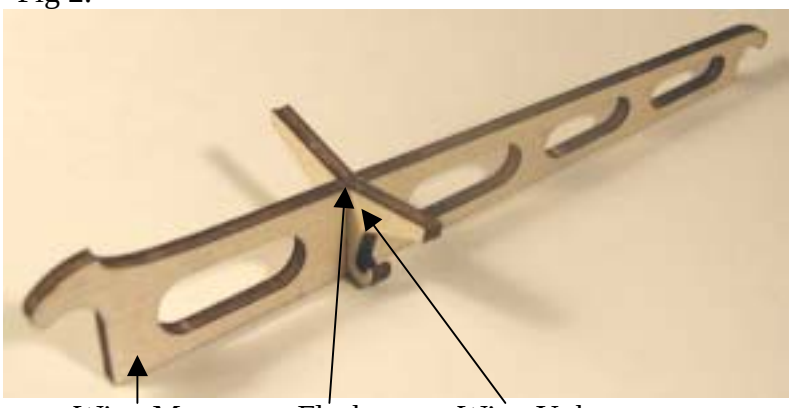
Motor Mount, Wing Mount, Wheel, and Servo Mount Assembly

1. Break apart all plywood parts, set control horns aside.
2. Glue two motor mounts together with thick CA.

Fig 1.

3. Cut out wing mount and wing yoke from 3/32” balsa.
4. Sandwich balsa wing mount with plywood wing mounts (plywood-balsa-plywood), glue with thick CA or white glue. Do the same for the wing yoke.
5. Slide the yoke into the mount, insuring that the yoke is flush with the top of the mount. Glue with thick CA.

Fig 2.



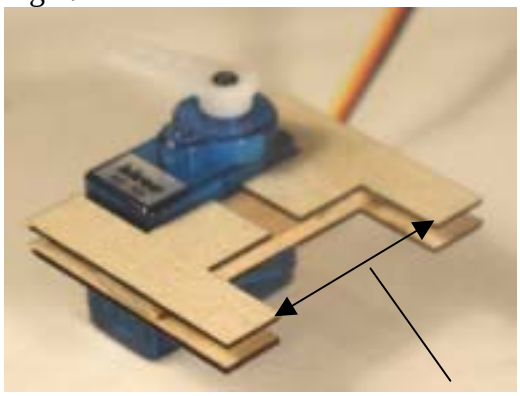
6. Build wheels the same as in step 3, i.e., sandwich plywood-balsa-plywood. In this case it is plywood hub, balsa hub, plywood wheel, balsa wheel, plywood wheel, balsa hub, plywood hub. Slide the parts over the aluminum tube and get everything aligned. The smaller round punch-out with the axle hole is the wheel hub. Flow thin CA over the wheel to glue it taking care to not get CA in the aluminum tube.

Fig 3.

Wrap the tire rubber around your wheel to measure it and cut it 1/16" too short. Glue the ends together with CA. You now have a ring. Slip the ring over the wheel, center it then glue it to the wheel with thin CA.

7. Using four plywood servo mounts and solid wood servo mount spacer, glue up servo mount with thick CA. Spacing is determined by the servos you use. The servo should fit snug but not tight. Trim excess solid wood.

Fig 4.

