# Mike Hausner’s Coyote E


*Simplistic construction and gentle flight characteristics await you*
*Design, construction article, and photos by Mike Hausner.*

My goal was to design a foam model that went beyond the usual flat-sheet wing. I was also interested in enticing members of our club, The Village E-Flyers in central Florida, to build an airplane from plans.

Newcomers can be intimidated by the covering process and all of the tools required, so this model is made of 3 mm and 6 mm Depron foam sheet. It had to be easy to build, but I wanted a model that flies well, too.

I made the decision to use a three-dimensional flat-bottomed wing and a simple, self-jigging, built-up fuselage. I used the basic shape of the full-scale RANS Coyote ultralight airplane and, since I only had pictures to go by, I applied model-design parameters to proportion the model.

As designed, the model has sufficient strength for normal flight loads and mild aerobatics. Don’t be tempted to overpower it. The prototype shown here flies fine on 87 watts of power.

The tools required to construct the model are limited to the basics: a hobby knife, a straightedge and ruler/yardstick, drafting triangles, a hobby saw (for the plywood parts), a 6-inch square, blue painter’s tape, sandpaper and a sanding block, pliers, wire cutters, a felt marking pen, and a flat building surface.

Most gluing on this model is with contact cement. Use epoxy or CA adhesives where noted. Before starting, read the instructions all the way through to get a better idea of the building process.

**The model is patterned after the RANS Coyote Ultralight.**

## Specifications

Type: Electric sport model
Wingspan: 39 inches
Wing area: 239 square inches
Weight: 18 ounces
Wing loading: 10.8 ounces per square foot
Power system: 100-watt brushless motor; 20-amp ESC
Propeller: APC 8 x 3.8
Battery: Three-cell 1,320 mAh LiPo
Radio: Four-channel; four micro servos (five if you add flaps)
Construction: Foam

## Coyote E Materials List

- Glues: Foam Safe CA, UHU POR (or suitable contact cement), and epoxy. 3M Super 77 (for temporary attachment of templates to foam)
- (1) Sheet 6mm depron foam 27” x 39”
- (1) Sheet 3mm depron foam 13-1/2” x 39”
- (4) Micro servos (HS-55 or 9 gram servos) for aileron (2), elevator, & rudder.
- (1) Micro servo as above for optional flaps.
- Brushless outrunner motor and appropriate ESC (E-flite 370, Super Tiger 370 or 400)
- Propeller adapter and propeller as required (8 x 3.8 SF)
- (2) .032” music wire x 36” long (control rods for ailerons, elevator, & rudder)
- (1) .047” music wire x 8” long (control rod for flaps)
- 1/16” I.D. aluminum tubing x 4-1/2” long (for FLAP torque rod bearings)
- Sullivan Gold-N-Rods #504 (control rod guide tubes – use inner yellow part)
- (1) 1/8” plywood 6” x 12” (Dihedral brace, firewall, main and tail wheel mounting plates)
- (1) 1/16” plywood 6” x 12” (Flap actuator parts, wing trail edge reinforcement)
- (4) 1/8” x ¼” hard balsa stringers x 36” (wing spars)

- (1) 3/16” diameter wood dowel X 9” long (Wing hold down dowels)
- Main landing gear (from E-flite Mini Pulse or use Great Planes #L-1 (GMPQ1810)
- Wheels as required (1-3/4” diameter) and axles as required
- Tail Wheel Assembly (World Models #PL3410030 or equivalent)
- (4) E/Z Links for .032 push rods (DuBro #849)
- (4) Micro control horns (DuBro #919)
- CA hinges (one package)
- Scotch tape (elevator & rudder hinges)
- Servo extension leads for ailerons and flaps
- (1) Optional Y harness (for aileron servos)
- #64 Rubber bands (wing hold down)
- (1) 3/16” OD Brass tube (to make hole punch)
- Paint: Use water base acrylic, plastic model paint, or Krylon Short Cuts in spray cans

## Motor mounting hardware

- 4-40 screws x 1-inch long (as required)
- 4-40 blind nuts (as required)
- 2 1/2-inch plastic or carbon fiber tube (motor stand offs)
- Two 10-32 or 10-24 nylon screws (for landing gear attachment)

## Building the Fuselage

The fuselage is designed to be self-jigging. Start by laying out the templates on the foam board. Spray contact cement, such as 3M Super 77, can be used to temporally attach the template to the foam. Because all of the parts are defined by straight lines, you can mark the corners by cutting through the pattern with your hobby knife and then cut between the corners using a straightedge. Try to keep the knife at 90° to the foam board.

On the fuselage sides, lay out the locations for the formers and servo rails with a fine felt-tip pen. Scribe vertical lines on the fuselage sides at the locations indicated on the plans using a dull pencil. This will aid in bending the sides later. Test to see that each crease allows the side to bend approximately 5° without cracking.

Experiment with this procedure on a piece of scrap foam board so you don’t make the crease so deep that it weakens the fuselage sides. Don’t forget to cut the holes for the wing hold-down dowels.

Glue the following pieces to the right fuselage side: F-2A, landing gear plate (foam), receiver tray, F-3A, and servo tray. Make sure all these parts are at 90° to the fuselage side. The landing gear plate and the two trays will help. When the glue has set, add 6mm x 3/8-inch strips to increase the gluing area and add strength.

Glue the right and left fuselage doublers to their respective sides. These parts will provide the proper alignment for the firewall assembly (F-1A and B).

When this assembly has dried, glue the left side in place. Make sure everything is square. As this is drying, lay out the motor mount hole pattern on the firewall, noting that the motor mount center is offset to the left when viewed from the front of the airplane. This is because of right thrust and will enable the motor shaft to be centered where it exits the fuselage.

The motor will be mounted using 4-40 screws and stand-off tubes. The stand-offs allow for better motor cooling, easier motor wire routing, and adjustment of the side- and downthrust if

necessary.

The motor I used has only three mounting lugs. If yours has four, modify the firewall as required. Be sure to add the cooling holes for the battery and ESC.

Drill out the motor mounting holes with a 5/32 drill bit. Install the 4-40 blind nuts from the backside. Place a dab of RTV silicone or Vaseline in the threads to prevent them from being plugged with epoxy. Next epoxy the firewall F-1A to F-1B, and clamp until cured.

Getting back to the fuselage, install the right and left doublers. Make sure the shorter one is on the right side when looking forward as if you were in the cockpit. Now install F2C. This piece will establish the taper of the front fuselage and, together with the fuselage doublers, the right-thrust and downthrust angles for the firewall/motor mount. Install the motor mount assembly (F-1A and B) to the fuselage using 5-minute epoxy.

To create the taper at the rear of the fuselage, install F3B, F-4, F-5, and F-5B, and allow the parts to completely dry. Install the front and rear dowel supports with contact cement, then install the dowels with epoxy to keep them in place. After this has cured, sand the top and bottom edges of all formers even with the fuselage sides.

Mark and drill holes in the aluminum landing gear for the two 4-40 screws and drill them out using a 1/8-inch drill bit. Now center the aluminum landing gear over the plywood landing gear plate even with the front edge of the plate. Drill through the plywood landing gear plate using the aluminum landing gear as a template.

Enlarge the holes in the plywood plate with a 5/32 drill bit and install the two 4-40 blind nuts as you did with the motor mount. Glue the plywood landing gear plate in place with epoxy and install the tail wheel plywood plate in the same manner.

