'Cuda ™
Rocket Glider

Assembly and Operation Manual

Kevin McKiou

Vectoraero, Inc.

6 South 211 Cohasset Road.

Naperville, Illinois 60540-3536

U.S.A.

1 630 717 5830

kmckiou@aol.com

Thank you for purchasing the 'Cuda Rocket Glider

We appreciate your business, and want you to know we are here to answer any questions you may have concerning this product. Please read the instructions in this manual carefully to insure the best possible result.

Warning!

The 'Cuda and the rocket motors that are used in it are not toys! The 'Cuda is a high performance radio controlled rocket glider designed for experienced pilots.

You are responsible for building it correctly, install your radio gear with care and fly it in accordance with safety codes established by the Academy of Model Aeronautics [3] (AMA). If this model is not built and flown correctly or misused it can cause bodily harm and property damage. We strongly suggest you join the AMA and maintain adequate liability insurance to protect you in the event of a mishap. If you need technical assistance in building this model, you may contact us at your expense at the telephone number and e-mail address on the first page of this manual.

We have exercised reasonable care in the design and manufacture of this product. However, once sold, it is your responsibility to assure careful storage, handling, transportation, building and flying. We will not assume any liability or be held responsible for any property damage or personal injury resulting from your use of this product. You assume all risks and liabilities for the building and use of this product and accept this product on that basis. If you do not accept it on that basis, return it immediately.

No warranty is made regarding this product except for repair or replacement in the event there is a defect due to manufacture.

Congratulations! You have purchased the highest performance S8E[1]/S8D Radio Controlled Rocket Glider (RCRG) kit in the world. The 'Cuda is the result of years of competition flying and hundreds of hours of computer simulation and airfoil analysis. It is designed for S8E competition but is also very pleasurable to sport fly. If you have never flown a high performance RCRG you are in for a treat. An E6 rocket motor will take this model from ground level to approximately 1000 feet in about 10 seconds.

This model is **not** intended for an inexperienced pilot. Boost speeds will reach 100 m.p.h. at the limits of visibility. You can quickly lose control if you lose orientation. In addition, a model this small flying at altitudes greater than 1000 feet can quickly disappear. But, don't worry; if you are experienced enough to feel comfortable flying a typical glider at any orientation you will do fine. Boost is quite easy with a D7 rocket motor and flying at altitudes under 500 feet is no problem.

You don't have a rocket motor handy? This model flies very well off a small highstart (sometimes called an upstart). Twenty five feet of tubing and 200 feet of line will launch Cuda high enough to get plenty of stick time. We'll explain how to add a towhook in the section on flying the 'Cuda.

The pod on Cuda will accommodate micro/mini receivers. Some examples of receivers which will fit in the pod include the RCD 535, Futaba R112JE, R122J, R148 and R114H receivers. If the receiver case fits in an space approximately 1.25" X 2.25" X.9", it should fit in the pod.

Micro servos are required. Futaba S133, S3101 and S5102; Hitec HS-80s and HS-60s; and Airtronics 94501.

The Cuda is designed to accept 50 - 100 mah flat battery pack. A 250 mah will physically fit, but it is much to heavy to balance correctly. These are available from many sources. We have been using Sanyo cells purchased from E.H. Yost [4]. You can quick-charge a battery between flights, though we prefer to charge 4 or 5 packs and change them after they reach about 4.7 V when tested with an expanded scale volt meter. We typically get 30 minutes from a 50 mah battery and 45 minutes from an 80 mah battery.

There is plenty of room for a battery switch designed into Cuda. However, to minimize weight, We use a Cannon [5] micro connectors to plug the battery into a lead coming from the receiver. If you want to put a switch in the pod, We recommend you use a 2.5mm two pole plug and normally closed jack. They can be wired so the battery can be charged when the plug is inserted. If you choose to set it up so the battery can be charged while it is in the pod, make up a separate plug which is "open" and has a streamer attached to it. Then you can leave the "open" plug installed right up to the minute you are ready to launch.

If you are building the alternate T-tail configuration: You should carefully read each section of the instructions for special notes in the T-tail configuration. The differences from the inverted V-tail assembly procedures are specifically identified, but may be interspersed in the normal flow of instructions. So, read carefully.

A special note about laser-cut balsa parts: Many of the balsa parts in this kit have been cut with a laser. You will notice some burn marks along the outline of the parts. That's normal. When the kit was designed, little tabs were left uncut to retain the parts in the balsa sheet. This is done because the sheeting protects the parts. As you remove the parts from the sheeting be sure you have cut all the little tabs. If a part is hung, check to be sure you have cut completely through the tabs with a sharp razor knife.

A special note on handling the wings and tail surfaces: The wings are constructed of 1/32" balsa over white foam. It is safe to handle them gently. You can, however, dent them by pressing too hard with your fingers or by knocking them against the corner of a table (or what ever). While holding the wing, do not grip them too tightly. If you work with the wings on a table surface, be sure to put something like a foam pad or the foam bed from which they were cut under them to avoid having a small point of contact between the wing and the table surface. We recommend you wrap the wings in a light foam packing material and tape it so you can slide it on and off like a sock. This will allow you to put the sock on when handling the wings and prevent accidental dents when you are not.

1. S8E is the FAI (international) competition class for radio controlled rocket gliders

A special note on dents in balsa-sheeted foam wings and bent trailing edges: When dents occur, you may be able to remove them. A damp cloth and an iron for applying heat shrinkable plastic coverings can be very effective in raising a dent. Hold the damp cloth on the dent and heat the iron to a temperature just below the melting point of the foam. Move it smoothly back and forth over the dent. Lift the iron after a few passes over the dent and allow it to cool. When it is no longer hot to the touch, do it again. After a bit you should see the dent beginning to raise and then disappear. The iron will also smooth surface irregularities. The iron can also easily dent the wing, so work carefully. We recommend the iron instead of a heat gun because it is easier to control the temperature of the foam surface and where you are applying the heat. You can accomplish the same task with a heat gun, but there is more risk in melting the foam or causing a skin separation.

Bent trailing edges can be repaired or reshaped by using a combination of an iron and foam-friendly CA. If you get a bent training edge, support the training edge (the wing bed or scrap foam is good for this) and gently iron it back to the shape you want. Soaking with thin foam-friendly CA finishes the job.

A special note on warped sheeting: Because the 1/32″ sheeting for the wings is thin and light, internal stresses caused by changes in humidity and temperature will show up as a warp or wave. This is quite alright. Unless there is an otherwise significant flaw, warped sheeting will have absolutely no affect on the wing. The sheeting is actually pretty elastic. When it is bonded to the wing core, it will stretch and conform perfectly to the foam.

We would appreciate your feedback. Drop us a note or send us email.

What You Should Find In This Kit

This kit includes everything you need to build the Cuda except adhesives, covering, radio gear and miscellaneous building supplies and tools. You should find the following:

- ’Cuda full-size plans
- ’Cuda Assembly and Operation Manual
- 2 foam wing sections
- 1 fiberglass fuselage boom
- 1 BT-50 tube for the motor tube
- 2 pushrod cables and sleeves
- 2″ x1/16″ brass tubing and 5″ x 0.032″ music wire for pushrod to servo attachment and pod hatch attachment pin
- 1 wood screw for pod attachment
- 1 6-32 x 1/2″ nylon bolt
- 1 6-32 blind nut
- 1 balsa nose block
- 1 balsa motor tube bulkhead
- 1 sheet of 1/8″ balsa laser-cut with tail parts
- 1 sheet of 1/16″ balsa laser-cut fuselage parts
- 4 1/32″ x 3″ x 24″ balsa wing skin sheeting
- 2 1/32″ x 4″ x 24″ balsa wing skin sheeting
- 2 1/4″x24″ square balsa for leading edges
- 1 1/8″x3/4″x18″ balsa for control surfaces
- 1 3/8″x1.25″x18″ balsa for pod
- 1 3/8″x1/2″x9″ balsa for wing tips
- 14.5′ of 1/2″ fiberglass
- 14″ of 2″ fiberglass
- 3″ of 3/16″ square spruce
- 1.5″ of 5/32″ dowel
- 1/32″ plywood triangle for nut-bolt plate, slotted rectangle for pod hold-down, 2 control horns

What You Will Need To Finish This Kit

- Aliphatic resin glue
- Laminating epoxy (you may be able to substitute spray adhesive or contact cement for wing sheeting)
- Old credit card or playing card to spread the laminating epoxy
- 5 minute epoxy
- 15 to 30 minute epoxy (referred to as 20 minute epoxy in the instructions)
- Thin CA (Cyanoacrylate Adhesive)
- Medium CA
- Microballoons or similar light weight epoxy filler
- Light spackling compound
- 120 grit, 240 grit, 400 grit and 600 grit (optional) wet/dry sandpaper
- 11" T-bar or sanding block (3 of them with different grits is preferred)
- Razor blade knife
- Razor saw
- Soldering iron, solder, soldering paste
- Ruler
- Straight edge which is 24" or longer
- Square or 90 degree triangle
- Masking tape
- Expended D11P, D12 or E6 rocket motor
- Scrap wire (coat hanger)
- Felt tip pen
- Dark large marker pen
- Needle nose pliers
- 1/32", 7/64", 5/32" and 3/16" drills
- Plastic food wrap
- Wax paper
- Vacuum cleaner with a brush attachment
- Kitchen sponge or paper towel
- Tac-cloth

'Cuda Specifications

Class: FAI S8E and S8D (Radio Controlled Rocket Glider)

Impulse: D (20 N-sec) through E (40 N-sec)

Recommended Motors: AeroTech RMS™ D7, E7, E6 and expendable E6 motors Estes D11-P motor

Target weight with expended E6 motor: Approximately 200 grams

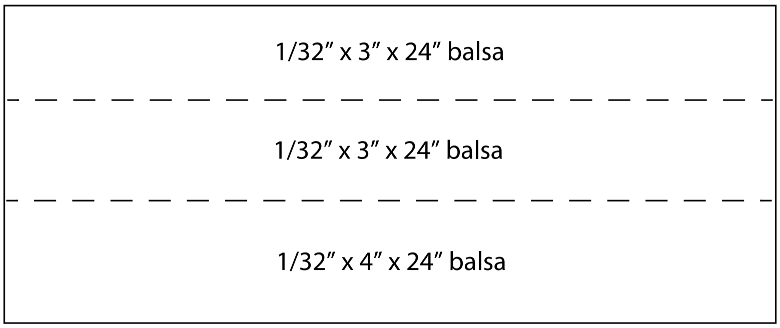
Wing Area: 194 sq. in.

Wing Span ~43"

Aspect Ratio: 9.45

Controls: 2 Channel ruddervators or conventional rudder and elevator

Airfoils: Wing KM7 (8%), Tail KM10 (6%) Custom airfoils for S8



The first step in constructing the wings is to assemble the wing skin blanks. Select two of the 1/32″ x 3″ x 24″ balsa sheets and one of the 1/32″ x 4″ x 24″ sheets. Try to select he sheets so the wing skin blanks are as close to equal weight as possible. Using a long straight edge, trim just enough of the edges to get a good fit where they butt together. Then use a T-bar sanding bar to clean up any minor problems. Only remove the minimum required to get a good fit.

Trial fit the sheets and when you are satisfied with the fit, temporarily tape them together with small pieces of masking tape. Then flip the sheets over and run a piece of masking tape down the full length of each seam. Rub the tape along the seam to be sure of good adhesion. Remove the temporary pieces of masking tape.

Trim & Glue Wing Skin Blanks

q **Trim edges of sheets**

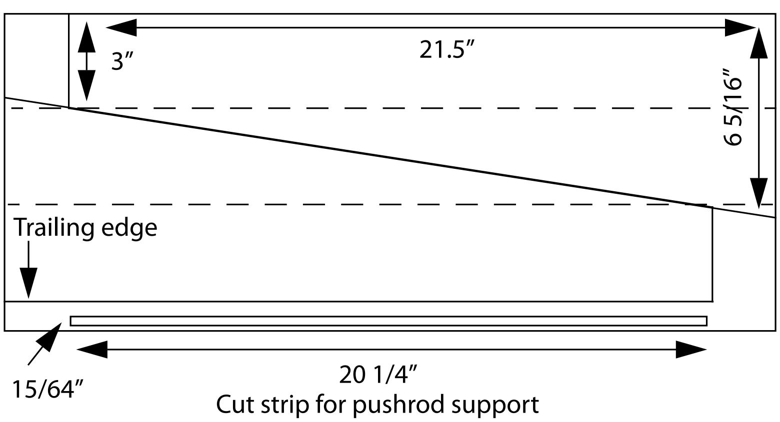
q **Glue three sheets together**

q **Stack books on them**

Flex one seam so the joint between the sheets opens. Run a bead of aliphatic resin glue along the open seam. Close the seam and wipe off any excess glue with a damp paper towel. Do the same procedure with the second seam. Lay the assembled sheets between two pieces of waxed paper and lay books on them until the glue is completely dry.

Assemble the other two 1/32″ x 3″ x 24″ and 1/32″ x 4″ x 24″ balsa sheets in the same fashion.

The next step is to hinge the skins at the trailing edge. Lay two skins together with their



When the glue in the wing skin blanks is completely dry, remove them from the wax paper. Remove the tape from the seams. Using a T-Bar sander with 120 grit sandpaper sand the skins smooth on both sides and pay careful attention to the seams. Be sure to remove any excess glue. Sand in the same direction as the grain to finish and leave the smoothest surface.