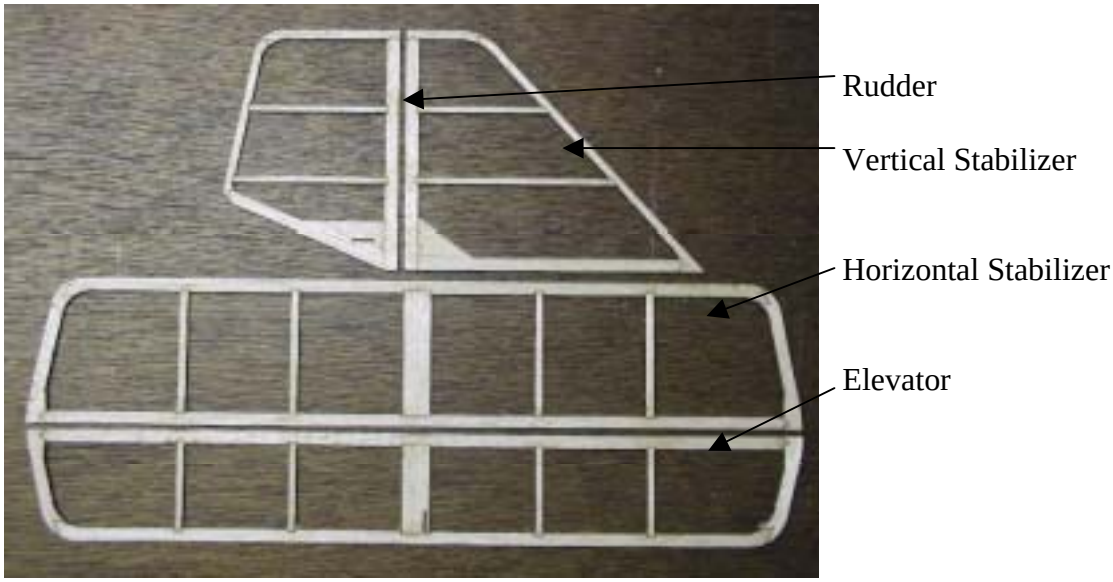


Spacing determined by servos.

Vertical Stabilizer, Rudder, Horizontal Stabilizer, and Elevator Assembly

The tail assemblies are made up from parts found on the 3/32" balsa laser cut sheet. The plans are laid out on a flat worktable and taped down, and then a sheet of wax paper is laid over the plans. This will protect the plans from the glue. The pieces of balsa are positioned over the plans. Each joint can be glued by holding the two pieces in place and applying a drop of thin CA to the joint. In the past, you may have used pins to hold parts down, but I find this process to be faster and you don't have to worry about the pin damaging the 1/8" balsa. You do have to worry about keeping your fingers far enough away from the joints or your fingers will become part of the model.

Fig 5.



1. Tape plans for vertical stabilizer and rudder to a flat building surface, and cover with wax paper.
2. Using the drawing as a guide, glue with thin CA the vertical stabilizer and rudder. When dry, remove from wax paper and reinforce joints with thick CA. Set aside.
3. Using the drawing as a guide, glue with thin CA the horizontal stabilizer and elevator. When dry, remove from wax paper and reinforce joints with thick CA. Set aside.

Wing Assembly

Note: The wing can be built as a dihedral or polydihedral, standard 42" or extended 50" wing. There are two extra ribs on the 3/32" balsa sheet for the extended wing. The standard wing is a good, all around wing, which can handle small amounts of wind. The extended wing is more suited for thermal chasing and slower flight but will be more susceptible to gusts. The polydihedral wing is an excellent wing for beginners. It is very stable and handles slow flight exceptionally well. The dihedral wing will loop better and is more fun at higher speeds.

Building the extended wing involves adding an additional rib to the end of each wing and moving the polydihedral break out one rib.

1. If you are not building the extended wing, cut off the extra length of the trailing edge. Cut outside the notch (keep the notch).

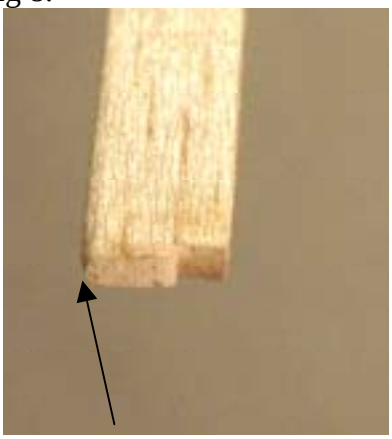
Fig 6.

If you are building the extended wing, glue the trailing edge extensions on to the trailing edge pieces with thick CA. Why didn't I just make the trailing edge 25"? The laser cutter will only cut up to 24"!

Fig 7.

2. Sand the rear edge of the trailing edge to make it rounded.

Fig 8.



Back of Trailing Edge rounded

3. Remove ribs from 1/16” balsa sheet. Stack up the ribs and lightly sand the edges to remove the little nubs that held the ribs in the sheet.
4. Tape the wing plans down on a flat building surface and cover the wing half you are building with a sheet of wax paper to keep the glue off the plans.

Polydihedral Wing Assembly (To build Dihedral Wing, go to step 26)

Note: R1 through R8 indicate rib 1 through rib 8.

Build center wing section

Fig 9.