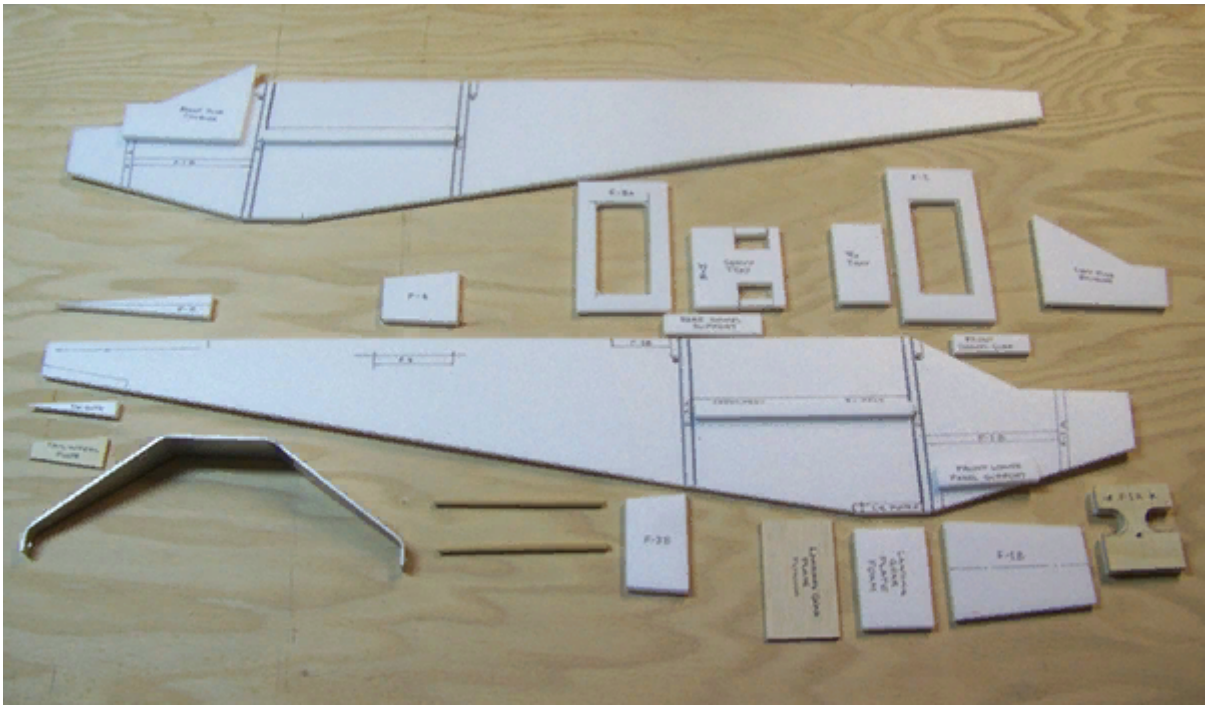
Run control rod conduits for the elevator and rudder. Note that as they cross at F-4, elevator is above and the rudder below. The elevator conduit exit at the tail is determined by the third hole in the control horn. The rudder conduit should exit lower than the elevator to avoid interference.

Cut out the elevator as one piece with a notch for a 1/4-inch dowel joiner. Cut a relief area for the joiner but do not separate the elevator halves. Epoxy the elevator joiner in place. After this assembly has cured, sand a 45° bevel on the hinge side (bottom) of the elevator. Sand the hinge side of the rudder as well. You have the option to taper the TE of the elevator and rudder. If you are going to taper the elevator and rudder, do it before you cut the elevator center. Refer to the plans for clarification.

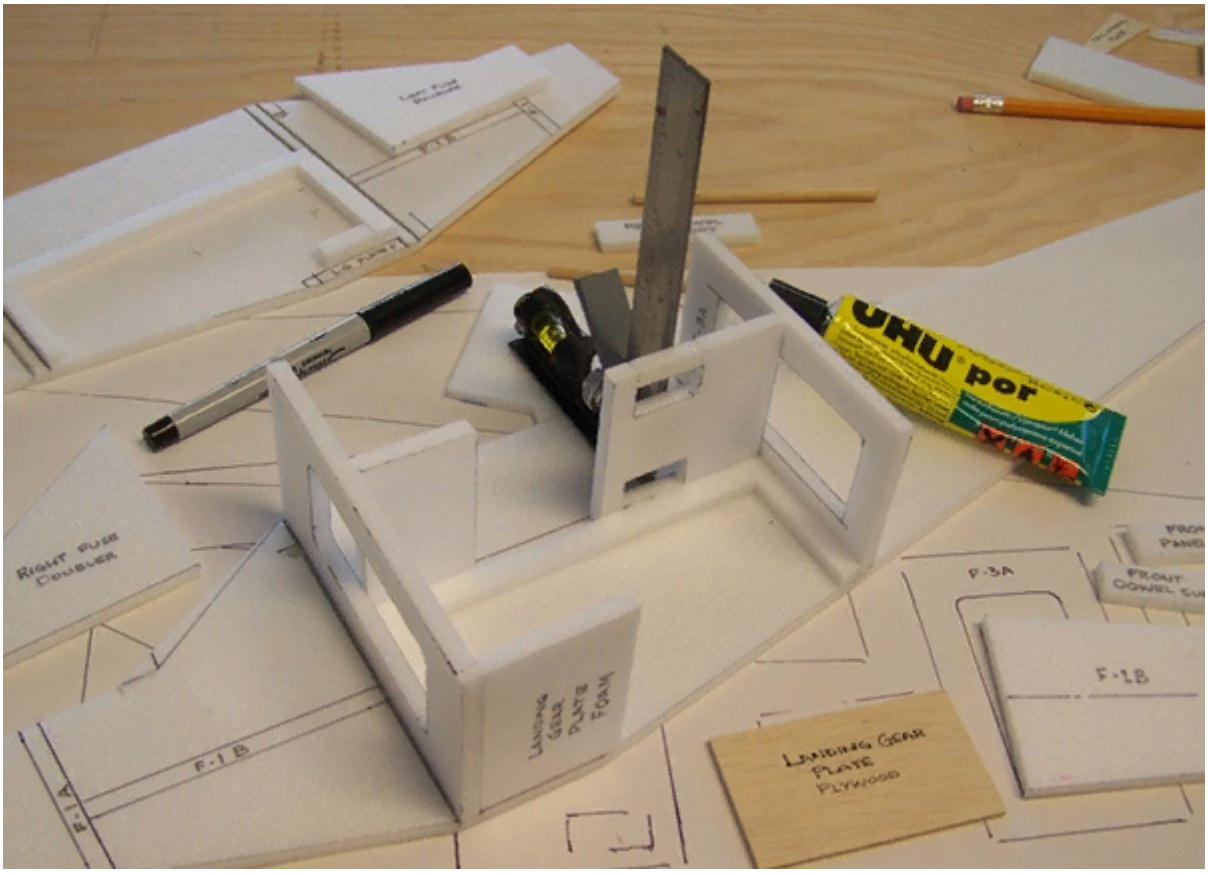
Hinge the elevator to the horizontal stabilizer with Scotch Tape. It is helpful to clean the surfaces with alcohol before applying the tape. Apply the tape to the top of the stabilizer and elevator, then bend the elevator over the top of the stabilizer and apply hinge tape to the bottom. Test it to ensure that you have sufficient surface movement up and down.

Trial fit the fin and rudder to the stabilizer assembly. You will have to cut a notch in the rudder to clear the elevator dowel as the elevator moves up and down. When you are satisfied with the fit, hinge the rudder the way you did the elevator. Epoxy the fin and rudder assembly to the stabilizer and elevator assembly. Use a square to make sure the fin is at 90°.