Mark on the blanks the outline of the wing skins. The dimensions of the skin is 21.5″ in span, the root is 6 5/16″ and the tip is 3″. Also mark the outline of a strip to support the pushrods. It is 20 1/4″ long, and 15/64″ wide. Only one pushrod support is required.

Sand and Cut the wing skins

q **Sand the blanks**

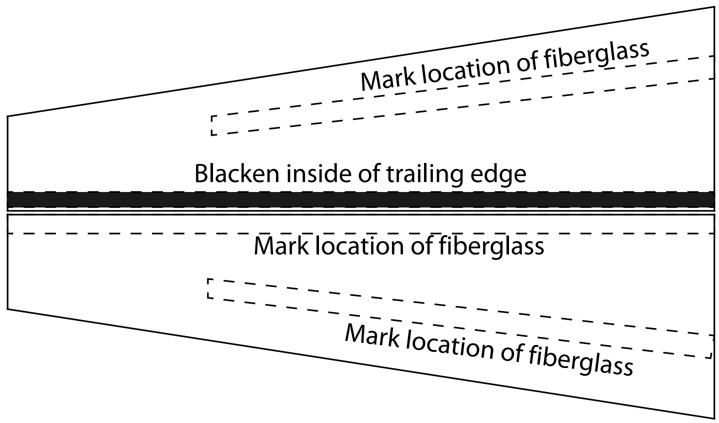
q **Cut the skins**

q **Stack-sand to final dimensions.**

q **Vacuum**

Carefully cut the 4 skins and pushrod support from the blanks. Set the pushrod support aside. Check the root of the skins with a square to be sure they are at a right angle to the trailing edge of the skin. Stack them together and use a T-bar sand the edges so all skins are the same dimensions.

Carefully vacuum the skins to remove the sanding dust. Then wipe them with a tac-cloth.



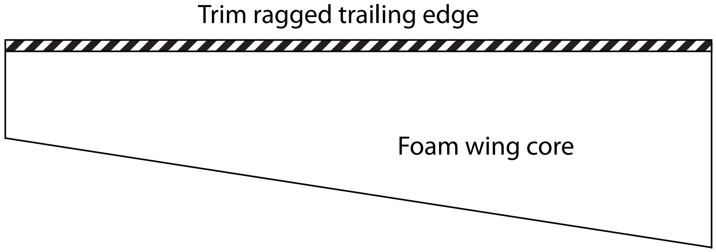
Hinge and mark the wing skins

- q **HInge the skins**
- q **Mark the location of fiberglass**
- q **Blacken inside of trailing edge**

trailing edges 1/8" apart. Make sure the root is at the same end for each skin!. Put a small (temporary) piece of tape across the gap between the trailing edges at the root and tip. Flip the skins over and run a strip of masking tape the entire length of the trailing edge, forming a hinge. Remove the small pieces of temporary tape. The tape is on the outside of the skins. Be sure you fold the hinge in the correct direction!

Mark the location of the fiberglass reinforcement on the inside of the skins. There is a fiberglass strip along the high point on the top and the bottom skin. There is also a **single strip of fiberglass inside the trailing edge**. It is not necessary to put fiberglass on the top and bottom of the trailing edge. One side is sufficient. Location of the fiberglass strips is on the full-size plans. Using a large dark marker pen, blacken about 1/2" of the inside of one of the skin trailing edges. This is needed so you can check your progress when sanding the trailing edge later. Prepare the second pair of skins in the same manner.

Cut pieces of fiberglass to size for application to wing skins. Be sure and cut all the pieces for both wings.



Prepare Wing Cores

- q **Trim wing core ragged trailing**
- q **Remove fuzzies**
- q **Clean dust from cores and beds**

During this series of operations, use the beds from which the wing cores were cut for support.

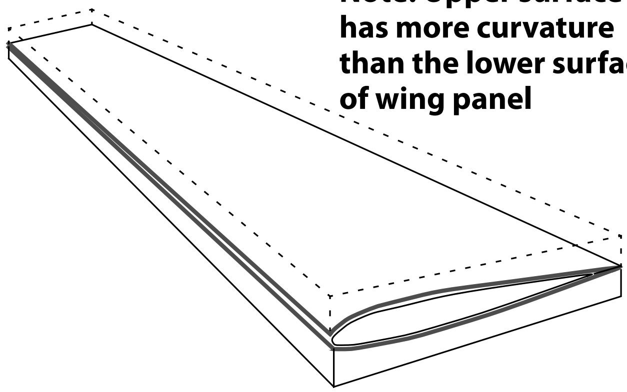
Clean up the trailing edge of each core by trimming any ragged foam along the trailing edge. You may have to trim 1/2" or so.

The foam core is covered with tiny strings (or fuzzies) which are left by the cutting process. These need to be removed and surface bumps removed before laminating the skins onto the core. Start by gently rubbing your hand over the core to remove the fuzzies. A paper towel or small kitchen sponge also work well. Work carefully. Hold the wing in the bed at the root with one hand. Then wipe down the span and toward the trailing edge so you don't accidently buckle the core. Now **gently** sand the cores with 120 grit sandpaper on a T-bar. Again hold the wind in the bed, hold it at the root and move the T-bar toward the tip and trailing edge. Keep the T-bar parallel to the wing span. You are only removing surface bumps, not reshaping the core. So don't over do it!

Vacuum the cores with a brush attachment to remove the dust. Again, you need to hold the cores at the root and slide the vacuum brush attachment toward the tip and trailing edge so you don't accidently buckle the core.

Clean the fuzzies and vacuum the wing beds as well. They will transfer fuzzy crud back onto

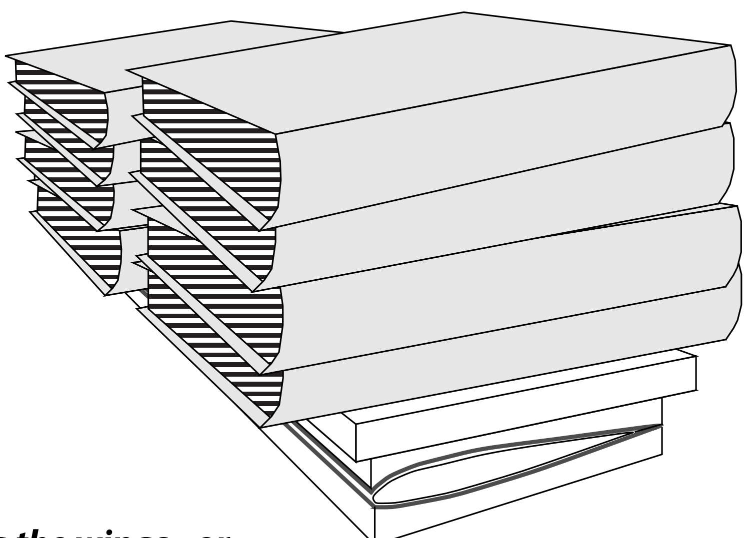
Note: Upper surface has more curvature than the lower surface of wing panel



Apply a thin layer of laminating epoxy to the inside of a pair of wing skins. (It may be possible to use a spray adhesive or other laminating adhesive. But, you should try it on a scrap before committing to use it.) Use a credit card or playing card to spread the epoxy. If you mix 8 grams of epoxy per wing panel, you should have plenty. Use the card to scrape off any epoxy sitting on the surface. Remove as much as you can. The weight of excess epoxy is a killer. Lay the fiberglass strips on the outlines for the reinforcements and smooth them into place. They should change color slightly as the absorb epoxy from the skin. If they do not wet-out evenly add a little more epoxy. Lay wing core on the bottom wing skin and fold the top skin over the top using the masking tape as a hinge. Position the leading edge of the core just behind the leading edge of the skin. Tape the skin in place. Now you have a wing-sandwich. Lay a piece of wax paper over the bottom bed and lay the sandwich in it as illustrated. Align the leading edge of the core with the leading edge of the bed. Tape it in place. Lay a piece of wax paper over the top of the wing sandwich. Tape it in place. If you are going to use a vacuum-bag to laminate the skins to the core, this is all you need to do. If you are going to stack weight on the wing to laminate the skins, you should put the top of the bed on top of the wing-sandwich and tape it in place. If you plan to vacuum bag or press both wing panels at the same time, prepare the second wing panel now. Else, wait until the first panel is cured.

Make a wing-sandwich

- ☐ **Spread epoxy on inside of skins**
- ☐ **Apply fiberglass reinforcement**
- ☐ **Wrap the skins**



You <u>must</u> have a **flat** work surface for this step!

If you are vacuum bagging the wings, now is the time to put them in the bag. Put the wing plus the bottom bed into the vacuum bag. Be sure you have a breather cloth or other method of "wicking" out the air. Pull a vacuum of 6 inches of mercury (about 3 pounds per square inch).

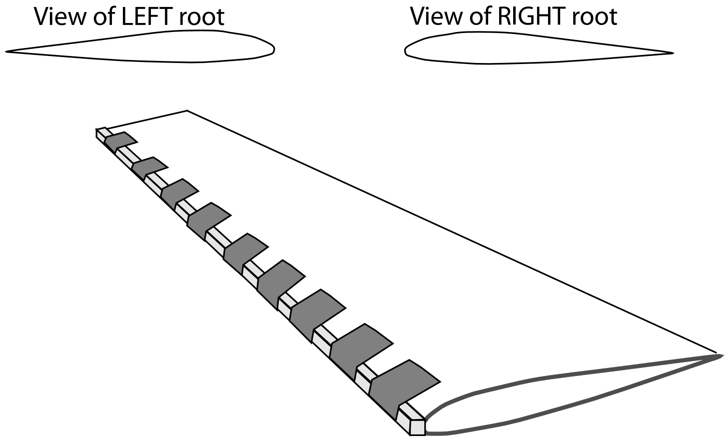
As you are pumping the air out of the bag, gently press the wing sandwich against the bottom bed and smooth the bag.

If you are stacking weight on the wings, make sure you have both the top and bottom of the bed taped securely around the wing-sandwich. Lay a flat board on top of the wing. Stack as much weight as you can on the wing. You should use more than 200 pounds per wing panel. 300 pounds is recommended.

Allow the wings to cure at least 24 hours before removing them from the bag (or weight).

Bag the wings - or-weight them

- ☐ **<u>Flat</u> work surface**
- ☐ **Vacuum-bag or weight the wing**
- ☐ **Cure 24 hours**



Add the leading edge

- q **Trim leading edge**
- q **Sand leading edge flat**
- q **Glue leading edge**

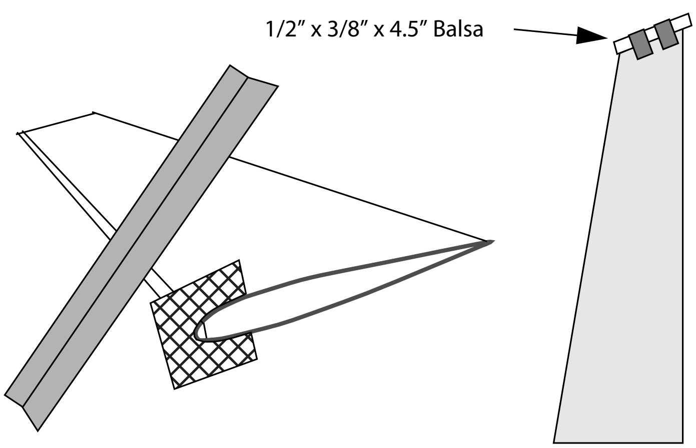
Remove the wings from the vacuum-bag (or weights).

Trim the sheeting at the leading edge so it is just even with the foam. Use a T-bar sander to flatten and straighten the foam edge so the leading edge will make good contact along the full length.

Find the 1/4″ x 1/4″ x 24″ square balsa sticks. These will become the leading edge. Trim them to the length of the wing panel. Put a thin layer of aliphatic glue on the leading edge of the wing-sandwich. Coat one edge of a balsa stick. Press the glued side of the stick to the glue-coated leading edge of the wing-sandwich. Wrap a piece of masking tape around the leading edge approximately every 2″. This will hold it in place until the glue cures.

Allow the glue to cure approximately 24 hours before proceeding.

A note on left and right: You can identify the right and left wing by looking at the airfoil a the root (the big end!) of the wing. The upper surface of the wing is more curved than the bottom. When looking at the wing roots, they should look similar to the illustration. After identifying the right and left wing, mark them to avoid mistakes later.



Shape the leading edge

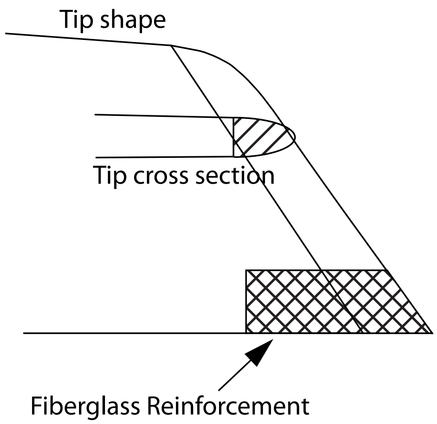
- q **Cut leading edge templates**
- q **Shape the wing**
- q **Trim the wing**
- q **Glue on the tip**

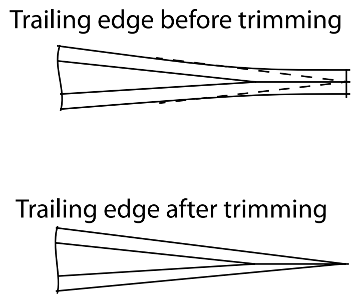
Copy the leading edge templates from the full-size plans. Glue them to a stiffener such as an index card and trim them to the wing profile.