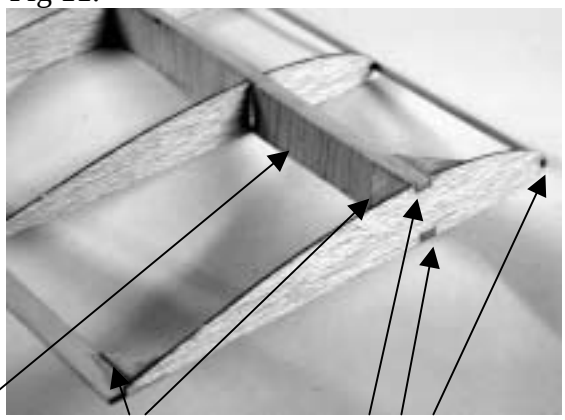
5. Cut trailing edge and lower spar (1/8”x1/4”) at the polydihedral break as marked on the plans. This is 14 inches out, or 17.5 inches out for the extended wing. Cut outside the notch on the trailing edge.
6. Position trailing edge and lower spar over plans.
7. Position ribs R2 – R4 (R2 - R5 for extended wing) on lower spar and trailing edge. Note that you are not gluing the end ribs on now, just the middle ribs.
8. When everything is aligned, glue ribs in place with thin CA.
9. Use rib gauge as shown to angle R1 inward. This creates the proper wing angle between the center wings.

Fig 10.

10. Use rib gauge to angle R5 inward (R6 for extended wing) inward.
11. Position top spar (1/8”x1/4”) across R1 – R5 (R6 for extended wing), mark length, cut, and glue with thin CA. Cut the spar so that the cut matches the angle of the ribs.
12. Position 1/8” leading edge dowel from R1 – R5 (R6 for extended wing), mark, cut, and glue with thick CA. The 1/8” dowel commonly has some warp to it. It is not necessary to remove the warp but it is a good idea to orient the bow horizontally, not vertically
13. Cut to length and glue with thin CA the 4ea 1/32” balsa spar webbing between R1 and R5.

14. Glue the eight ¾" triangle braces in place with thick CA.

Fig 11.



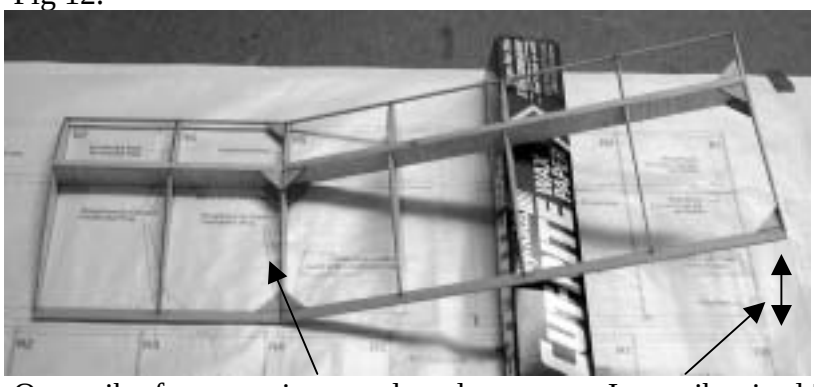
15. Sand the ends of the leading edge, trailing edge, and two spars so that they are flush with ribs.

Build outer wing section

We will build the outer wing directly onto the center wing to ensure a good fit between the two. The outer edge of the center wing will be held down with tape to hold it in position, and the inner edge of the center wing will be lifted to form the correct angle between the center and outer edge. See Fig 13.

16. Tape R5 (R6 for extended wing) to wax paper over plans.
17. Lift R1 until it is 5" high, measured from the bottom of the rib.. This will set the proper dihedral angle for the outside wing (for the extended wing, measure 5" from R2).
18. Sand outer-lower spar until it mates with center wing section lower spar. Cut to length.
19. Sand outer-trailing edge to mate.
20. Position trailing edge and lower spar over plans.
21. Position R6 and R7 (R7 and R8 extended) over spar and trailing edge and glue with thin CA.
22. Position top spar (1/8"x1/4"), mark length, cut, and glue with thin CA. Cut the spar so that the cut matches the angle of the other spar so that they meet flush.
23. Position 1/8" leading edge dowel, mark, cut, and glue with thick CA. You should sand the dowel so that it is flush with the inner leading edge dowel.
24. Cut to length and glue with thin CA the remaining 1/32" balsa spar webbing. On the extended wing, the last rib bay does not get spar webbing.
25. Add the four ¾" triangle braces.
26. Make other half of wing following the previous steps.
27. Go to "Completing the wing".

Fig 12.