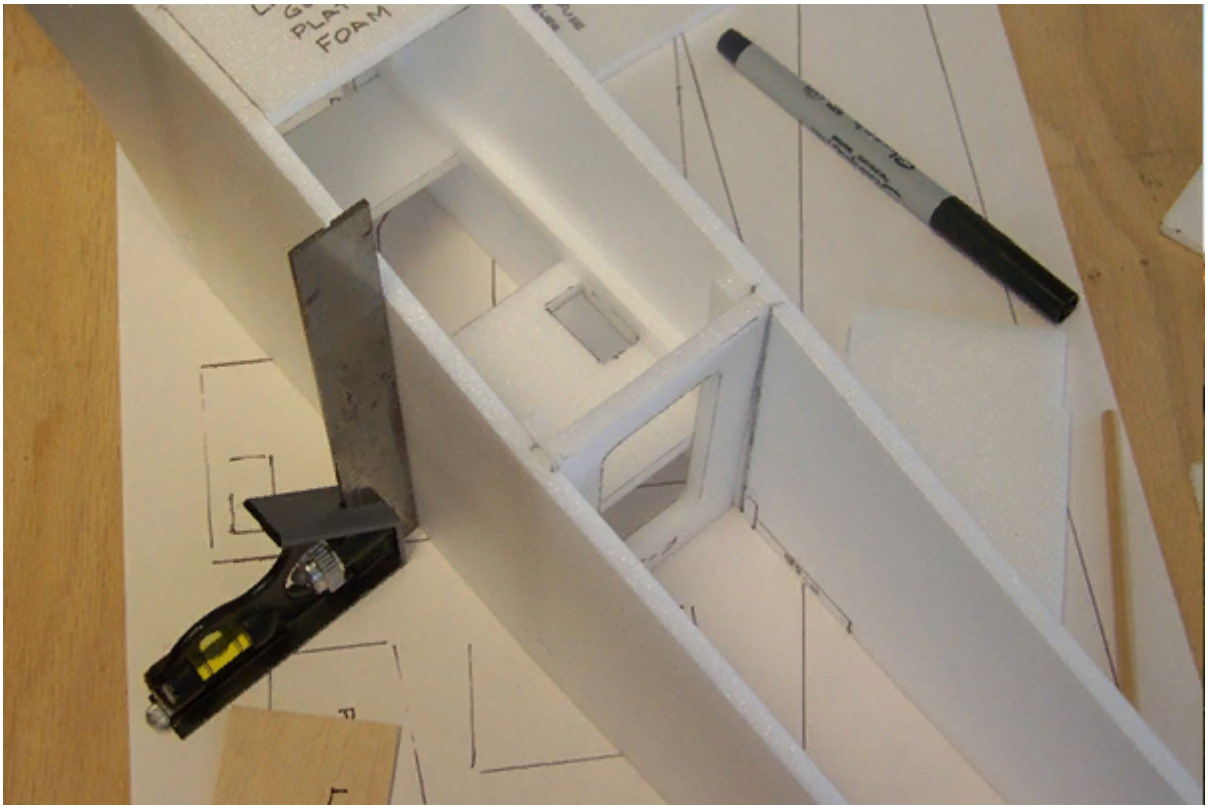
Trial fit the fin and stabilizer assembly to the fuselage. Make sure the horizontal stabilizer is parallel to the top fuselage sides where the wing will be attached. Lay a straightedge across the fuselage where the wing will set and sight from the front. Make your corrections now. It is important that the wing and stabilizer are parallel to each other and that the fin and rudder are centered. When satisfied, epoxy the fin and stabilizer assembly to the fuselage.



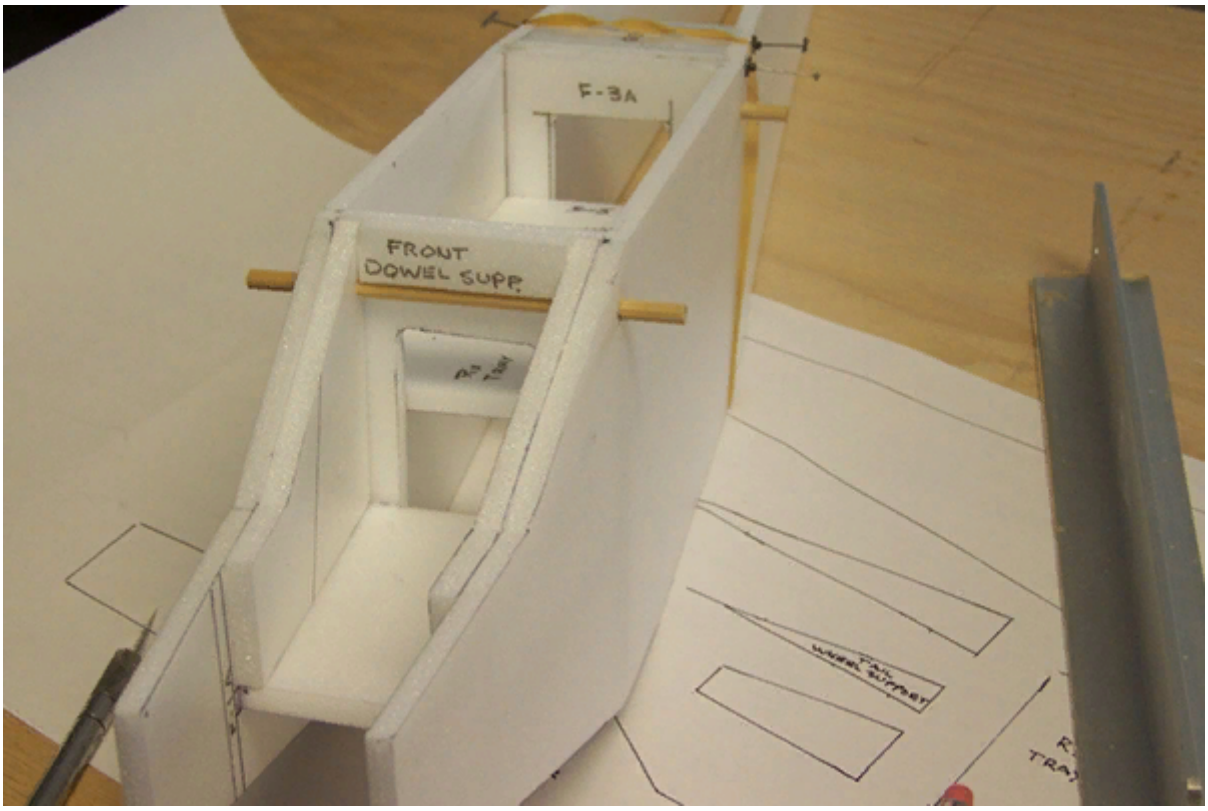
**Cut out all the parts for the fuselage, including the plywood pieces.**