Rough-sand the leading edge to the approximate shape. You can get pretty close by just following the contour of the upper and low skin as it approaches the leading edge. If you just extend this line though the square leading edge, you will be getting pretty close to the leading edge shape. Use the templates to guide your final shaping. Check the shape often as you sand. Be especially careful to not cut into the skin just behind the leading edge.

Trim the wings to the size and shape on the plans. Start by aligning the leading edge over the plans. Then trim the trailing edge to the correct shape. Then, trim the wing root so it is at right angle to the trailing edge. Finally, trim the tip at the proper angle per the plan. Note, if you trim too much and the wing is a little bit short, it's no big deal. This will make the airplane a tiny bit more stable. You can adjust the stability by moving the CG to suit your flying style later.

Cut a 4.5″ piece of the 1/2″ x 3/8″ stock and use aliphatic glue to attach it to the tip the same way you did the leading edge. Allow it to cure before proceeding.





Finish shaping the wing

q **Shape the tip**

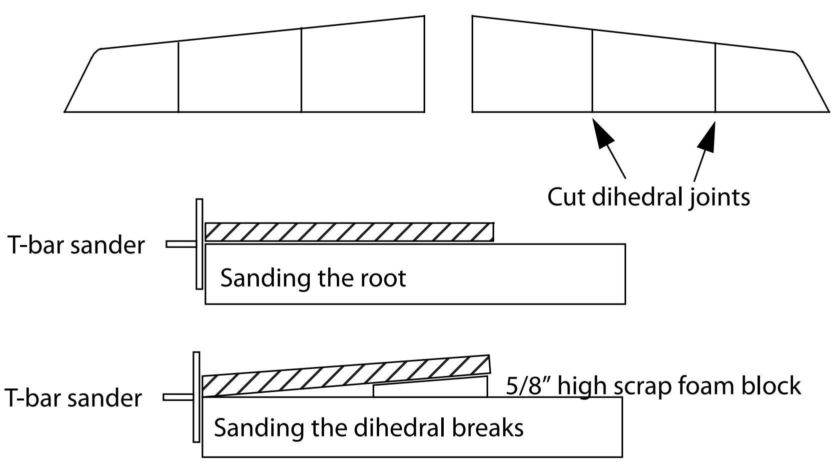
q **Sand the trailing edge**

q **Reinforce the tip trailing edge**

Sand the wing tip to the shape indicated on the full-size plans. The cross section should be similar to the diagram.

The trailing edge must be sanded to a sharp edge for the best performance. Using a T-bar sand the trailing edge holding the sander parallel to the sheeting where it approaches the tailing edge. When you are done, it should transition to a straight sharp edge. This is where the blackened sheeting inside the trailing edge will help you. When you begin to see black peeking through at the trailing edge, proceed slowly. When you are finished sanding you should have a black band along the trailing edge. The fiberglass which you sandwiched inside the trailing edge should also help guide your sanding. It will leave a strong trailing edge when you are finished.

The very tip of the wing at the trailing edge is quite fragile now. Laminate a 1″ length of the 1/2″ wide fiberglass cloth onto the wing tip as indicated in the illustration. Use medium CA as the adhesive. You can use a piece of wax paper to rub it into the wood. Laminate fiberglass on the top and bottom of the tip. After the CA cures, carefully sand the tip smooth and then soak it with thin CA and finish sand it.



Dihedral Joints

q **Mark the panels**

q **Cut the dihedral joints with a new blade**

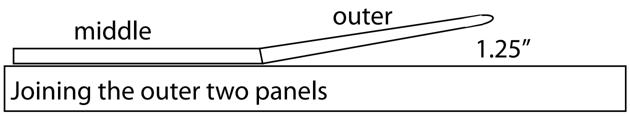
q **Sand dihedral into the joints.**

Lay each wing panel over the full-size plans and mark the location of the dihedral breaks. The marks should be approximately 7 1/8″ and 14 3/8″ from the root. Using a square, draw a line perpendicular to the trailing edge at each mark. The line should run from the trailing edge to the leading edge.

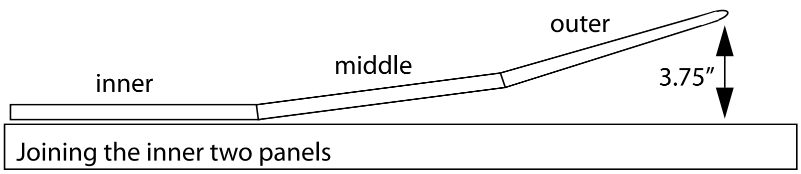
Using a new razor blade knife, cut the wing at the dihedral breaks. Take your time and don't try to cut too much in a single stroke of the knife. Change blades if it starts to drag when cutting the foam.

Note on the plans the amount of dihedral at each break. The root has no dihedral, the first and second breaks each have about 1.25″ of dihedral. You must sand half the dihedral into the panel on each side of the break. Otherwise the sheeting will not properly meet on top of the wing. So, the root can be sanded with the wing panel flat. The first break requires that the panels on each side of the break be propped up 5/8″.The second break is the same as the first.

The breaks are sanded by placing the wing sections on a flat work surface with a square edge. The T-bar sander then uses the square edge of the work surface as a guide for sanding the dihedral joint. Be sure to keep the trailing edge and tip of the leading edge at the same height when you prop up the wing with a scrap foam block.



Start gluing the dihedral joints together at the outer break. Temporarily tape the outer two wing sections together at the dihedral joint.Lay the middle panel on the work surface and check the height of the tip. It should be 1.25″. If it is not, make the necessary adjustments. Be sure to correctly align the trailing edge and tip of the leading edge.

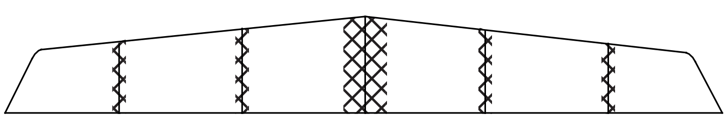


Tape the lower surfaces together on the outer wing sections the way you want them to mate-up. Mix some 5 minute epoxy and put a thin coat inside both sides of the joint. Close the joint and tape it together on top. Lay it back on the work surface and check the tip height again. Hold it in place until the glue sets.

Glue Dihedral Joints

- q **Check joints**
- q **Glue joint with 5 min epoxy**
- q **Hold in place until glue sets**

Now, temporarily tape the inner panel to the outer two panels. Lay the inner panel flat on the work surface. The tip height should now be 3.75″. If it is not, make any adjustments necessary at the inner dihedral joint. Tape the lower surfaces together on the inner and middle wing sections the way you want them to mate-up. Mix some 5 minute epoxy and put a thin coat inside both sides of the joint. Close the joint and tape it together on top. Lay it back on the work surface and check the tip height again. Hold it in place until the glue sets.



The center section is joined just as the dihedral joints. Temporarily tape the center section together. Prop the wing with scrap foam blocks. The wing tips should be 3.75″ above the work surface. When you have made the necessary adjustments, tape the foam blocks to the work surface. Put a few strips of tape across the bottom surface of the joint. Open the top of the joint and coat each side of the inside of the joint with 5 minute epoxy. Place the wing back on the work surface and position it in the blocks so the wing tips are 3.75″ above the work surface.

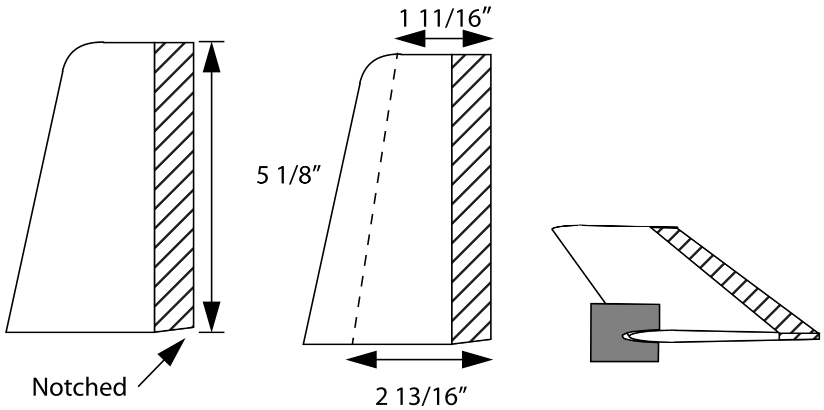
Joining wing halves

- q **Check fit**
- q **Glue joint with 5 min epoxy**
- q **Reinforce all joints with fiberglass**

After the center section joint has cured, laminate the center section joint with a 2″ wide strip of fiberglass. Laminate each of the dihedral joints with a 1/2″ wide strip of fiberglass. Reinforce the top and bottom of all joints. Use laminating epoxy to laminate the fiberglass to the joints.

After the epoxy has cured, carefully trim the excess fiberglass and sand it smooth.

Skip this page if you are building the T-Tail



Cut the control surfaces (elevons) from the 1/8"x3/4" hard balsa strip the length of the main tail surface (approximately 5 1/8"). Glue the control surfaces to the rear of the main tail surface using aliphatic resin. Wipe a thin coat on each surface to be joined and then butt them together. Lay the assembly on a flat surface and tape each side to hold it while the glue sets.

After the glue has cured, notch the end of the elevon which will be at the root as indicated on the plans. Draw a line down the center of the trailing edge. Then, draw another line 1/64" to each side of the center line. These lines mark the thickness of the trailing edge (1/32").

Shape the tail

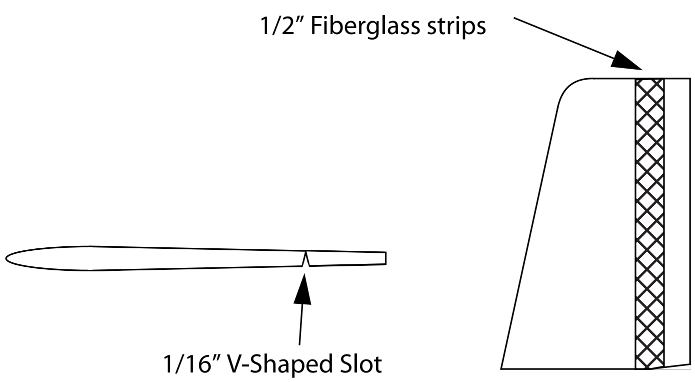
q **Glue elevon to tail**

q **Mark high point & trailing edge**

q **Shape tail**

Put a mark on top and bottom of the root of the tail 2 13/16" from the trailing edge. Put another mark on top and bottom of the tip of the tail 1 11/16" from the trailing edge. Draw a straight line between these two points on the top and bottom surface. This line marks the high point of the tail profile.

Copy the tail leading edge templates and glue them onto index card stock. Use them to guide your shaping of the leading edge. Taper the airfoil from the line at the high point to the lines on the trailing edge. Taper and round the leading edge using the templates as your guide.



Choose a right and left tail surface. Using laminating epoxy, laminate a 1/2" wide strip of fiberglass over the top of the joint between the elevon and the main tail. Lay the pieces of fiberglass in place and then wet them with laminating epoxy. Cover the tail with waxed paper and put something flat on it (like a small board) and weight it until the epoxy has cured.

The fiberglass on the top surface is going to be the hinge for the elevon. Flip the tail surface upside down and slice a 1/16" wide v-shaped slot centered on the joint between the elevon and the main tail piece. Don't cut all the way to the top surface.

Hinge the tail

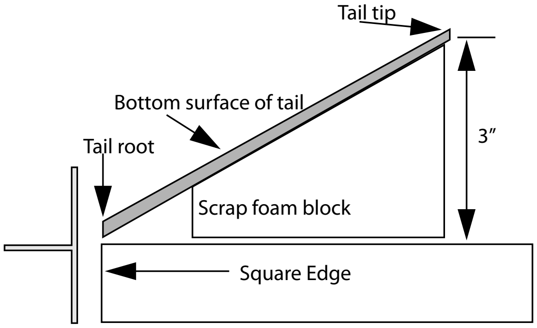
q **Laminate fiberglass on joint**

q **Cut V-shaped slot on bottom of joint**

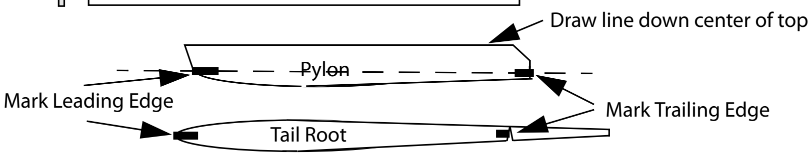
After cutting the v-shaped slot in the bottom, flex the control surface and be sure there are no cuts through the hinge. If an area is damaged, just laminate another piece of fiberglass over that area.

Finish the job by smoothing the edges and lightly sanding any rough spots.

Skip this page if you are building the T-Tail



Referring to the diagram, prop the tip of the tail surface up 3″ while the root is at the edge of a work surface (with a square edge). The bottom surface of the tail must be up (remember your left and right). Using the square edge of the table as your guide, gently sand the correct anhedral joint angle into the root of the tail surface. Repeat for the other surface.



Using a marker pen, put a mark on each side of the pylon (see the figure) where the line running down it’s length on the plans intersects the leading and trailing edges. Also put a mark on the leading edge of the tail and at a point midway between the upper and lower surfaces right in front of the hinge. You will use these lines to align the tail for gluing.