Dihedral Wing Assembly

28. Cut trailing edge and lower spar (1/8”x1/4”) to length as marked on the plans. This is 21 inches out, or 25 inches out for the extended wing. Cut outside the notch on the trailing edge. The extended wing trailing edge is already the correct length.
29. Position trailing edge and lower spar over plans.
30. Position ribs R2 – R7 (R2 – R8 for extended wing) on lower spar and trailing edge. Note that you are not gluing the center rib (R1) on now.
31. When everything is aligned, glue ribs in place with thin CA.
32. Use rib gauge as shown to angle R1 inward. This creates the proper wing angle between the center wings. (Fig 10)
33. Position top spar (1/8”x1/4”) across R1 – R7 (R8 for extended wing), mark length, cut, and glue with thin CA. Cut the spar so that the cut matches the angle of the center rib.
34. Position 1/8” leading edge dowel from R1 – R7 (R8 for extended wing), mark, cut, and glue with thick CA. The 1/8” dowel commonly has some warp to it. It is not necessary to remove the warp but it is a good idea to orient the bow horizontally, not vertically
35. Cut to length and glue with thin CA the 6 1/32” balsa spar webbing between R1 and R5. (Fig.11)
36. Glue the five ¾” triangle braces in place with thick CA
37. Sand the ends of the leading edge, trailing edge, and spars so that they are flush with ribs. (Fig 11)
38. Make other half of wing following the previous steps.

Completing the wing

39. Glue wing halves together using thick CA. Rather than concern yourself with the angle of the two halves, ensure that the halves meet flush and that you have a good glue bond.
40. Glue the 7” strips of carbon fiber tape to the top and bottom spars where they join using thin CA. The CA must flow under the entire length of the carbon tape. Use wax paper to hold tape down.

Fig 13.

41. To prevent the outer ribs from bowing in when you cover the wings, glue a piece of 1/8” x 1/4" balsa from the trailing edge to the spar webbing and another from the spar webbing to the leading edge.