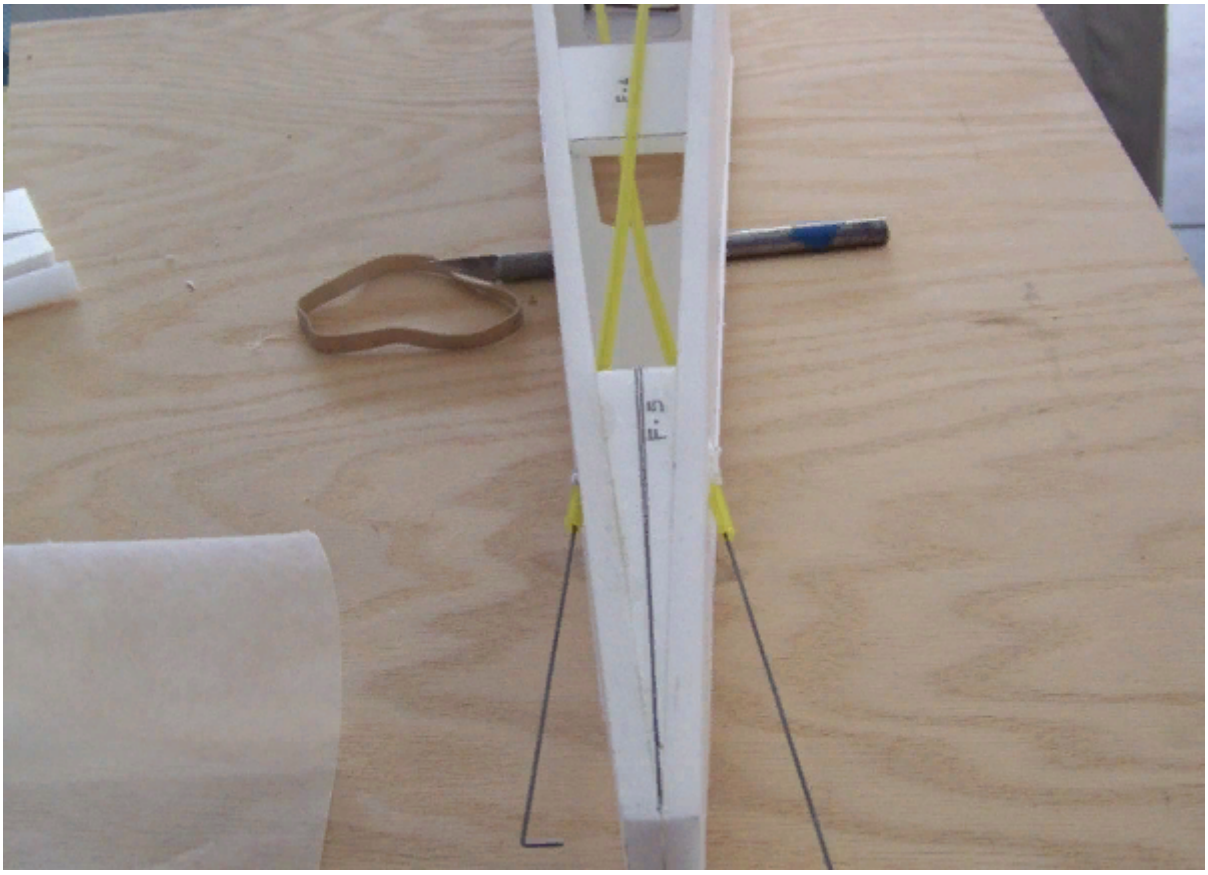

**The fuselage is designed so that it is self-jigging. Here the landing gear support, receiver tray, and servo tray are being glued in place.**