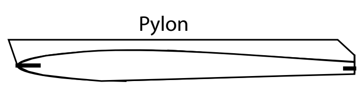
Prepare Tail parts

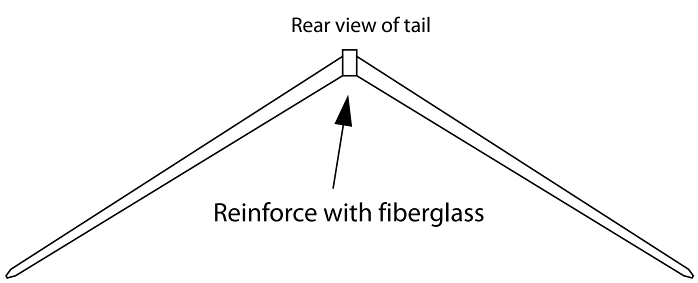
q **Sand dihedral in tail sections**

q **Mark Pylon**

q **Groove top of pylon**

Draw a straight line down the centerline of the top of the pylon. Carefully cut a “V” in the top of the pylon along the centerline. Wrap 120 grit sand paper around the end of the boom and sand the V on top of the pylon into a curved trough to receive the end of the boom. The curve of the trough should be as close to the outside curvature of the end of the boom so there is no “play” in the joint.





Lay the pylon on its side and align the tail surface on the exposed side and trace a line around it on the pylon. Remove the tail surface and make pinholes in the pylon inside the outline of the tail root airfoil. Do both sides of the pylon. Shape the curvature of the bottom of the pylon as close a possible to the curvature of the lower tail surface.

The plans contain a large inverted “V” behind the tail which indicates the correct angle for the inverted V-tail. The included angle is 110 degrees. Use the V on the plans to guide the angle of the tail surfaces. Using aliphatic resin glue coat the pylon and root of one tail surface that mates to it. Align the marks at the leading and trailing edges. Hold the tail surface in place until the glue sets. Do the same to the other tail surface.

Assemble Tail

q **Trace tail on pylon**

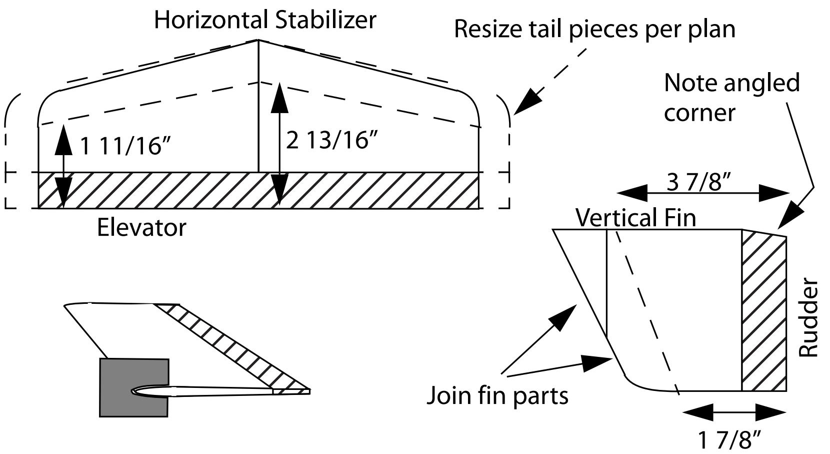
q **Assemble tail pieces to pylon**

q **Reinforce joint**

Carefully sand and shape the pylon to blend with the airfoil surfaces. Round the leading edge of the pylon and leave the trailing edge blunt.

Reinforce the lower surface joint between the tail surface and the pylon with a strip of fiberglass cloth and laminating epoxy.

Skip this page if you are building the V-Tail



You will need to recut the tail pieces to the size shown on the full-size plans to create the horizontal stabilizer. Stack the halves together and sand them to identical shape. The elevator will also need to be cut to size per the plans

Join the stabilizer halves as shown in the illustration using aliphatic resin. Then, glue the elevator to the stabilizer

.The vertical fin is already cut to the correct size. Glue the two pieces of the vertical fin and rudder to the fin as shown in the illustration using aliphatic resin glue. Temporarily tape all the joints and press on a flat surface until the glue cures.

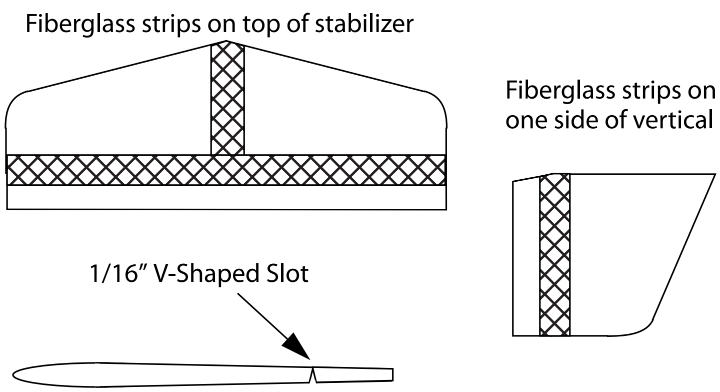
Shape the tail

q **Recut the stabilizer per the plan**

q **Glue stabilizer and vertical fin pieces**

q **Shape using tail leading edge templates**

After the glue has cured, draw a line down the center of the trailing edge of the elevator and rudder. Then, draw another line 1/64″ to each side of the center line. These lines mark the thickness of the trailing edge (1/32″). Draw lines on both sides of the stabilizer and vertical fin shown by the dashed lines in the illustration. These lines mark the high point of the tail profiles. Copy the tail leading edge templates from the plans and glue them onto index card stock. Use them to guide your shaping of the leading edges. Taper the airfoil from the line at the high point to the lines on the trailing edge. Taper and round the leading edge using the templates as your guide.



Using laminating epoxy, laminate a 1/2″ wide strip of fiberglass (top side only) on the joint down the center of the stabilizer, the joint between the elevator and the stabilizer and the right side of the joint between the rudder and vertical fin. Lay the pieces of fiberglass in place and then wet them with laminating epoxy. Cover the tail pieces with waxed paper and put something flat on it (like a small board) and weight it until the epoxy cures.

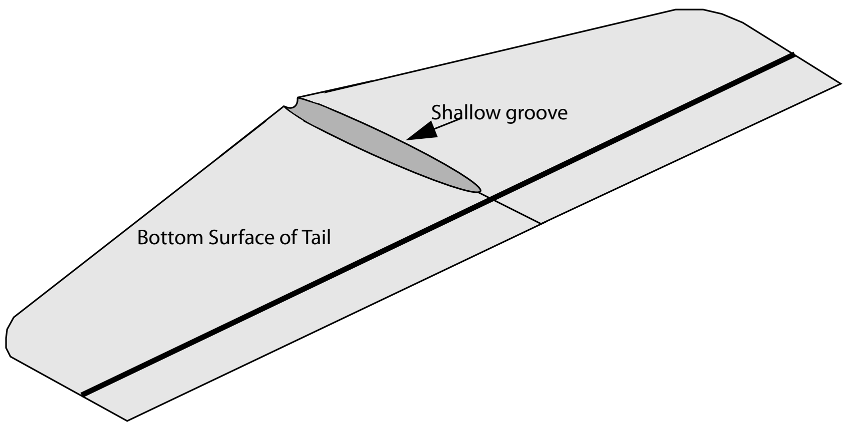
The fiberglass on the tail surfaces is going to be the hinge for the elevator and rudder. Lay the tail surfaces on a work surface with the fiberglass side down and slice a 1/16″ wide v-shaped slot centered on the joint between the elevator and the stabilizer and on the joint between the rudder and vertical fin. Don't cut all the way through to the top surface. After cutting the v-shaped slot, flex the control surface and be sure there are no cuts through the hinge. If an area is damaged, just laminate another piece of fiberglass over that area.

Hinge the tail

q **Laminate fiberglass on joint**

q **Cut V-shaped slot on bottom of joint**

Finish the job by smoothing the edges and lightly sanding any rough spots.



Skip this section if you are building the V-Tail. Carefully cut a small (1/8") wide V shaped shallow groove in the bottom surface of the stabilizer down the centerline. Begin the cut about 2" from the leading edge and end about 1/4" from the leading edge. This will be your guide to sand a semicircular groove to receive the end of the boom.

Wrap 120 grit sandpaper around the small end of the boom and carefully sand the V-shaped trough into a semicircle to receive the end of the boom. The bottom of the trough should connect a line between the hinge line and a point just below the tip of the leading edge as shown

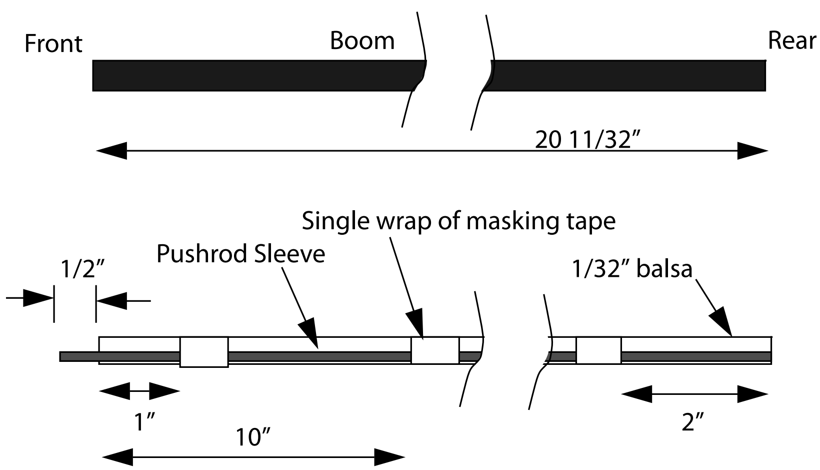
Fit Stabilizer to boom

q **Cut groove in bottom**

q **Sand semicircle groove**

q **Fiberglass**

Reinforce the joint in the bottom of the horizontal stabilizer same way you did on the top surface. Be sure the fiberglass cloth is pressed into the trough until the epoxy cures. After the epoxy cures, trim the excess fiberglass and sand the fiberglass cloth to remove any rough spots. Make sure the end of the boom will fit in the trough. If the trough has closed up a bit just sand it out with the sandpaper wrapped around the end of the boom.



Caution! The boom is made of fiberglass. Dust from it is hazardous. Use adequate precautions when cutting or sanding it.

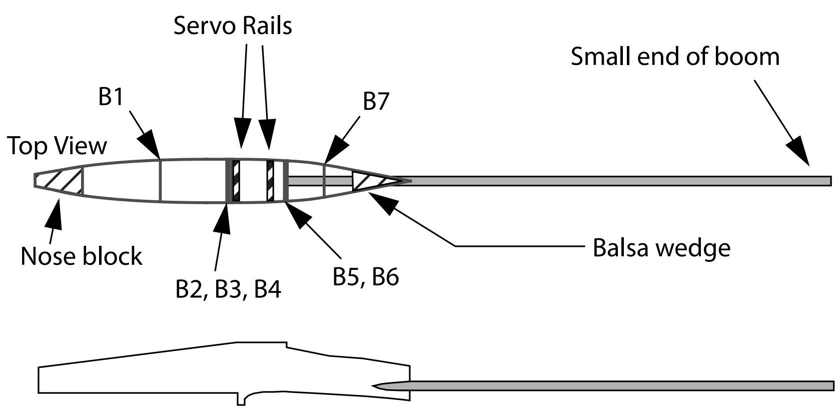
Cut the boom to the length indicated on the plan (approximately 20 11/32″) with a razor saw. Wrap the location of the cut with masking tape to keep it from splintering. Clean up the ends with sandpaper when you are finished.

Cut the pushrod sleeves to approximately 21″ and attach one to each side of the pushrod support as illustrated. Run a bead of thin CA along the length of the pushrod sleeve to firmly attach it to the balsa support. The masking tape wrap is added support. Be sure to note that one end of the balsa pushrod support is narrower than the other. This is to allow for the taper of the boom.

Slide the pushrod assembly in the boom. Adjust it, if necessary. **DO NOT GLUE!**

Prepare Boom and Pushrod assembly

- q **Cut and wet sand boom**
- q **Glue pushrod sleeves to support**
- q **Put assembly in boom**



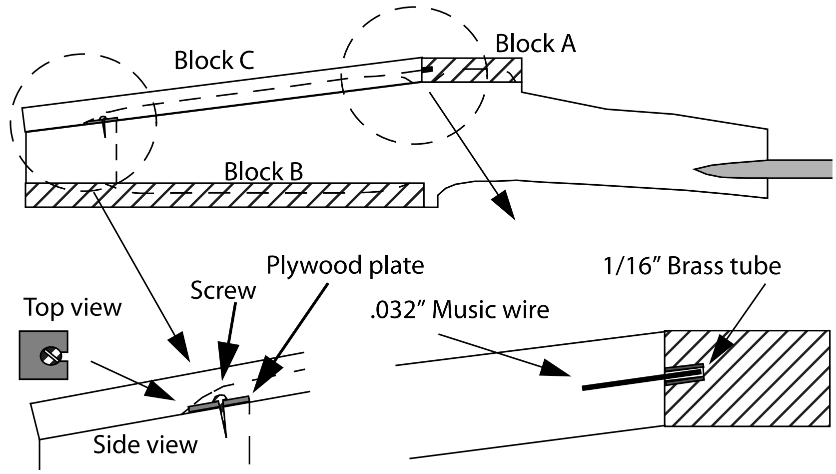
Using aliphatic resin glue bulkheads B5 and B6 together. Make sure the holes and sides are aligned! Slide bulkheads B5, B6 and B7 on the large end of the boom into their correct position. Adjust the opening in the bulkheads for the boom if necessary. Don't glue the boom to the bulkheads yet. Working over the plans to be sure you maintain proper alignment, attach the fuselage sides to B5, B6 and B7 by running a bead of thin CA at their point of contact. Remove the boom and glue the rear of the fuselage together with thin CA. Reinstall the boom and check the fit and alignment with the plans. Don't glue the boom yet.