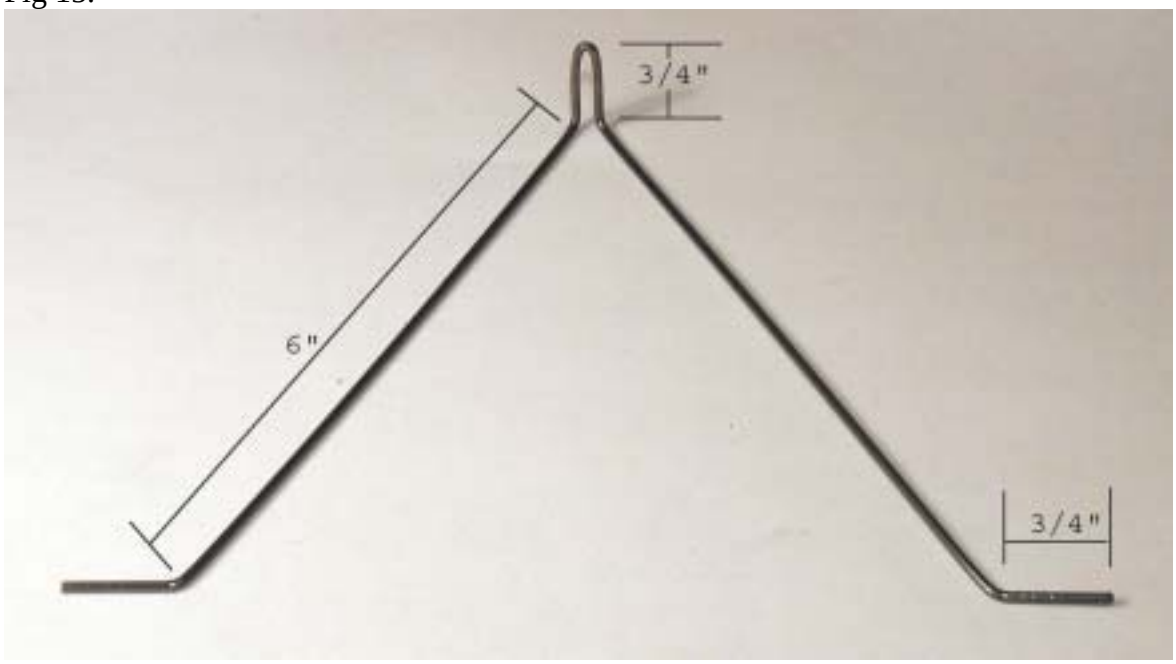
Fig 14

42. Set aside for covering later.

Fuselage Assembly

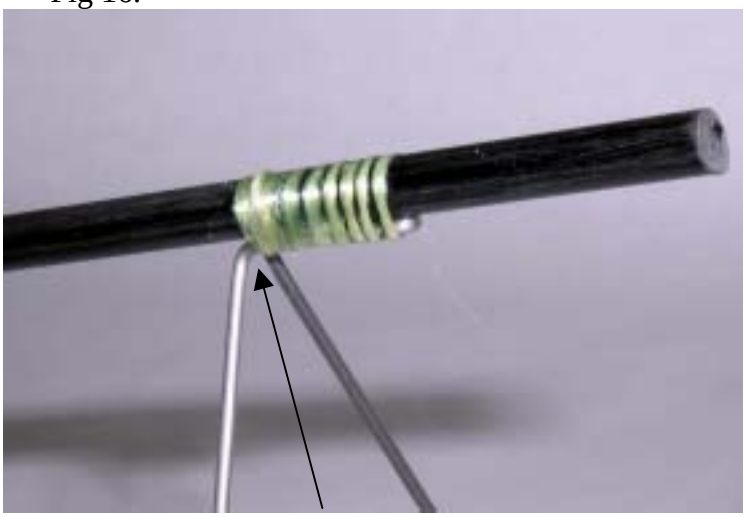
1. Lightly sand the carbon fiber fuselage tube to remove any coating so that the CA will stick to it better.
2. Bend the 1/16” music wire landing gear as follows:
   2a. Bend the 1/16” music wire in half.
   2b. Measure back ¾” from bend and make the second 90 deg bends, angling out slightly from each other.
   2c. Create the final bend for the wheels 6” from previous bend insuring that the legs are the same length.

   Fig 15.



3. Attach landing gear 2” back from end of the carbon fiber tube. Wrap the gear and fuselage with Kevlar thread then apply a few drops of thin CA till the threads are soaked. Save some thread for the tail skid.

Fig 16.



Two inches back from front of fuselage tube.

4. Glue motor mount to top of fuselage with thick CA. The motor mount should be flat on the fuselage and level with the work surface, side to side, when the landing gear is resting on the work surface.

Fig 17.

5. Glue wing mount to fuselage with thick CA. Front of wing mount is 3.75” from front of fuselage measured from where the wing mount touches the fuselage. The wing mount should be perpendicular to the work surface when the landing gear is resting on the work surface.

Fig 18.

6. Glue the servo mount to bottom of the fuselage with thick CA. The back of servo mount is 1” forward of back of wing mount. The servo mount should be parallel to the work surface when the landing gear is resting on the work surface.

Fig 19.

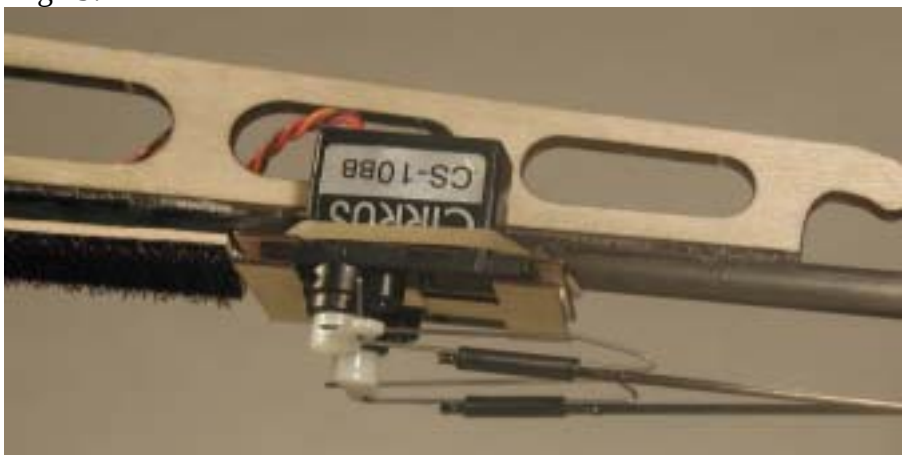
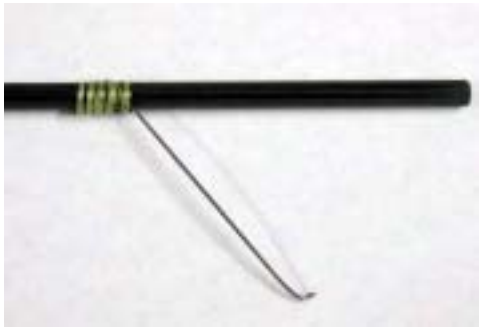


Photo shows underside of fuselage. Note rubber band holding servos in place.

7. Bend the tail skid out of a 3½" piece of the thin music wire using the plans as a guide. Note that you start by bending the wire back on itself to form a ½" long loop. Attach the tail skid to the fuselage 3" from back of fuselage. Wrap with Kevlar thread and glue with thin CA.