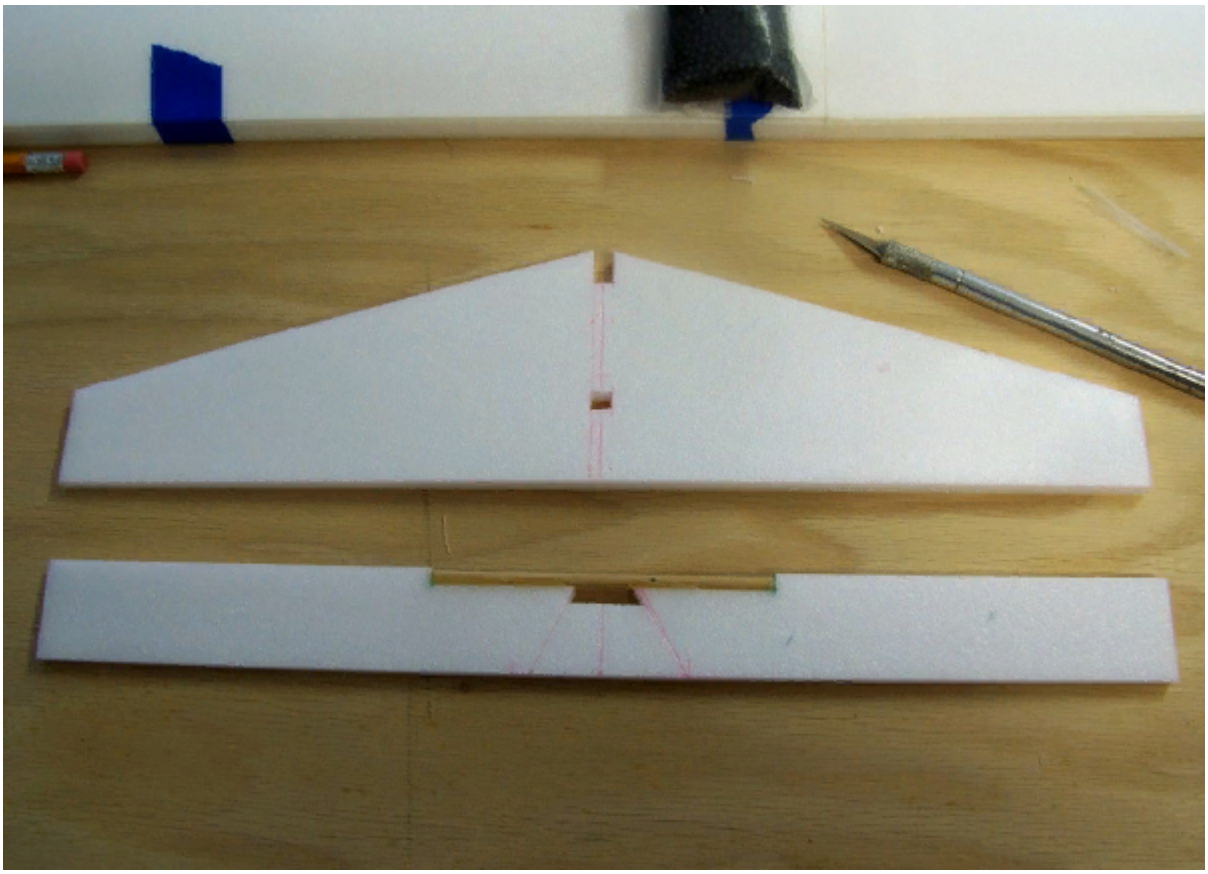
**Make sure the fuselage is square.**



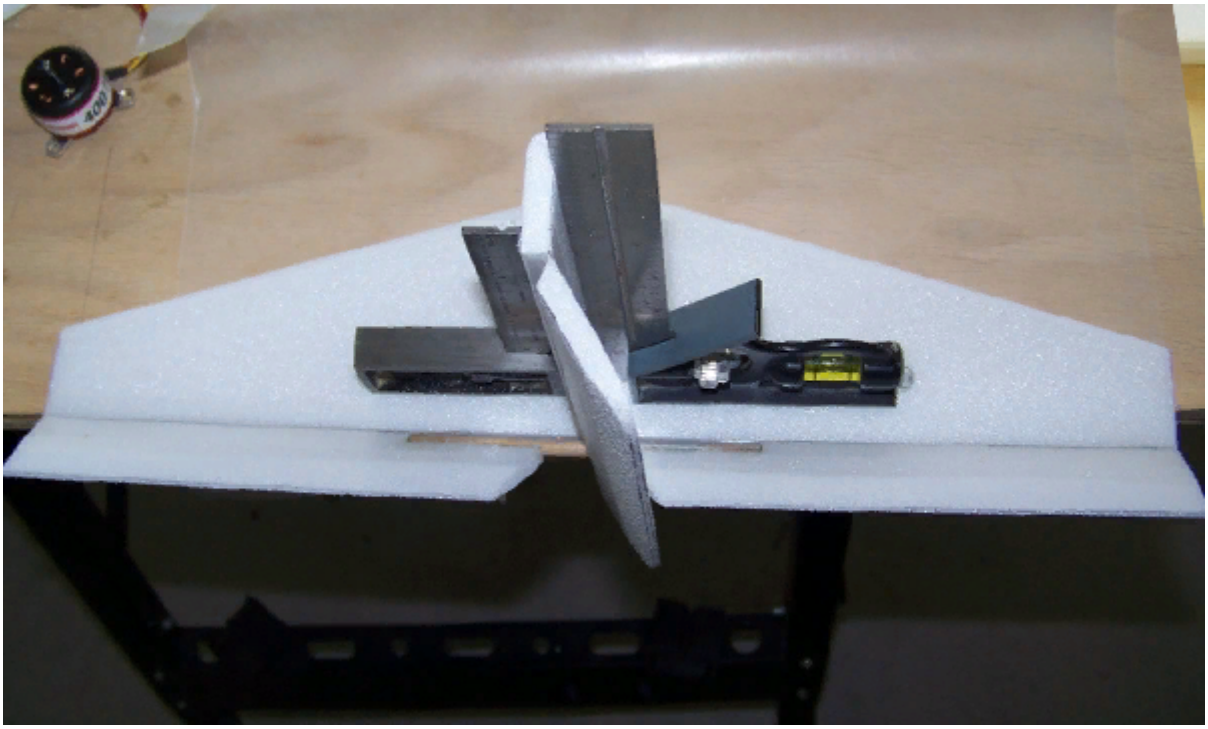

**Fuselage doublers and F2C create the front fuselage taper.**



**The elevator servo will be on the right, with the conduit crossing to the left rudder servo. Mark the fuselage's centerline.**



**Note the glue relief area for the elevator joiner. Cut away the center area after all sanding is completed.**



**Use a square to make sure the fin and stabilizer are at 90°.**

## Battery Access Hatch

Cut and fit a piece of 6mm foam to the front lower fuselage, but do not glue in place. Read this step through completely and decide if you want this type of latching system.

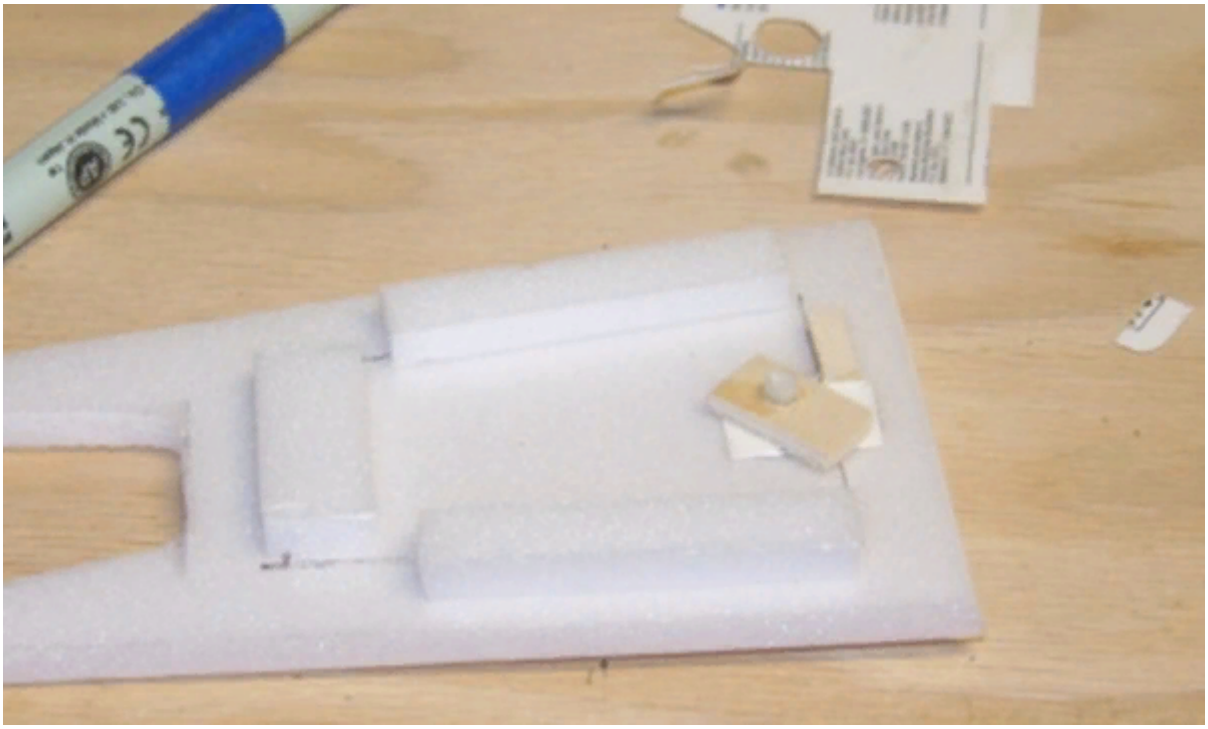
Otherwise you can hold the battery hatch in place with tape or magnets.

Use foam-safe CA to make a battery hatch as shown. The two long pieces of 6mm x 3/8-inch strips of foam are glued to the sheeting to keep the hatch from falling through. The shorter piece on the left is the tongue, glued to the hatch only, and it keeps the hatch from falling out. The latch is a piece of 1/8 light plywood drilled and tapped for a 6-32 nylon screw.

The drag of the threads allow plywood pawl to rotate with the screw until it hits the stop where the screw will then tighten the hatch. I used pieces of an old plastic card to make support shims under the screw head and latch pawl and also under the area where the latch pawl will move across the foam sheeting.

Install a small plywood stop to keep the pawl from rotating after the hatch is latched. When looking from the inside, tightening the screw will rotate the pawl counterclockwise. When satisfied with this assembly, glue it to the fuselage with contact cement.

Cut out pieces of 3mm foam for the rear top and bottom sheeting. Attach them using contact cement. Trim as required when dry. If desired, you can round the fuselage corners with 150-grit sandpaper.



**This shows the lower front fuselage sheeting with hatch and latch pawl.**

## Building the Wing

With the fuselage nearly complete it is time to build the wing. Start with the main wing spars. The wing spars are a sandwich construction using two 1/8 x 1/4 x 19-3/4 hard balsa sticks separated by a strip of 6mm foam. The balsa sticks are purposely cut longer than needed. They will later be trimmed.

Cut two strips of 6mm x 3/4-inch Depron 20 inches long. It is difficult to cut 6mm foam and maintain a 90° square edge, so after cutting, square up one of the long edges with a sanding block.

Using epoxy, glue one of the balsa sticks to the 3/4-inch wide surface of each foam strip so the 1/8-inch edge is even with the squared foam edge. It is important to use a straightedge to keep the balsa stick straight. When this has cured, epoxy another 1/8 x 1/4 balsa stick to the other side of the foam strip. Allow this to thoroughly dry then trim the extra foam to create the balsa/foam/balsa sandwich. Use the dihedral gauge found on the plans to sand one end of each spar to match the dihedral angle.

Cut the bottom wing skin from 3mm Depron 5 x 39 inches long. This is slightly long, but it will be trimmed later. Find the center and draw a perpendicular line using a fine felt-tip pen and a square or drafting triangle. Using the wing centerline on the plans, lay out the servo access panels.