Using aliphatic resin, glue bulkheads B2, B3 and B4 together so the small holes align and the sides are even. When this assembly is cured, glue it and B1 into the fuselage using thin CA. Install the nose block using a thin coat of aliphatic resin. Make sure the **top** of the nose block is flush with the fuselage sides. Make one final check of the boom and pod alignment over the plans. When you are satisfied, glue the boom in place with thin CA. Soak the points of contact with the bulkheads with thin CA. Fill any gaps between the boom and bulkheads with a small bead of medium or thick CA.

Trial fit the servos in the fuselage as indicated on the plans. Cut servo rails from 3/16″ spruce and glue in place with medium CA. Make small holes around the ends of the rails with a pin and soak the area with thin CA. Finally, glue the triangular shaped wedge of balsa in place at the back of the fuselage.

Pod and Boom Assembly

- q **Fit bulkheads and boom**
- q **Glue bulkheads and nose block**
- q **Glue boom**



Cut blocks A, B, and C from the 3/8″ stock. Sand the end of Block C to butt cleanly to Block A. Hollow the three blocks as indicated in the plans and illustration to reduce their weight a bit. Attach Block A to the fuselage with aliphatic resin. Do **not** attach Blocks B and C. Allow the glue to cure

Block C is held to the fuselage front by a slotted plywood plate that slips over a small screw in the nose block. At the rear a 1″ piece of 0.032″ music wire is glued into Block C which slides into 1/4″ of 1/16″ brass tubing inserted in Block A. Block C is removed by sliding it towards the front. Locate the plywood plate on the bottom of Block C. Recess it so it is flush with the bottom of the block. Glue it in place.

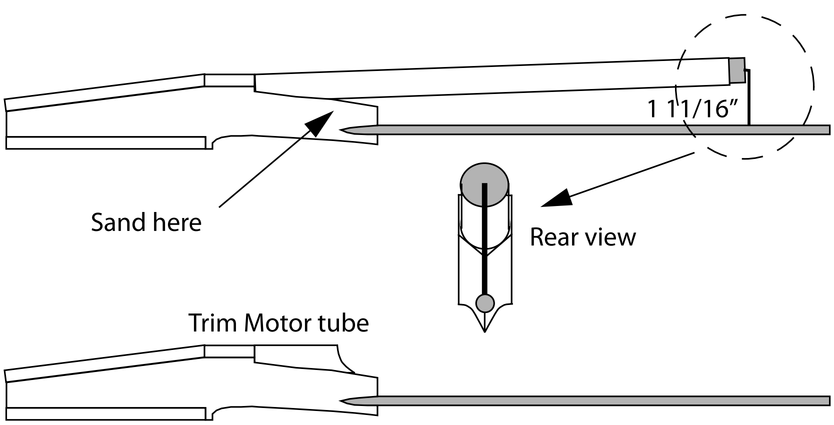
Attach Blocks to Fuselage

q **Glue Block A**

q **Attach mounts for Block C**

q **Glue Block B**

CA a 1″ piece of 0.032″ music wire in the center of the rear of Block C. Allow 3/16″ to stick out. At the spot where the wire hits Block A put a 1/4″ of 1/16″ brass tubing in Block A. Trial fit Block C and adjust the tube as needed to get a tight fit against the fuselage. Glue the tube in place. With Block C in place on the fuselage (from the bottom) mark the location of the screw on the nose block and put a mark on the bottom of Block C at the rear of the noseblock. Using these marks as references locate the position of the screw in the nose block. Insert the screw and trail fit Block C. Make sure it is centered and firmly attached. Glue Block B to the fuselage bottom.



It will be necessary to sand away a bit of the triangular piece of balsa at the rear of the fuselage to allow the motor tube to “settle” into the cutout in bulkhead B7. Wrap sandpaper around a spent 24 mm motor to sand the triangular balsa at the rear of the fuselage so it matches the contour of the motor tube.

Glue the motor tube bulkhead in the end of the long motor tube with aliphatic resin. Bend a piece of scrap wire (e.g., coat hanger) in to the shape of an L. Make the long side of the L 1 11/16″. Glue the short end of the L into the nozzle of a spent 24mm rocket motor. Slip the motor into the end of the long motor tube. The wire will be used to set the angle of the motor tube. Trial fit the motor tube in the fuselage until you are satisfied with the fit.

Attach Motor tube

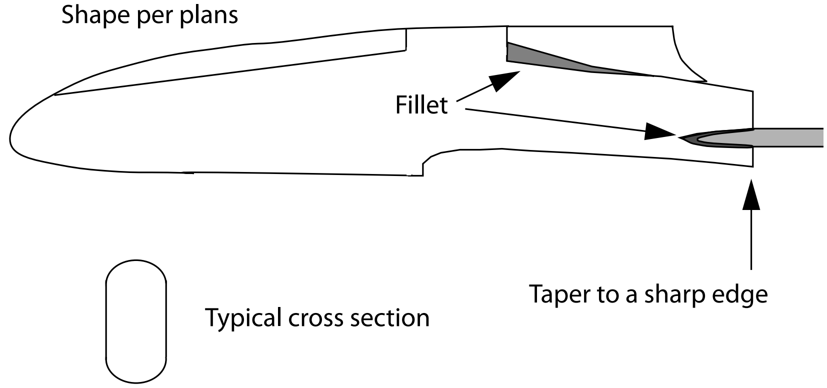
q **Glue bulkhead**

q **Make alignment tool**

q **Shape fuselage**

q **Attach and trim motor tube**

Apply a mixture of 5 minute epoxy and microballoons at the points of contact between the motor tube and fuselage and place the motor tube in position. From the rear, the motor tube with the wire should look as illustrated. Hold the motor tube until the epoxy has set. After the epoxy has cured, trim the motor tube as shown.



Shape the fuselage as shown on the plans. Note that the typical cross section is very rounded. Of course, you must have the hatch in place while shaping. Just be sure it is tightly attached so it does not shift during sanding.

Pay careful attention to the area around the top of the motor tube and at the trailing edge of the fuselage. The top of the fuse at the joint with the motor tube should be shaped to blend smoothly into the motor tube. Taper the trailing edge of the fuselage to a sharp edge

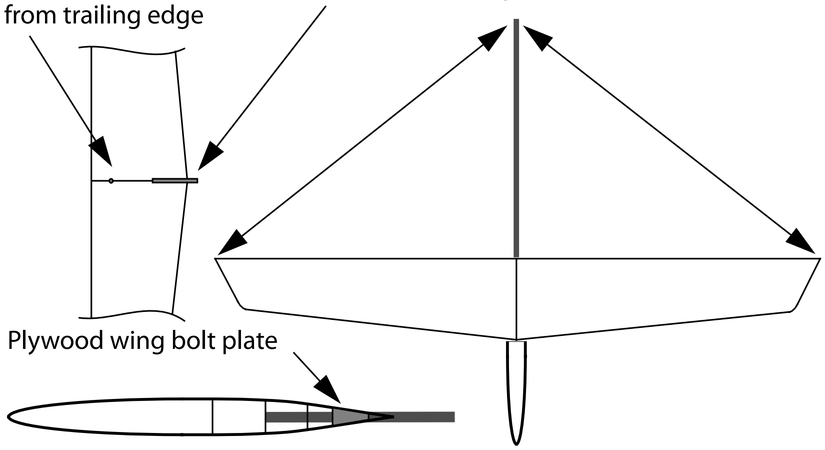
Shape Fuselage

q **Shape the fuselage per the plans**

q **Add fillets around motor tube and boom**

If you are too enthusiastic about your sanding you may sand through the sides of the fuselage at the joints with the blocks on top and bottom. It is not a big deal. You can do a couple of things to repair the spot. Probably the easiest is to glue a patch on the inside the hole. Make the patch of scrap 1/32" balsa. The other alternative which works very well for a spot that is thin but not broken through, is to glue a piece of fiberglass over the spot. Thin CA works well for this.

When you have finished shaping, use a light spackling compound to form a fillet around the motor tube and where the fuselage intersects the boom.



Round the edges on the 1.5" x 5/32" spruce dowel. Use a 5/32" drill to drill a hole in the leading edge of the wing at the center section joint. See the full size plans for the orientation. Put 5 minute epoxy in the hole. Insert the dowel allowing 3/16" to protrude.

Use a 7/64" drill to make a wing bolt hole through the wing 1 3/8" from the trailing edge centered on the center wing joint. It may help to drill a 1/16" pilot hole first.

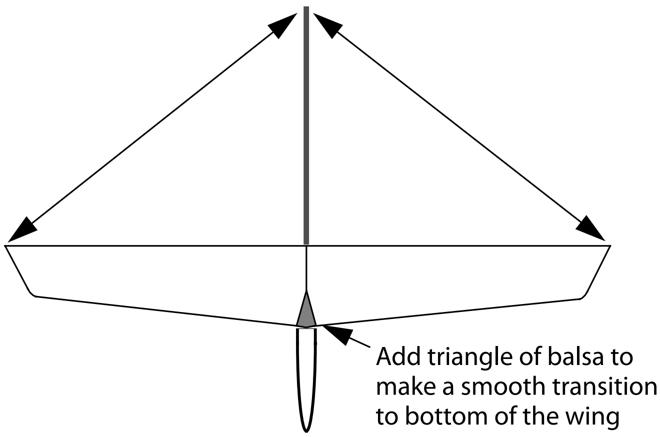
Mount the wing

q **Install wing dowel**

q **Drill wing bolt hole**

q **Glue blind nut in wing bolt plate**

Tape the plywood wing bolt plate in the bottom of the fuselage. Mark the plate and inside of the fuselage so you can relocate the plate in exactly the same spot. Attach the wing to the bottom of the fuselage inserting the wing dowel all the way into the bulkhead. Adjust the hole in the bulkhead as needed to allow the wing dowel to slide all the way in the bulkhead. Temporarily tape the wing in place. Measure the distance from each wing tip to the tip of the boom. Adjust the location of the wing until the distance from each wing tip to the tip of the boom is the exactly the same. When the wing is correctly located, drill through the hole in the wing with a 7/64" bit just enough to mark the location on the plywood wing bolt plate. Remove the wing and remove the wing bolt plate. Drill a 3/16" hole in the wing bolt plate at the mark. Press the blind nut into the **BACK** of the plate. Put some 20 minute epoxy around it to make sure it does not move. Allow it to cure.



Put the wing bolt plate back in the fuselage using the reference marks. Make sure the blind nut is against the boom. Tape it in place. Remount the wing and insert the wing bolt screwing it into the blind nut. Trimming it to the correct length.

Recheck the wing tip to boom tip distances. When satisfied, remove the wing and wing bolt plate. Put a small piece of tape on the back side of the blind nut to keep the epoxy out and put a sufficient amount of 20 minute epoxy around the plate to be sure it bonds to the boom. Put it back in the fuselage.

Finish wing mounting

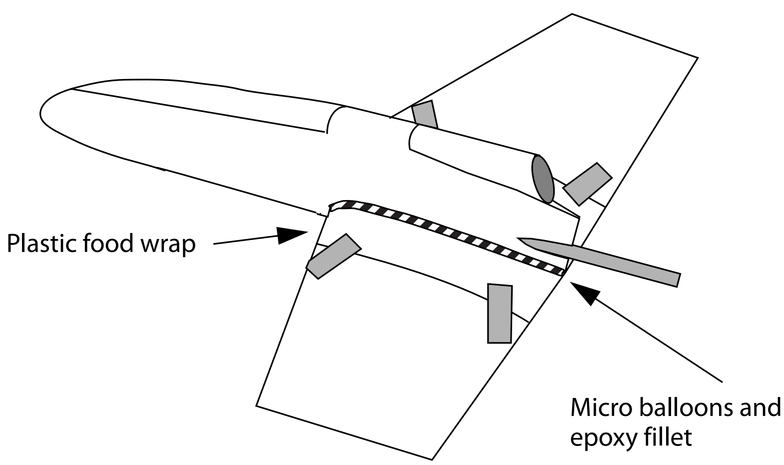
q **Epoxy wing bolt plate in fuselage**

q **Petroleum jelly on bolt threads**

q **Triangle on bottom**

Remount the wing and reinsert the wing bolt. We recommend you put a bit of petroleum jelly on the threads just in case some epoxy finds its way into the blind nut. Don't screw it all the way in because you will pull the wing bolt plate up against the wing. Tape the wing into place and recheck the wing tip to boom tip distances. Hold the wing in position until the epoxy on the wing bolt plate cures.

Finish the job by cutting a scrap of 1/8″ balsa in a triangle and adding to the bottom of the wing right behind the lip of the fuselage. Shape it to make a smooth transition between the bottom of the fuselage and the bottom of the wing.



Remove the wing and tape plastic food wrap around the center section. Reattach the wing and be sure to screw the bolt all the way in. Make sure the wing is square with the fuselage. That is, the fuselage should not be tilted to the right or left.

Make a thick mixture of epoxy and micro-balloons. Use the mixture to make fillets between the wing and fuselage and fill any gaps. The plastic food wrap will protect the wing.