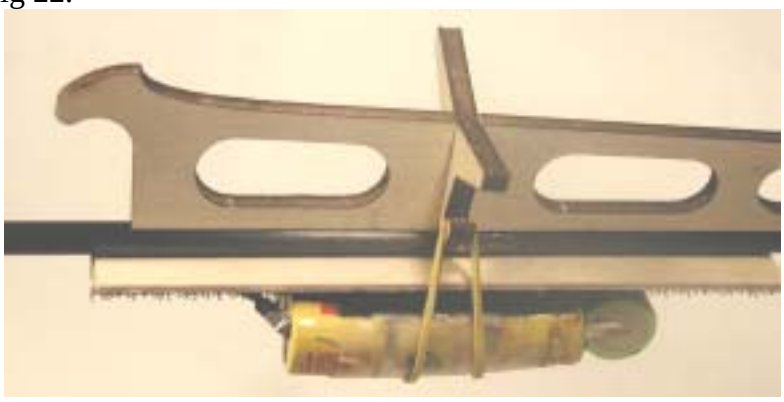
Fig 20.

Fig 21.



8. Glue the 5"x3/4"x1/16" plywood battery holder under wing mount with thick CA.
9. Attach Velcro to the plywood battery holder.

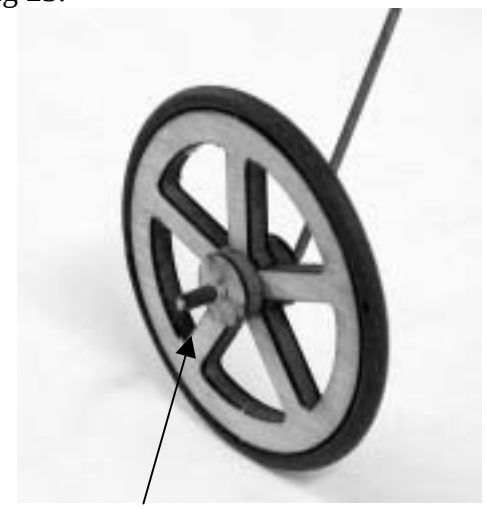
Fig 22.



Battery mount showing rubber band backup.

10. Slide wheels over axle and retain with 3/16" long heat shrink tubing. Heat the tubing then set with a drop of thin CA, taking care to not get any CA on the wheels.

Fig 23.



Heat Shrink Wheel Retainer

Covering The Tail

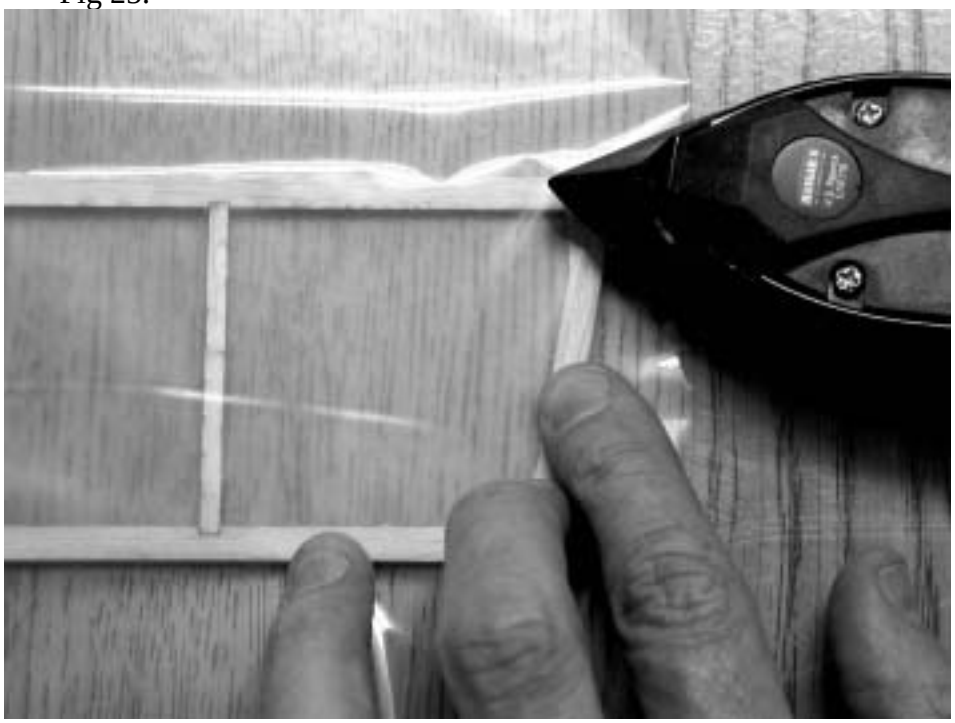
1. Sand the vertical stabilizer, horizontal stabilizer, rudder, and elevator smooth and round edges (except bottom of vertical stabilizer where it will be glued to the fuselage).
2. Sand bevel between vertical stabilizer and rudder, and horizontal stabilizer and elevator.