Mark the left and right access panels and cut them out, separating them at the center. Align the bottom wing skin over the plans and temporarily tape it in place. Transfer the rib and hinge locations to the panel. Lay out the locations of the 7/16 LE, the 3/4 TE, and the spars on the bottom wing skin.

The CA hinges that come with the model are too big, so cut the 3/4 x 1-inch hinge material in three pieces. You will need to make eight for the ailerons and four more if adding flaps. Cut the

corners of one end of the end hinge to a 30-45° angle, as shown on the plans, to make it easier to install the control surfaces. Glue the hinges to the bottom sheeting as shown on the plans using foam-safe CA.

Install the right and left spars on the wing panel with epoxy. Leave a 1/32-inch gap at the center for dihedral bend clearance. To make the alignment of the spar easier, tape a straightedge to the panel.

Next install the 3mm x 3/4-inch TE over the CA hinges with contact cement. Leave a slight gap at the center for the dihedral bend. Install the 6mm x 7/16-inch LE in the same manner.

When you cut out the wing ribs, it is easier if you take the time to make a plywood template for W-1A and W-1B. The pieces will be more accurate and uniform. Use 1/16 or 1/8 plywood and glue on a handle for holding the template in place while cutting out the parts.

Install the three outboard LE ribs—W-1A—on the right and left wing panels. The six W-1A center ribs will be installed later.

To provide clearance for the aileron servo wires, cut a clearance notch in the bottom of six of the TE ribs—W-1B (see plans). Install these ribs in their location over the servo wire cutout. Do not install the two center ribs at this time, but go ahead and install the four W1-B pieces without a clearance notch to their locations on the right and left wing panels.

Trim six LE ribs—W-1A—so that the 1/8 plywood dihedral brace will fit ahead of the wing spar. Sand a slight bevel on the bottom edge of two LE ribs (W-1A), and two TE ribs (W-1B), so that they will sit at an angle on the wing skin. Use the dihedral gauge as a guide.

Glue these two LE and TE ribs in place at wing centerline. Install the remaining LE ribs. Cut a strip of 3mm foam 3/8 x 39-inches long. Cut this into pieces to fit between the ribs. These pieces will support the servo wire access panel when it is reinstalled. Glue them to the bottom skin so that roughly 1/8 to 3/16 inch overhangs the servo wire cutout.

Sand the LEs and TEs, being careful not to sand through the hinges. Trim the spar, LE, TE, and bottom wing skin flush to the outboard ribs. Next, weight one wing panel and prop up the other until the wingtip is elevated 11-1/16 inch above the building surface. Apply epoxy to the area between the center ribs and where the dihedral brace will be installed. Install the dihedral brace and clamp. Remove excess epoxy before it dries. Once cured, clean up any mismatch between the top of the spar and the dihedral brace.

For the top wing skins, cut two pieces of 3mm Depron 5-3/16 wide x 19-1/2 inches long. Carefully form the wing skin using a broom handle or 3/4-inch diameter tube or dowel. Roll the dowel over a flat surface with the foam between the dowel and your hands. Work slowly, applying light pressure to form the skin. This will give the foam a slight curve making it easier to attach to the wing assembly. Each wing panel should look like the one in the photo.

Trial fit one of the top skins to the left wing panel. Care must be taken to align the TE and the center dihedral joint when the panel is glued in place. When satisfied with the fit, apply 30-minute epoxy to the wing spar only. Next sparingly apply two lines of contact cement to the TE. Continue along each rib, and then put two lines along the LE.

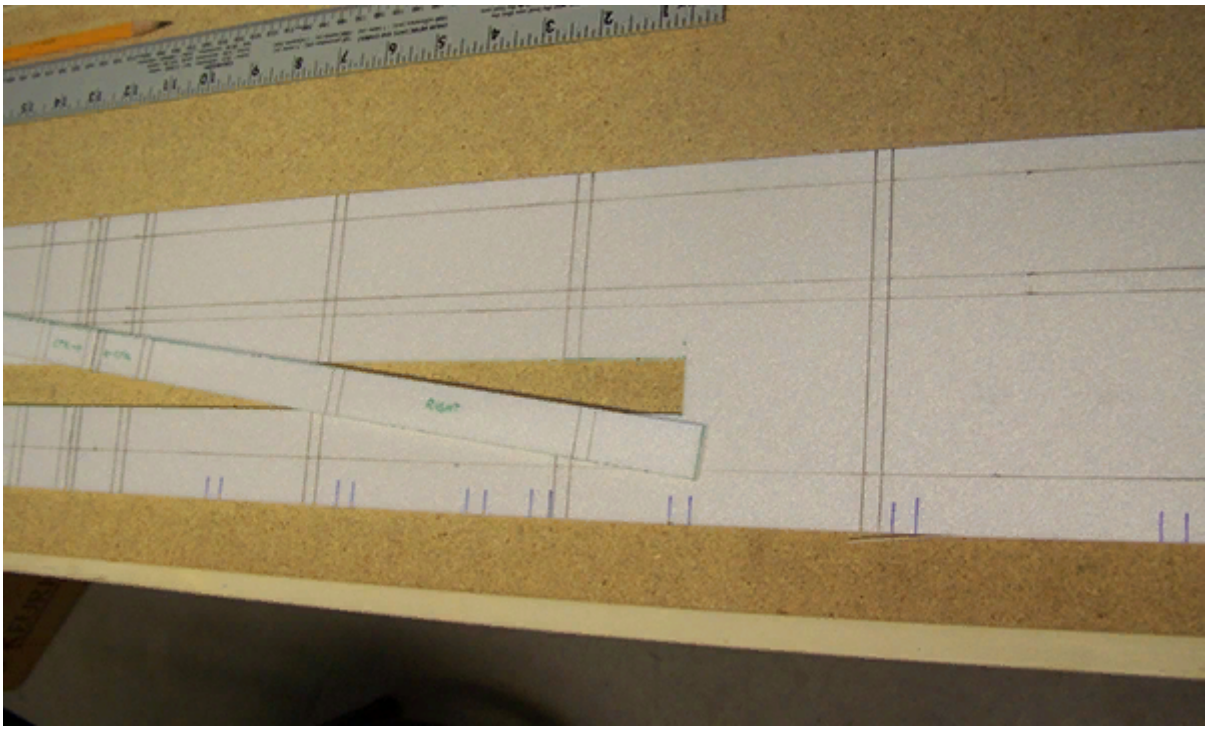
With the left wing half on a flat surface, place the top skin on the panel and lightly smooth it down so glue is transferred to the wing skin. Remove the skin and let it dry for a few seconds then reinstall by aligning the TE and center edges. Apply low-tack tape to the LE to help secure the top sheeting. Before the adhesives cure, slip a piece of 6mm foam under the outboard TE corner of the wing to provide washout in the wing, which will improve stall characteristics.

Place weights on the LE and TE at the center of the wing and one weight at the wingtip LE, not over the corner with the 6mm shim. Smooth down the LE and spar areas, making sure the skin is adhered.