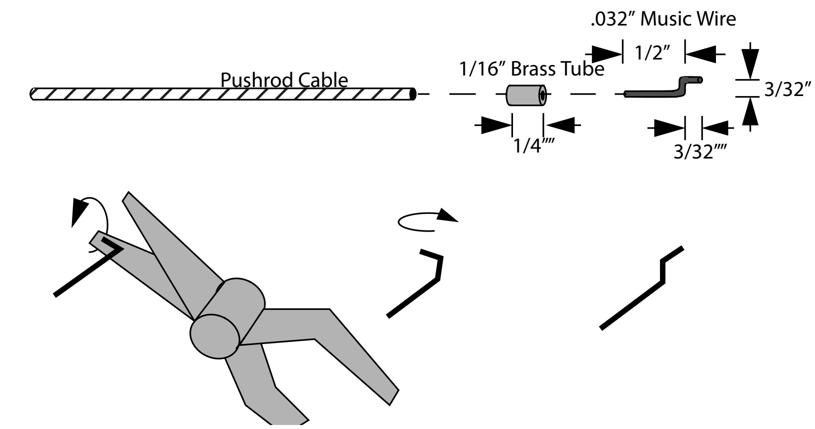
Fillet the fuselage-wing joint

q **Wrap plastic food wrap around wing**

q **Micro-balloon and epoxy fillet**

When making the fillet, we recommend you wear a rubber glove or stretch plastic food wrap over your finger. Dip your covered finger in alcohol and smooth the epoxy and micro-balloon fillet

When the fillets are cured, remove the wing and discard the plastic wrap. Clean up the edges of the fillet with sandpaper.



An optional modification to the standard pushrod cable will make them extra stiff. Suspend the cables with tape and anchor the hanging end to something solid. Coat the cable with soldering flux (used for plumbing work). Starting at the top of a cable heat it with the soldering iron and run a bead of solder all the way down its length. Try to work fairly quickly and not leave any lumps behind. After the solder cools, repeatedly draw the cables between pieces of 120 grit sandpaper until they are smooth. Trial fit the cables in the sleeves. They should be quite free to move.

Prepare Pushrods

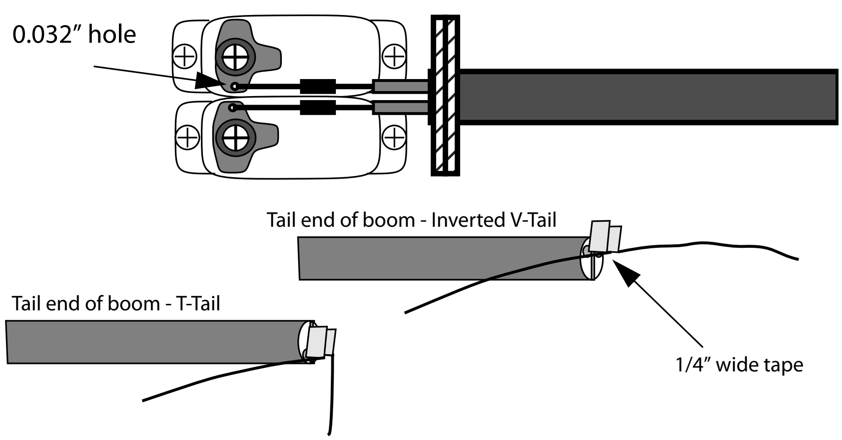
q **Coat pushrods with solder**

q **Bend Z-bends**

q **Cut collars**

q **Solder pushrod & Z-bend in collar**

Make 2 Z-bends from 0.032” music wire having the dimensions indicated. A trick to making really small Z-bends is to make the second bend first. Then make the “first” bend by gripping the second bend between the jaws of pliers and rotate it 90 degrees to the shaft of the Z-bend. Now the tip of the Z-bend will be sticking off to the side of the shaft. So, just twist it into a line parallel with the shaft. Using a razor saw cut two 1/4” collars from 1/16” brass tubing. Polish the end of the Z-bend with 120 grit sand paper and coat it with solder paste. Coat the end of the pushrod cable with solder flux. Insert the pushrod cable and Z-bend into the brass collar meeting at the center. Tape a pushrod and Z-bend to a board so your hands are free. Heat the brass collar with a soldering iron and touch solder to one of the open ends. The solder should be immediately drawn into the collar solidly joining the Z-bend to the cable. Join the pushrod and Z-bend on the second cable.



The servo horns must be but cut down so they are no wider than the body of the servo. Remove the servo horns from the servos and drill a 0.032” hole in each horn to receive the Z-bend on the end of the pushrod cables. Use a piece of 0.032” wire in a Dremel tool to drill the holes. Take note that the left and right horn have the hole on opposite sides. Drill the hole as close to the output shaft as possible. To get the proper clearance on the Z-bends you will need to bend the tip of the “Z” away from the shaft.

Install servos and pushrods

q **Insert pushrods**

q **Install servos**

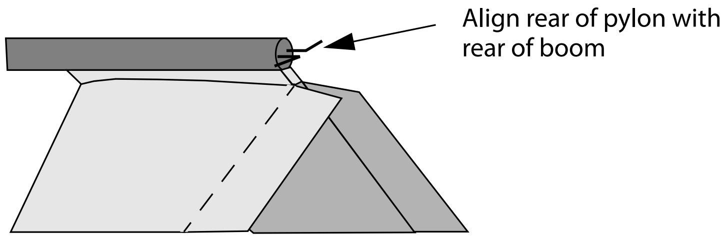
q **Bend ends of pushrods**

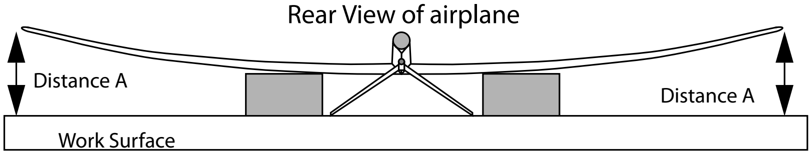
q **Trim pushrods**

Install the servos as indicated. Remove the servo arms, attach the servos to a receiver, power-up the receiver and center the servos. Slip the pushrods into their sleeves and attach them to the servo arms. Reattach the servo arms to the servos. Cut two 1/2” x 1/4” strips of masking tape. Wrap a strip around the pushrods where they exit the sleeves at the rear of the boom. Make sure the tape is just touching the end of the sleeve.

If you are building the inverted V-Tail, Grip the tape with a pair of needle nose pliers so the edge of the pliers is flush with the rear edge of the tape. Bend the left pushrod 90 degrees to the left and the right pushrod 90 degrees to the right. **If you are building the T-Tail,** bend the left pushrod 90 degrees to the left and the right pushrod 90 degrees down. Trim the pushrod ends to 1/4” in length.

V-Tail





Assemble V-Tail

q **Support wing**

q **Align tail to boom**

q **Glue tail to boom**

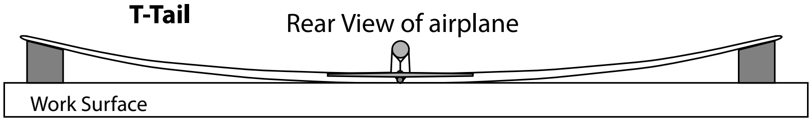
q **Reinforce joint with boom**

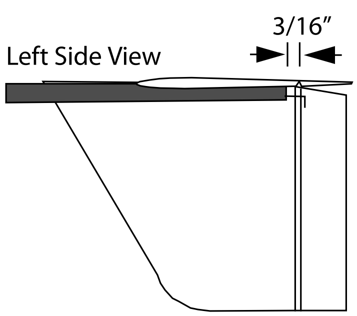
Put the wing and fuselage assembly on a flat work surface. Put a support under the wing so it is approximately the same height as the tail as illustrated. Slip the tail under the end of the boom. Adjust the wings so each tip is the same distance from the work surface. Distance A should be the same for each wing tip.

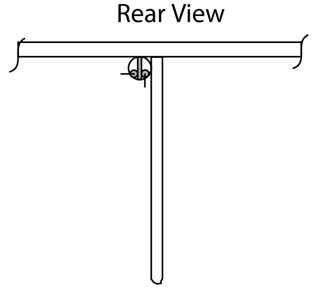
Temporarily tape the tail to the end of the **bottom** of the boom. NOTE! This is an inverted V-tail. The rear of the pylon should line up with the lower edge of the end of the boom as illustrated. The boom should fit snugly in the trough you sanded in the top of the pylon. If not, take corrective action now. The trough is assuring that the tail is aligned parallel to the boom. Adjust the inverted V-tail so when you sight down the center of the "V" inside the tail it is aligned with the boom. Put thin CA along each side of the joint between the boom and the tail.

Reinforce the joint between the boom and the pylon and the upper joint between the pylon and tail surfaces with a strip of fiberglass cloth and laminating epoxy. After the epoxy cures, sand the fiberglass and fillet with 5 minute epoxy and micro-balloons as needed to make a smooth joint. Caution!!! Fillet sparingly on the tail since it adds weight and affects the CG location.

T-Tail







Assemble T-Tail

q **Support wing**

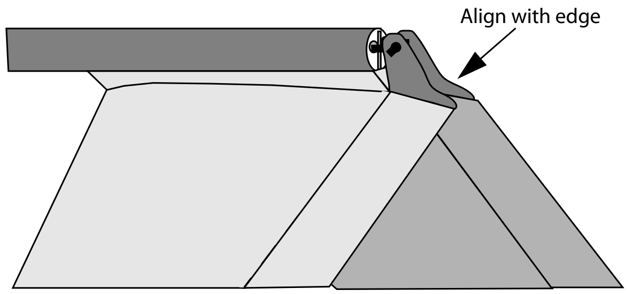
q **Align tail to boom**

q **Glue tail to boom**

q **Reinforce joint with boom**

Put the wing and boom assembly on a flat work surface. Keeping the wing flat, support the tips so they are equal distance from the work surface. Tape the boom to the work surface. Temporarily tape the horizontal stab on the boom with the center seam aligned with the boom.The hinge line should be 3/16" beyond the end of the boom. Adjust the horizontal stab until it is level. Measure the distance from the right wing tip to the right horizontal tail tip. Then measure the distance from the left wing tip to the left tail tip. The distances should be exactly the same. If they are not, adjust the tail and try again. When you have it where you want it, mark the location of the tail relative to the boom. Putting some marks on the work surface to reorient the tail should be sufficient. Lift the tail and put a line of 20 minute epoxy and micro balloons in the trough on the bottom of the tail. Put the tail back on top of the boom taking care to align the marks. Check to be sure it is horizontal and tape it in place until the epoxy sets. The vertical fin goes on right side of the boom with the top butted under the horizontal stab. The rudder hinge line should be directly under the elevator hinge line as shown. Us a 90 degree triangle to make sure the vertical fin is perpendicular to the horizontal stab. Glue the vertical fin in place with 5 minute epoxy. Reinforce the joints with a strip of fiberglass cloth and laminating epoxy. Fillet as necessary to make smooth joints. Caution!!! Fillet sparingly on the tail since it adds weight and changes the CG location.

Inverted V-Tail



Tape something straight (a piece of wire will do) on the tip of the control surfaces to hold them straight. Attach the servos to your receiver and center the control arms.

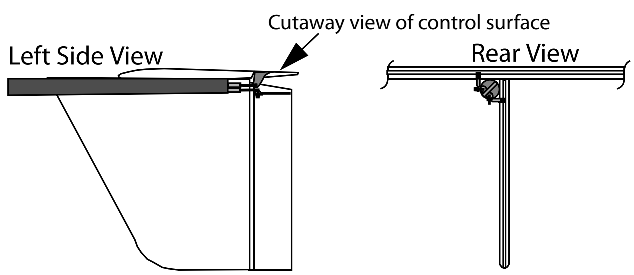
If you are building the inverted V-tail, Work the control horns over the end of the pushrod cables. Attach each control horn to the edge of each control surface with CA. Both control horns must be in the same position relative to the hinge line. Otherwise, control throw will be different on each one.

If you are building the T-Tail, work the control horn onto the end of each pushrod. You will need to rotate the end of the balsa web between the pushrod sleeves about 45 degrees to get the most clearance for each of the control horns. Cut a groove in the control surface for the horn to seat. Sink it as far as possible into the control surface. When you have it right, it should look like the bottom illustration. Attach the control horns to the control surfaces with CA.

Trial fit control horns

- q **Tape control surfaces neutral**
- q **Slip control horn on pushrod**
- q **Glue horn in place**

T-Tail



Both inverted V-Tail and T-Tail - Reinforce the control horn attachment with a wrap of fiberglass cloth and 5 minute epoxy. After the epoxy has cured, remove the piece of wire (or what ever) you have taped to the tail tips to hold the control surfaces straight. To prevent the pushrods from slipping out of the control horns, trim the end so approximately 3/32" sticks out of the control horn. Smash the end flat with a pair of pliers.

Hook up the radio gear again and work the controls. Each control horn should exactly center and the control linkages should be free of any play. If there is any play in the interface between the pushrod linkage and the control horn (like the hole is too big), you can put a tiny bit of thick CA on the pushrod right where it enters the hole in the horn. [Caution! This is extremely dangerous at this point. If any CA gets on the inside of the pushrod sleeve, it will glue the linkages solid and you will have to replace them. It is advisable to put petroleum jelly around the pushrod where it exits the sleeve. This will help prevent any accidents. Use a toothpick to apply the CA.