Fig 24.

3. On a flat table, lay a sheet of covering over the surface being covered leaving at least an inch around all edges. The glossy side of the wrap should be away from the surface being covered. The frosted side contains a heat activated adhesive.

4. With a hobby iron, tack the corners down (after tacking the first corner down, make sure the wrap stays snug while tacking the other corners down).

Fig 25.

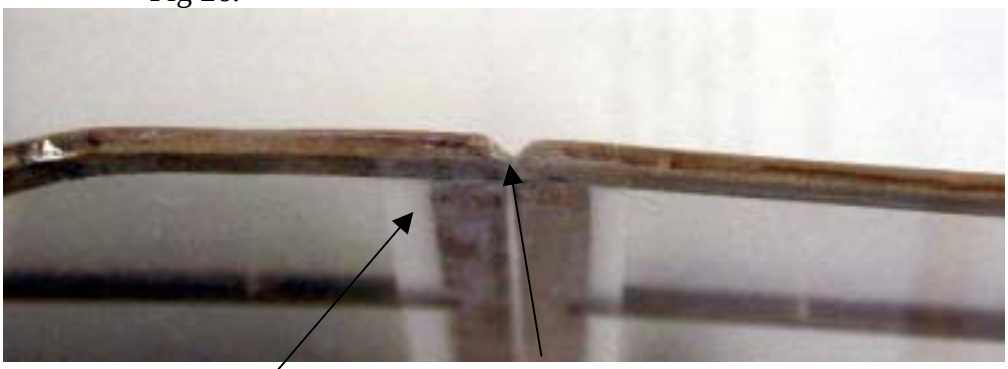


Note: Do not put wrap on bottom of vertical stabilizer. This area will be glued to fuselage.

5. Slide the iron along all edges to glue the covering down.

6. Flip the surface over so that the covering is under the surface and trim the wrap with NEW Xacto blade leaving 1/8" excess.
7. Tack the excess wrap down with the hobby iron.
8. Cover the other side the same way.
9. Once both sides have been covered, tighten the covering by passing the iron over the middle of the covering. Go slowly and try not to over-shrink the covering.
10. Check for warps induced by the covering being shrunk. If a surface is warped, heat the covering while gently bending the surface the opposite direction from the warp.
11. Once all the tail surfaces are covered, we will apply the hinges. I have had excellent results using Scotch Tape as a hinge. Position the two surfaces being hinged so that there is a slight gap (~.010") between them, bevels facing down. Apply the scotch tape to the top side only, being careful to maintain the gap between the surfaces. Ensure the control surfaces move freely.

Fig 26.



12. Cut slots for control horns as per the drawing and glue control horns in place with thick CA.
13. You can now apply a light misting of paint if you like. Take care to not use too much paint. Paint is quite heavy.
14. Carefully remove a 1/8" wide strip of covering off the top of the horizontal stabilizer so that the glue will adhere to the balsa, not the covering. Glue the stabilizer to fuselage using thick CA. The horizontal stabilizer should be parallel to the work surface when the landing gear is resting on the work surface.
15. Glue the vertical stabilizer to the top of the fuselage tube using thick CA. The vertical stabilizer should be perpendicular to the horizontal stabilizer.

Fig 27.

Coffee cup not included in kit

Wing Covering

1. Lightly sand the trailing edge, end ribs, the rib at the polydihedral break if applicable, and the center ribs.
2. We will cover one section at a time so if you built the dihedral wing, you will have a total of four sections – two top and two bottom. When you are covering a section that is adjacent to a section that has already been covered, allow the covering to overlap the other section around 1/8" to give the new covering something to adhere to.
3. Lay the wing on your workbench right side up.
4. Cut off a sheet of covering for the area you are about to cover.
5. Tack down the covering at the four corners then work along the width, tacking the edges down. Work along the leading and trailing edge pulling the wrap snug as you tack it in place.