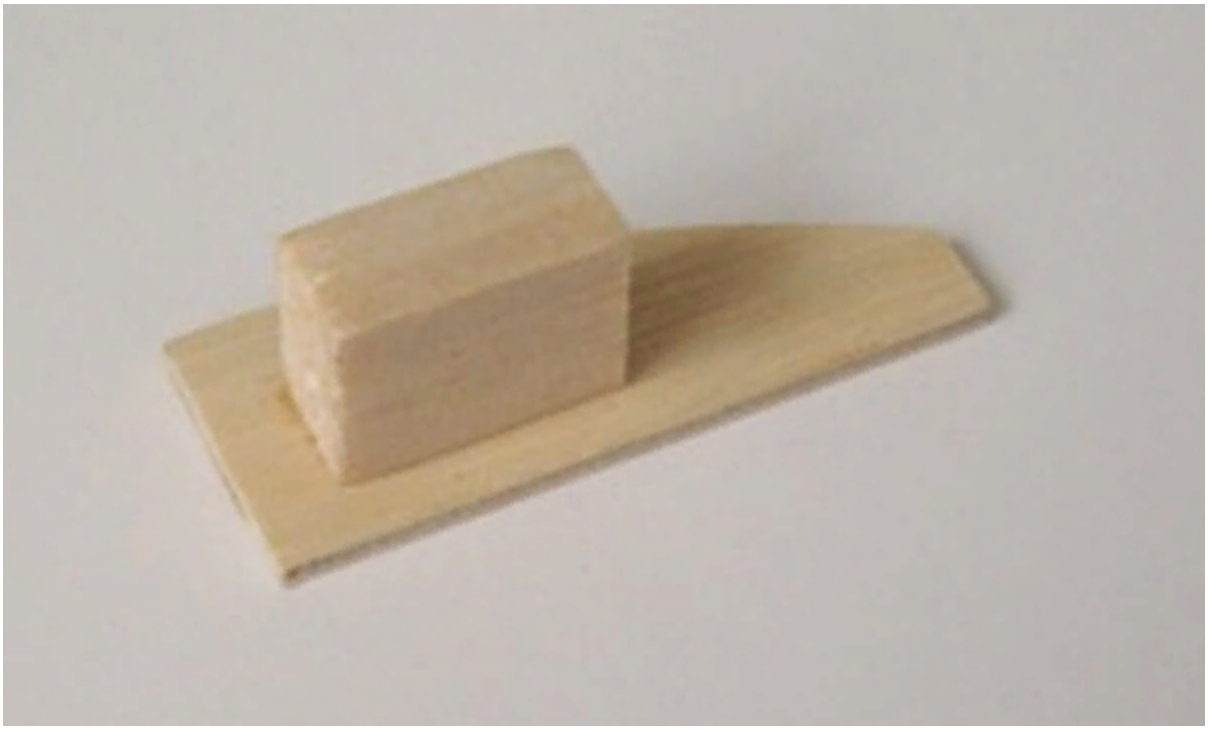
Do not touch the TE except at the center rib. Give this assembly at least an hour to dry, then remove the weights and place the TE on the edge of your work surface and gently press it down. When you sight down the end of the wing, you should be able to see a slight twist—the TE at the wingtip is higher than the LE.

Fitting the right wing skin at the center will require sanding a slight curve to match the left wing skin. When satisfied with this fit, glue the skin to the wing using the same procedure as before. Don’t forget the shim under the outboard TE.

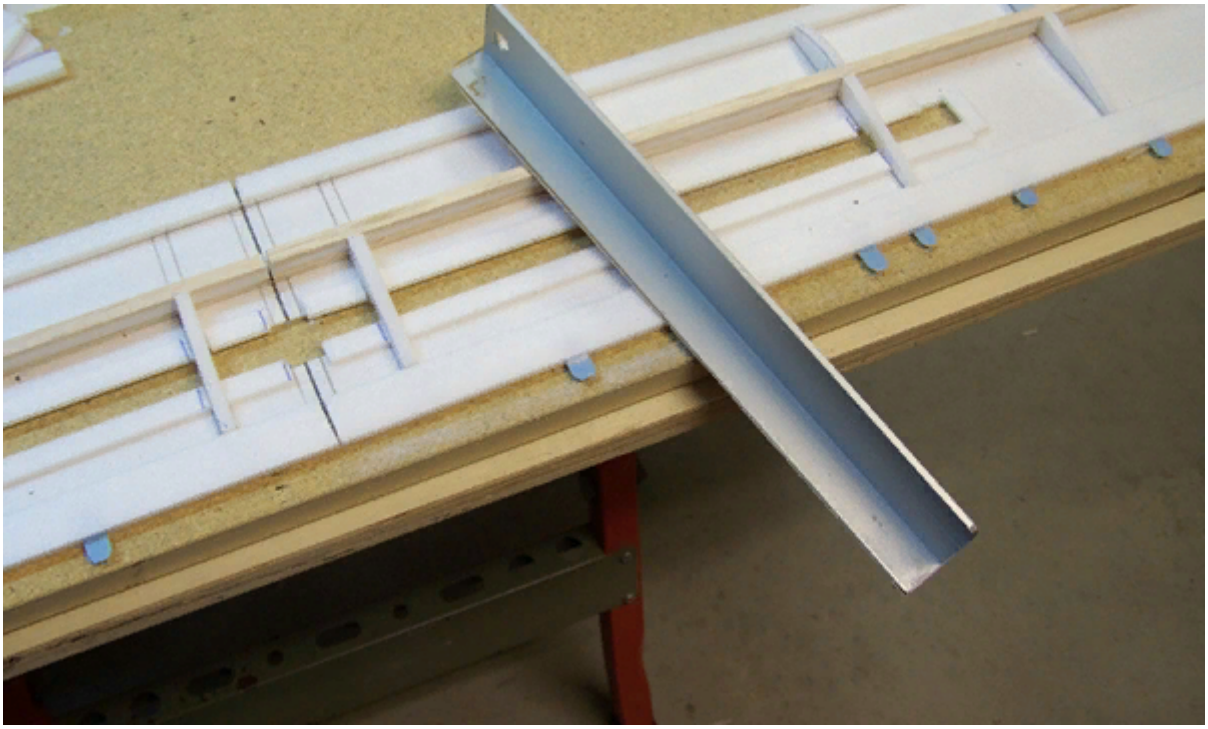

**Wing spars are made with 6 mm foam sandwiched between two balsa sticks.**



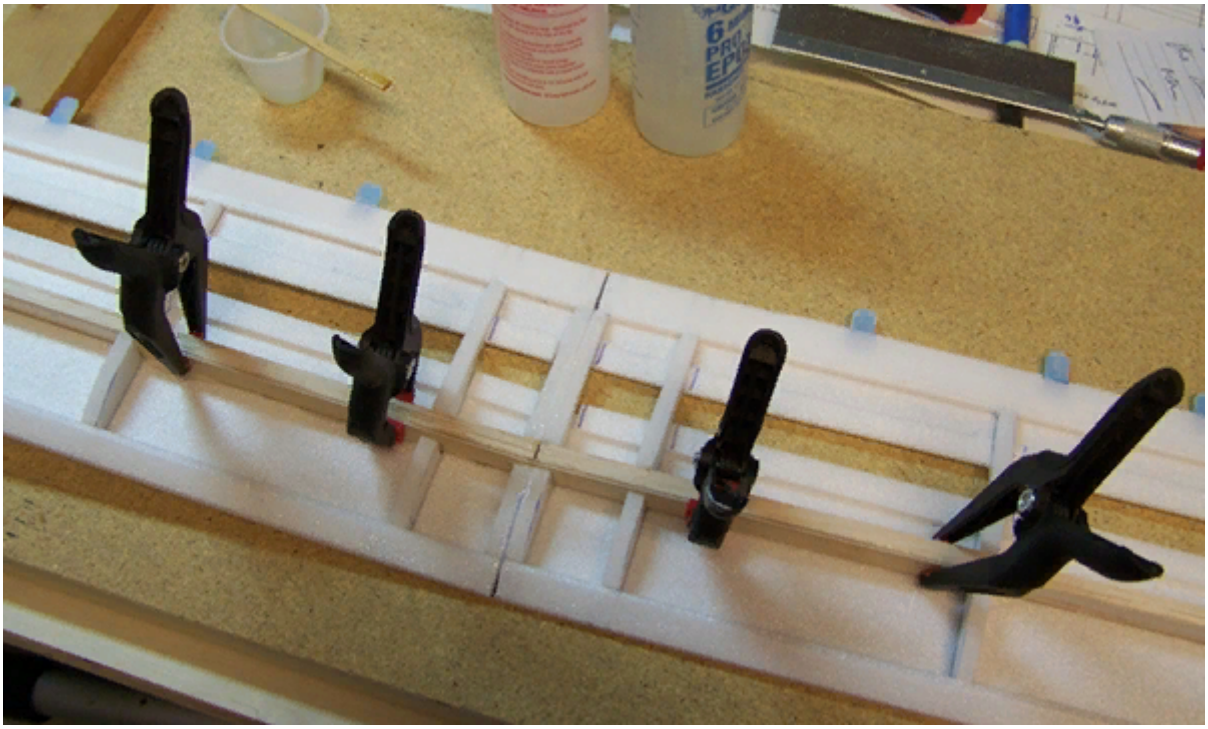
**Lay out the rib, spar, LEs, TEs, and hinge locations on the bottom wing skin.**