Finish control horn installation

- q **Reinforce control horn attachment**
- q **Clip excess pushrod**
- q **Smash end of pushrod**

Lateral Balance

Lateral balance is very important to good handling during boost and glide. If one wing is heavier than the other, the 'Cuda will tend to yaw on boost and turn in glide toward the heavier wing. When the model is suspended inverted, the wings should remain level. Invert the model and suspend it at a point on the pod in front of the wing and at a point behind the wing. If one wing drops, add weight to the opposite wing tip until the wings remain level. A small nail pushed into the wing tip makes a good wing tip weight. You can then fill the hole with a little light spackle or epoxy and microballoons.

Finish and Color

If you are sport flying the 'Cuda, you might want to consider fiberglassing the outside of the pod. You can easily do this with some 0.75 oz. fiberglass cloth and laminating epoxy. You can also use CA to attach the fiberglass. Sand the fiberglass well to remove any excess epoxy/CA and smooth the surface. If you are flying 'Cuda competitively and are an experienced RC pilot, we would not fiberglass the pod, since every gram counts.

The best colors we have found are black and orange. Black is usually very good on the bottom of the wing. However on "blue days" we find orange to give better contrast. You can safely use low-temperature heat-shrink films to cover the wing. "Standard" heat-shrink coverings probably should not be used. They are heavy and every time we have used them on a wing like the 'Cuda wing, we have inadvertently melted the foam under the sheeting.

Dope and Japanese tissue make an excellent covering because of its light weight. However, you **must** be sparing with the dope. If it seeps through the sheeting, it will dissolve the foam like cotton candy in your mouth.

The ultimate in low weight finish is no finish. Use a big marker pen to color the wing. You can do this if you feel the wing is rigid enough to handle the rocket motors you are using. Be careful about using D11P or D12 motors. They tend to stress the airframe. we do not recommend their use if you don't cover the wings unless they are already quite rigid.

One of the most important things to remember is to **keep the tail light!** It takes 2 grams in the nose to balance an extra gram in the tail. That's 3 extra grams. Keep this in mind. Every extra gram of weight reduces the boost altitude approximately 2 meters and the duration about 6 seconds.

If you want a nice finish on the boom, put a couple coats of clear dope on it.

Installing the Receiver

The pod on Cuda will accommodate micro/mini receivers. Some examples of receivers which will fit in the pod include the RCD 535, Futaba R112JE, R122J, R148 and R114H receivers. If the receiver case fits in a space approximately 1.25" X 2.25" X 0.9", it should fit in the pod. Removing the receiver case may save as much as 10 grams. That would increase the duration as much as 1 minute!

Substituting a light weight wire for the standard antenna on most receivers will save a couple of grams and make it easier to keep the CG in the recommended range without adding nose weight. You may want to do some experimentation in routing the antenna. we have been able to route the antenna inside the boom and even cut the length to about 750 mm without significant loss in range. You will need to try it to determine if it will work for you. Be sure to check your range with the antenna taped to the bottom of the boom from several angles, recording the distance. Then route the antenna inside the boom and determine if you still have adequate range. Getting the antenna inside the boom can be a challenge. An easy way to do it is to slide a thin piece of music wire in the rear of the boom. When it exits inside the pod, grab it with a pair of needle nose pliers and pull it out the opening in the front. You can either tape or solder the end of the antenna wire to the music wire. Then pull it through the boom. It is often convenient to put a pin connector about 1" from the receiver. These connectors are available from Radio Shack and are used as pins/sockets in RS232 connectors. If you do add a connector, be sure to completely insulate it. If you do have a significant loss in range when routing the antenna inside the boom, make a small hole for it to exit the pod and tape it along the bottom of the boom.

The Cuda is designed to accept up to a 110 mah flat battery pack. These are available from many sources. We have been using Sanyo cells purchased from E.H. Yost [4]. You can quick-charge a battery between flights, though we prefer to charge 4 or 5 packs and change them after they reach about 4.8 V when tested with an expanded scale volt meter. We typically get 30 minutes from a 50 mah battery and 45 minutes from an 80 mah battery.

There is room for a battery switch in the Cuda. However, to minimize weight we use a Cannon [5] micro connectors to plug the battery into a lead coming from the receiver. If you want to put a switch in the pod, We recommend you use a 2.5mm two pole plug and normally closed jack. They can be wired so the battery can be charged when the plug is inserted. If you choose to set it up so the battery can be charged while it is in the pod, make up a separate plug which is "open" and has a streamer attached to it. Then you can leave the "open" plug installed right up to the minute you are ready to launch.

Setting up the Controls

This is not a normal V-Tail aircraft! The most convenient approach is to use the Elevon mode on your transmitter. Though we have never tried it, we have been told you can use the V-tail mode. If you run into problems try switching the left and right channels at the receiver.

You don't need a lot of control throw; 5/32" total travel in each direction is plenty. Set your control centers and then adjust the throw volumes to give total travel of 5/32" in each direction. It is critical you get exactly (as possible) the same total travel on each control surface. Otherwise you will introduce a roll component when you give the model up or down. This is very disturbing at 100 m.p.h. on boost. You can flight-check your control throws by doing inside loops to check the up travel and outside loops to check the down travel. There should be no roll induced in either loop.

Of course for the T-tail configuration, you just need to adjust the neutral setting. Your total control throw will be dictated by the geometry. If you can adjust the throw volume we suggest starting with it to give 5/32" of total control surface travel.

Longitudinal Balance

The flight behavior of the 'Cuda can be changed dramatically by changing the Center of Gravity (CG) - the point where it balances front-to-rear. The recommended CG range is from 3 1/8" to 3 5/8" from the trailing edge of the wing. You will notice it being much more sensitive when the CG is near the rear of the range. You may even have to hold opposite rudder in the turns to keep it from tightening on you. Near the center of the range it should become much smoother. At the forward limit it should be stable and docile in glide. Start with the CG in the center and experiment to find the behavior you like best.

Launcher

The really cheap and dirty way to launch the 'Cuda is by putting a launch lug on it somewhere and launching it off a 1/4" steel rod. But that would be a terrible thing to do given how much work went into the design and building of this airplane. Build a simple launch tower as illustrated in Figure 1. To build the tower you will need some 1/2" plywood or similar wood, 1/2" dowels or Fiberglass tubing which can be obtained from a kite sales company such as Into the Wind [6] and 1" x 2" lumber.

The tower base is just two pieces of wood bolted together in an inverted T with an elevation brace hinged to it. Little blocks are glued and nailed on either side of the upright to prevent it form tipping side-to-side. On top of the upright is a ceramic tile blast deflector. It can be mounted by drilling a hole through it and putting a screw into the top of the upright. Then just hang the blast deflector on the screw. Drill holes in base to allow large spikes to be used for stabilizing the launcher in windy conditions.

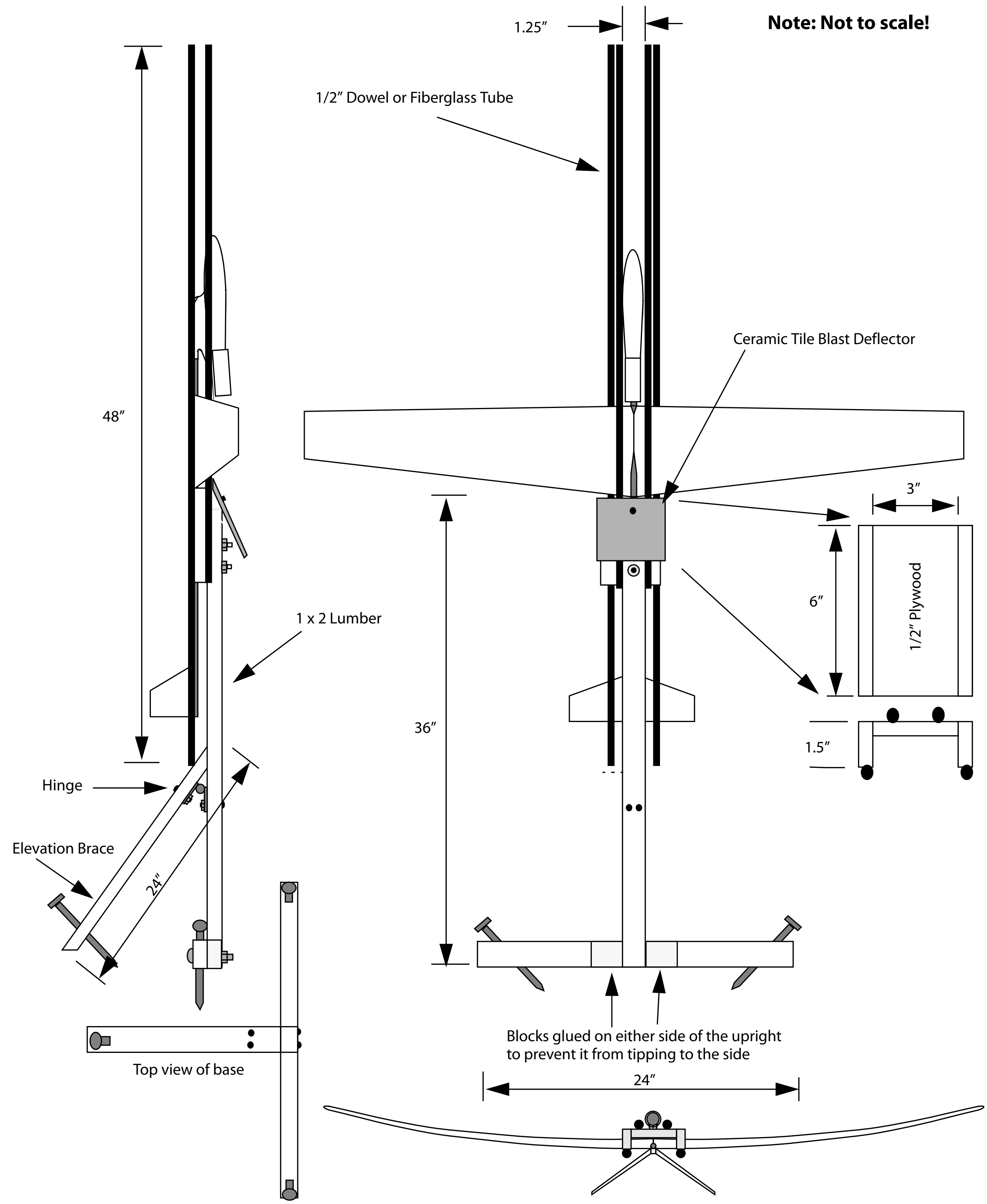


Figure 1 - Launcher Tower Configuration

Ignition System

The rocket motors used in 'Cuda are no different than other rocket motors and should be ignited with a standard model rocket 12 V. electrical ignition system. However, there are some additions which are beneficial. It is not always convenient to have someone ignite the motor for you. If you add 100 feet of 18 gauge lamp cord to extend the igniter leads and foot pedal switches, you will be able to ignite the rocket motor and have your hands free to hold the radio transmitter. Figure 2 is a schematic for a simple rocket motor ignition system. The foot switches can be just a doorbell switch mounted on a board. Or, you can go to an industrial supply house and pick up some foot switches for controlling machinery. The piezo electric buzzer can be found at Radio Shack. Pick out one that will not draw more than 50 milliamps. When switch #1 is closed the circuit through the buzzer is completed telling you if there is continuity through the ignitor - call it the "Arming "switch. Foot switch #2 completes the firing circuit. You need both switches to be safe and avoid an accidental launch.

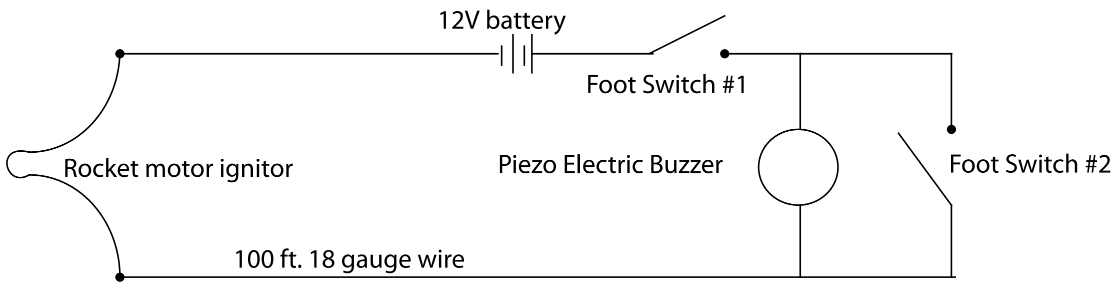


Figure 2 - Rocket Ignition System Schematic

Flying the 'Cuda

Be sure you have an expended motor or appropriate ballast in the motor tube before trimming the 'Cuda for glide. If you do not have an expended E6 motor, 4 nickels are a suitable ballast. Trim the 'Cuda for a straight, flat, fairly fast glide. Once you have it trimmed for this mode of flight, you are ready to boost it. But, what motor to use? We highly recommend you purchase a RC Reloadable Motor System™ (RMS™) from AeroTech™ [1]. The 24 mm RC RMS will accept propellant slugs for the D7 (20 newton-sec), E7 (30 newton-sec) and E6 (40 newton-sec). This is the most economical method of rocket boosting the 'Cuda. It is what we use for practice flights. For competition AeroTech produces two single-use motors; the E6 and E4.5. Both are super motors for competition use. The E6 has a little higher average thrust (6 newtons) and the E4.5 burns a little longer (almost 10 seconds). These are by far the best motors to use in this glider.