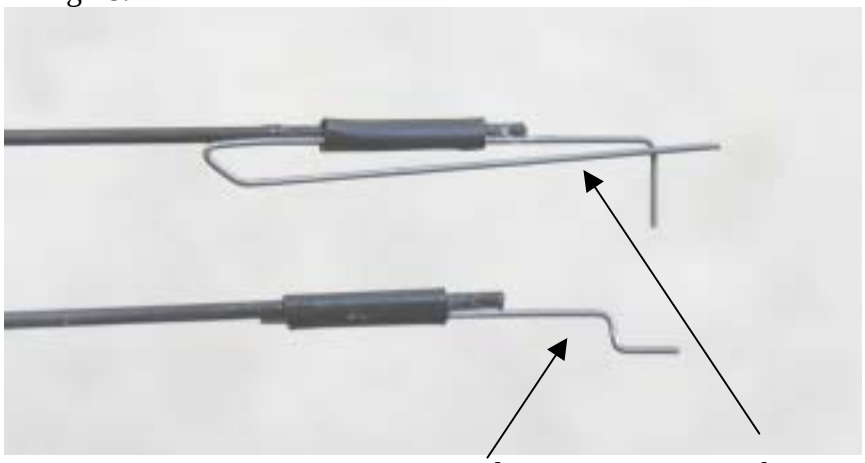
Note: At the polydihedral breaks and at the center of the wing, the wrap will be trying to pull up and away from the ribs so be sure to do a good job adhering them.

6. Cover all the sections before shrinking the covering.
7. When the covering is all glued down, pass the iron over the covering to shrink it. Go slowly to reduce the amount of warp.
8. Once the covering is reasonably tight, check for warps and remove them by gently twisting the wing opposite the direction of the warp while heating the covering.
9. When the wing is straight you can apply a light misting of paint if you like. Again, take care to not apply too much paint to keep the weight down.

Final Assembly

1. Make up the pushrod assemblies by bending the thin piano wire according to the plans. You will need two Z bends and two locking L bends. Slip a piece of ½" long heat shrink tubing over the locking L shaped wire before bending. When the ends are made, attach them to the carbon fiber pushrods with the heat shrink tubing. Carefully heat the tubing to shrink it over the pushrod.

Fig 28.



2. Insert two servos into the servo mounts and ensure that the control arms are centered. Wrap a rubber band or two around the servos to retain them. See fig. 19. Insert the Z ends of the pushrods into the tail control horns and the locking L bends into the servo control arms. Use the center holes in all control arms. Adjust the length of the push rods by sliding the wire in or out of the pushrods until the tail control surfaces are even. Carefully secure the wires in position with a

drop of thin CA. Ensure that the locking arm is in place – opposite the L bend. See fig 19. You can choose to pull the pushrods in to the fuselage using the black wire tie. Adjust the length of the pushrods after pulling them in to the fuselage and don't tighten the wire tie to the point where the pushrods bind against the fuselage. The rudder travel should be around 2 ¾" to 3" and the elevator should be 1 ½" to 1 ¾".

Fig 29.

3. Rubber band a 3/16"x5/16" breakaway stick to the motor mount leaving 1 ¼" in front of the mount. Use at least two rubber bands. Slide the GWS motor over the breakaway stick. If it isn't a tight fit, you will shortly have a glider. The breakaway stick has been designed to break before the motor does in the event of a hard landing. Carry extra breakaway sticks with you when you fly.

Fig 30.

4. Install receiver and speed control. The receiver is velcroed directly in front of the servos on to the battery mount and the speed controller is light enough to be suspended by its wires. Wire the speed control and servos to the receiver. Rudder servo goes to channel one, elevator servo to channel two, and speed control to channel three. Run the receiver antenna up and over the top of the vertical stabilizer.

Flying

Attach the wing to the wing mount with around 5 rubber bands. Check that none of the control surfaces are binding and that everything, including the battery, is secure.

Before you fly the DuskStik, check that the control surfaces move the correct directions. Always check the directions while you are behind the airplane. I highly recommend that you check the control surfaces before EVERY takeoff. I know for a fact that the DuskStik flies fairly well without elevator control from when I accidentally knocked off the control rod and failed to notice it.

The center of gravity (CG) should be directly under to ¼" behind the wing spar. With the battery installed, place a finger on each side of the fuselage just behind the spar and lift the DuskStik. It should balance there. If not, adjust the battery forward or backwards till the CG is correct.

You may want to shim that back of the balsa motor mount to give the motor some down thrust and twist the motor sideways to give it some right thrust.

Adjust your radio trim so that the rudder is straight back and the elevator is level.

For your first flight, be patient and wait for a calm day. Choose a large field where you have a smooth surface to use as a runway. Set the plane down pointing away from you. I would say to point it into the wind but it's a calm day, right? If everything goes well, applying full power will result in a short rollout and a rapid climb with little to no need to trim the plane. Initiate turns slowly till you get used to the way the DuskStik flies. I hope you have as much fun flying your DuskStik as I have flying mine.