The Estes [2] D11-P is an acceptable motor for sport flying. However, it has a rather high peak thrust and can reach burnout speeds as much as 20% higher than a D7. So, you need to be careful if you use this motor. Don't do any abrupt maneuvers at speed. When using a D11-P, wrap masking tape around the nozzle end of the motor so it will just stay in the motor tube when holding the glider vertical. The D11-P is a black powder motor. Sometimes this type of motor experiences catastrophic failures due to temperature cycling and separations between the propellant grain and the paper casing. If this occurs, it almost always blows the propellant grain out the top of the casing in a big fireball. You want the motor held as loosely as possible in the motor tube so it will blow itself out the back instead of blowing the pod to pieces. There is no guarantee the model will survive a catastrophic motor failure, but at least you will have done what you can to minimize the damage.

The first time you fly the 'Cuda, you should use a D impulse motor. Leaving the model in the trim for a fast flat glide, aim the launcher approximately 70 degrees above the horizon. Cuda should arc up to vertical as the speed builds. On each launch you should make adjustments to remove any roll/yaw or pitch from the boost. The ideal boost will travel out about 70 degrees above the horizon and arc to vertical about 2 seconds into the boost. Total boost altitude on a D impulse motor should be about 300 feet.

After the boost phase, be sure to readjust the trims for glide. If you have a computer radio, a very convenient method to control the boost and glide trim is to use the “gear” switch (channel 5) to switch between the trim settings. The ‘Cuda will glide fairly slowly, but it is not a floater. To get the correct minimum sink trim, keep adding up-trim until it begins to visibly “mush” (sink rate increasing while the nose is up). Then, add 3 or 4 clicks of down trim to get it moving again. If you notice it being difficult to handle or “twitchy”, move the CG forward a bit.

If you stand directly behind the ‘Cuda during boost you might notice a couple of problems. First, the model can be quickly obscured by the exhaust plume from the motor. Second, the roll orientation of the model is sometimes difficult to quickly determine. One way to alleviate these problems is to stand approximately 30 degrees to the side of the model and about 100 feet away during launch. Also, launching the model out at an angle (~70 degrees) and then pulling up to vertical allows you to maintain visual contact throughout the boost phase. If you launch vertically off the launcher, the model will quickly disappear in the plume. Likewise, if you are standing too close on launch the plume will obscure the model.

You should be quite confident of your control of the ‘Cuda on a D boost before trying an E6. You can trim the ‘Cuda to boost hands-off on a D. You **will** have fly it through boost with an E6. For some reason, this knowledge psyches some rookie pilots so much that they will loose control right off the launcher. This is almost always due to over control. The thing to remember is to not rush. If the ‘Cuda is starting to stray off course during boost, don’t be in too big a hurry to correct it. Gently and slowly make corrections. It is flying at about 100 m.p.h. and is quite responsive at those speeds. We recommend for the first E6 launch to trim it for a hands-off boost on a D7. Then, don’t even touch the controls during the first few seconds of boost. If after about 4 seconds it is starting to wander, make small corrections moving the sticks slowly and smoothly.

The objective of S8e is duration and the ‘Cuda is an excellent thermal ship with good speed range. Experiment with that range at lower altitudes so you will know how to handle it when you are in lift or sink at the top of boost. If you should find yourself in strong lift use due caution. Because the ‘Cuda is small, under some circumstances it will disappear at about 2000 feet. This seems like a long way up, but, consider that you start your thermal hunting at the top of a 1000 foot boost. If you notice it is getting quite uncomfortable to fly you should immediately take action to reduce its altitude. Unlike a typical sailplane, you can safely fly the ‘Cuda straight down to terminal velocity. BUT! make your pull out a gentle one. You can pull a lot of Gs from a vertical dive.

Adding a towhook

It is not always convenient to fly with rocket motors. If you want to have some fun and build stick time, add a towhook and use a small up-start to tow the ‘Cuda to a couple hundred feet. A towhook can be fabricated from a piece of 1/16” music wire and a piece of 1/16” plywood as illustrated in Figure 3.Once the towhook is fabricated it can be glued or taped to the bottom of the model with the most forward part of the bend of the towhook 5/32” ahead of the center of gravity. Get the towhook as close to the centerline of the model as possible. The model will tow to altitude just like a normal sailplane.

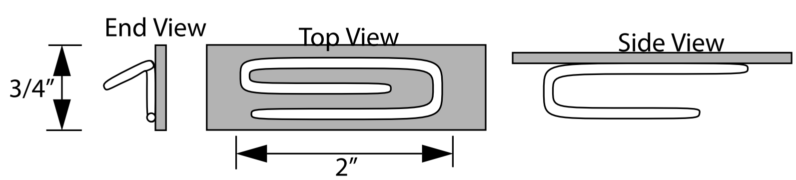


Figure 3 - Fabricating a Towhook

Safety Issues

Adequate safety measures must be observed when flying any RC model and rocket powered models in particular. Two safety codes are applicable: The Academy of Model Aeronautics [3] (AMA) aircraft safety code and Model Rocketry Safety Code.

1997 Official AMA National Model Aircraft Safety Code

General

1. I will not fly my model aircraft in sanctioned events, airshows, or model flying demonstrations until it has been proven to be airworthy by having been previously, successfully flight tested.

2. I will not fly my model higher than approximately 400 feet within 3 miles of an airport without notifying the airport operator. I will give right-of-way and avoid flying in the proximity of full-scale aircraft. Where necessary, an observer shall be utilized to supervise flying to avoid having models fly in the proximity of full-scale aircraft.

3. Where established, I will abide by the safety rules for the flying site I use, and I will not willfully and deliberately fly my models in a careless, reckless and/or dangerous manner.

4. At all flying sites a straight or curved line(s) must be established in front of which all flying takes place with the other side for spectators. Only those persons essential to the flight operations are to be permitted on the flying side of the line; all others must be on the spectator side. Flying over the spectator side of the line is prohibited, unless beyond the control of the pilot(s). In any case, the maximum permissible takeoff weight of the models is 55 pounds.

5. At air shows or model flying demonstrations a single straight line must be established, one side of which is for flying, with the other side for spectators. Only those persons accredited by the contest director or other appropriate official as necessary for flight operations or as having duties or functions relating to the conduct of the show or demonstration are to be permitted on the flying side of the line. The only exceptions which may be permitted to the single straight line requirements, under special circumstances involving consideration of site conditions and model size, weight, speed, and power, must be jointly approved by the AMA President and the Executive Director.

6. Under all circumstances, if my model weighs over 20 pounds, I will fly in accordance with paragraph 5 of this section of the AMA Safety Code.

7. I will not fly my model unless it is identified with my name and address or AMA number, on or in the model. Note: this does not apply to models flown indoors.

8. I will not operate models with metal-bladed propellers or with gaseous boosts, in which gases other than air enter the internal combustion engines(s); nor will I operate models with extremely hazardous fuels such as those containing tetranitromethane or hydrazine.

9. I will not operate models with pyrotechnics (any device that explodes, burns, or propels a projectile of any kind) including, but not limited to, rockets, explosive bombs dropped from models, smoke bombs, all explosive gases (such as hydrogen-filled balloons), ground mounted devices launching a projectile. The only exceptions permitted are rockets flown in accordance with the National Model Rocketry Safety Code or those permanently attached (as per JATO use); also those items authorized for Air Show Team use as defined by AST Advisory Committee (document available from AMA HQ). In any case, models using rocket motors as a primary means of propulsion are limited to a maximum weight of 3.3 pounds and a G series motor. Note: A model aircraft is defined as an aircraft with or without engine, not able to carry a human being.

10. I will not operate any turbo jet engine (axial or centrifugal flow) unless I have obtained a special waiver for such specific operations from the AMA President and Executive Director and I will abide by any restrictions(s) imposed for such operation by them. (Note: This does not apply to ducted fan models using piston engines or electric motors.)

11. I will not consume alcoholic beverages prior to, nor during, participation in any model operations.

Radio Control

1. I will have completed a successful radio equipment ground range check before the first flight of a new or repaired model.

2. I will not fly my model aircraft in the presence of spectators until I become a qualified flier, unless assisted by an experienced helper.

3. I will perform my initial turn after takeoff away from the pit or spectator areas, and I will not thereafter fly over pit or spectator areas, unless beyond my control.

4. I will operate my model using only radio control frequencies currently allowed by the Federal Communications Commission. (Only properly licensed Amateurs are authorized to operate equipment on Amateur Band frequencies.)

5. I will not knowingly operate an R/C system within 3 miles of a pre-existing model club flying site without a frequency sharing agreement with that club.

6. I will not fly my model aircraft in any racing competition which allows models over 20 pounds unless that competition event is AMA sanctioned. (For the purposes of this paragraph, competition is defined as any situation where a winner is determined.)

7. Every organized racing event requires that all officials, callers, and contestants must properly wear helmets which are OSHA, DOT, ANSI or SNELL approved **while on the race course.** In addition, all officials occupying safety cages wear protective eyewear.

Free Flight

1. I will not launch my model aircraft unless at least 100 feet downwind of spectators and automobile parking.

2. I will not fly my model unless the launch area is clear of all persons except my mechanic and officials.

3. I will employ the use of an adequate device in flight to extinguish any fuses on the model after it has completed its function.

Control Line

1. I will subject my complete control system (including safety thong, where applicable) to an inspection and pull test prior to flying.

2. I will assure that my flying area is safely clear of all utility wires or poles.

3. I will assure that my flying area is safely clear of all non-essential participants and spectators before permitting my engine to be started.

0.1 The AMA Official National Model Rocketry Safety Code

(for all Space Modeling activities)

1. **CONSTRUCTION** - My model rockets will be made from lightweight materials such as paper, wood, rubber, and plastic, without any substantial metal or any hazardous material as structural parts.

2. **ENGINES** - I will use only pre-loaded factory made model rocket engines that comply with the NFPA codes governing model rocket engines that contain no more than 62.5 grams (2.2 oz.) of propellant.

3. **RECOVERY** - I will always use a recovery system in my model rockets that will return them safely to the ground so that they may be used again. I will use only flame resistant recovery wadding in my rockets.

4. **WEIGHT LIMITS** - My model rockets will not weigh more than 1.5 pounds (681 grams) at lift-off. The weight of my model rockets will be less than the manufacturer's recommended limits for the engine I use in that model.

5. **PAYLOADS** - My model rocket will never carry live animals, or payloads intended to be flammable or explosive.

6. **LAUNCH AREA** - I will launch model rockets outdoors in a cleared area free of tall trees, power lines, and buildings. I will ensure that people in the launch area are aware of the pending rocket launch and are in a position to see the rocket's lift-off before I begin my audible five-second countdown.

7. **LAUNCHER** - I will launch my model rockets from a launch rod or other device which provides rigid guidance until the rocket has

reached a speed adequate to ensure a safe flight path. To prevent accidental eye injury, I will always place a launcher so that the end of the rod is above eye level. I will cap or disassemble my launch rod when not in use, and will never store it in an upright position. My launcher will have a jet deflector device to prevent the engine exhaust from hitting the ground directly. I will always clear the area around my launch device of brown grass, dry weeds, and other easy-to-burn materials.

8. **IGNITION SYSTEM** - The system I use to launch model rockets will be remotely controlled and electrically operated, and will contain a launching switch that will return to off when released. The system will contain a removable safety interlock in series with the launching switch. All persons will remain at least 15 feet from the model rocket when I am igniting engines totaling 20 N-sec or less of total impulse; and at least 30 feet from the model rocket when I am igniting engines totalling more than 20 N-sec total impulse. I will use only electrical igniters that will ignite my rocket engine(s) within one second of actuation of the launching switch.

9. **LAUNCH SAFETY** - I will not let anyone approach a model rocket or a launcher until I have made sure that the safety interlock has been removed or the battery has been disconnected from my ignition system. In the event of a misfire I will wait one minute before allowing anyone to approach the launcher.

10. **FLYING CONDITIONS** - I will launch my model rocket only when the wind is less than 15 miles per hour and under conditions where the model will not fly into clouds, fly near aircraft in flight, or be hazardous to people or property.

11. **PRE-LAUNCH TEST** - I will check the stability of my model rockets before their first flight even when conducting research activities with unproven designs or methods. I will, when possible, determine their reliability through pre-launch tests. I will conduct launchings of unproven designs in complete isolation from persons not participating in the actual launching.

12. **LAUNCH ANGLE** - I will not launch rockets so that their flight path will carry them against targets. My launch device will be pointed within 30 degrees of the vertical. I will never use model rocket engines to propel any device horizontally.

13. **RECOVERY HAZARDS** - If a model rocket becomes entangled in a power line or other dangerous place, I will not attempt to retrieve it.

NOTE: Rocket engine specifications cited above conform to all United States Regulations currently enforced at this time of publication (January 1, 1993). Revisions will be made as required to maintain compliance. Further, this code is structured to meet the world standards established by the FAI.

References

[1] AeroTech, Inc., 1955 S. Palm St., Suite #15, Las Vegas, NV 89104, (702) 641-2301

[2] Estes Industries, 1295 H. Street, Penrose, CO 81240, (719) 372-6565

[3] Academy of Model Aeronautics, 5151 East Memorial Drive, Muncie, Indiana 47302-9252

[4] E. H. Yost, 7344 Tetiva Rd, Sauk City, WI 53583, 608-643-3194, Fax 608-643-4439

[5] Cannon Electronics, 2756 N. Green Valley Parkway, Suite 405, Henderson, NV 88014, 702-896-7203, Fax 702-896-7206.

[6] Into the Wind, 1408 Pearl Street, Boulder, Colorado, 80302-5307, telephone 800-541-0314