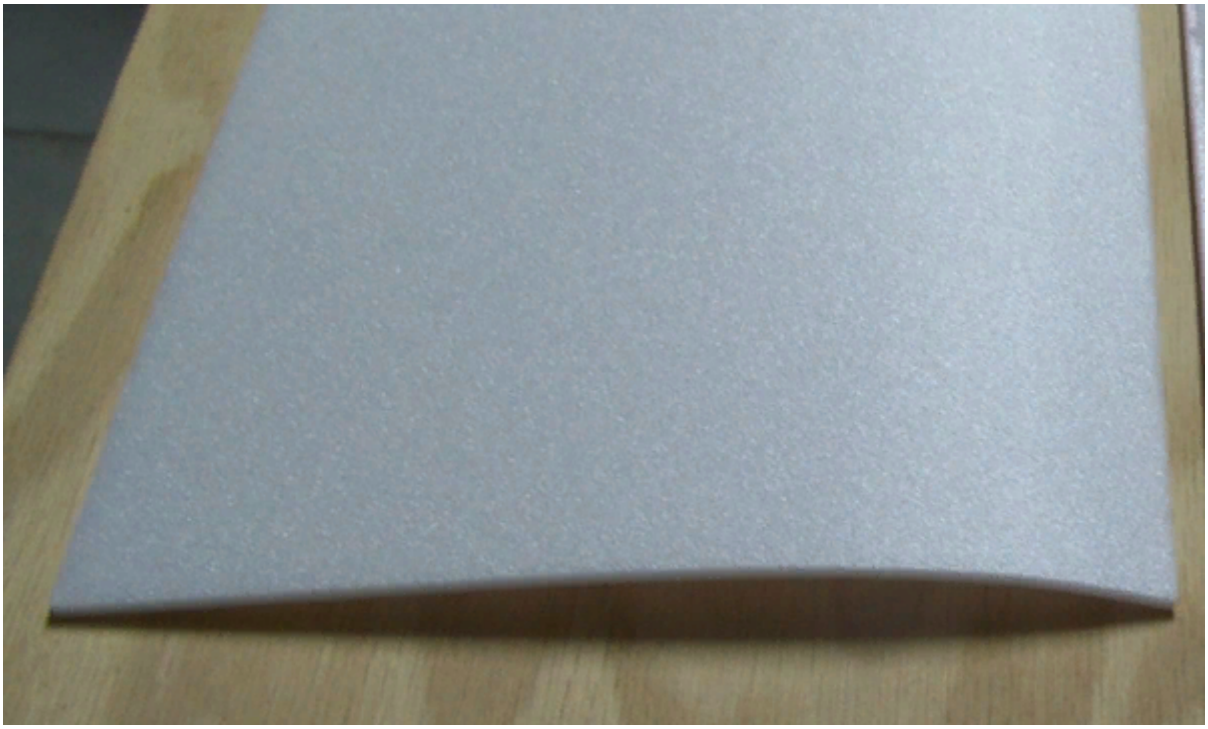
**Cutting out the wing ribs is easy if you make a template similar to this.**



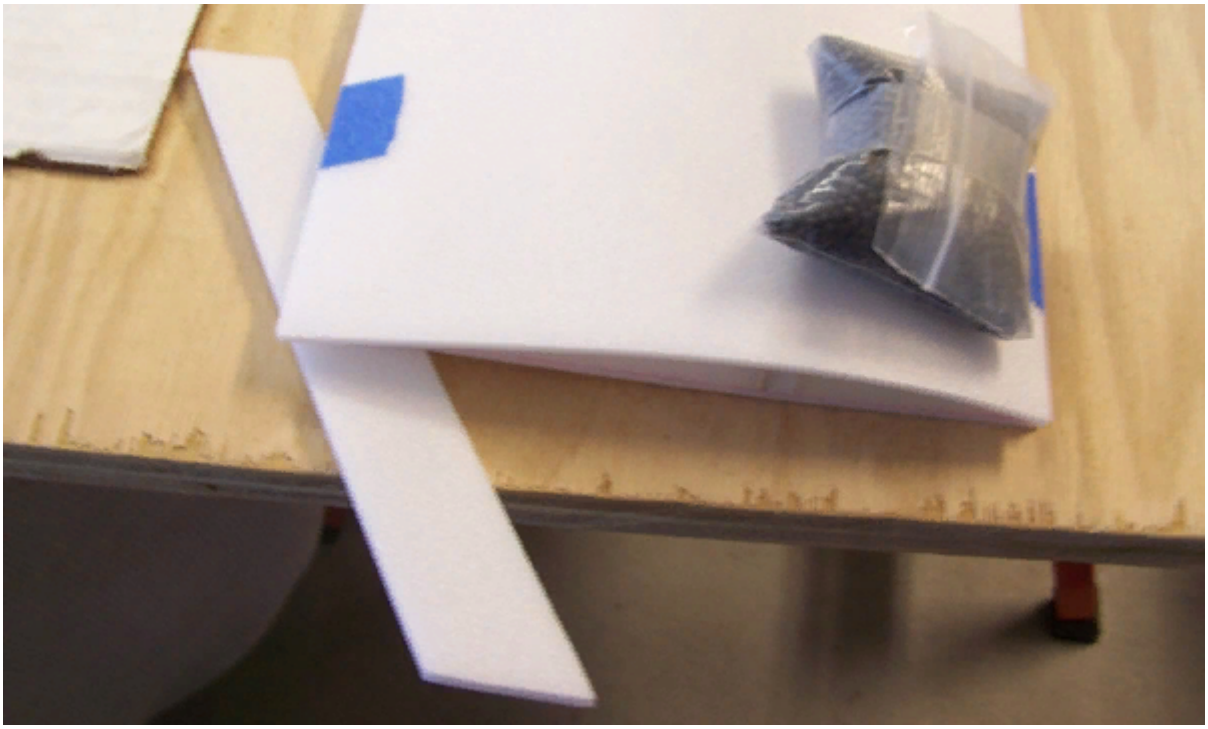
**When sanding the TE, take care not to sand through the hinges. This can be tedious, so take your time.**



**Clamp dihedral brace and center ribs until cured.**



**Roll form the top wing skins using a broom handle or 3/4-inch dowel.**



**With one wing panel weighted down, support the other panel 1-11/16 inches off the board and install the dihedral brace. Wingtip washout will improve stall characteristics.**

# Flaps

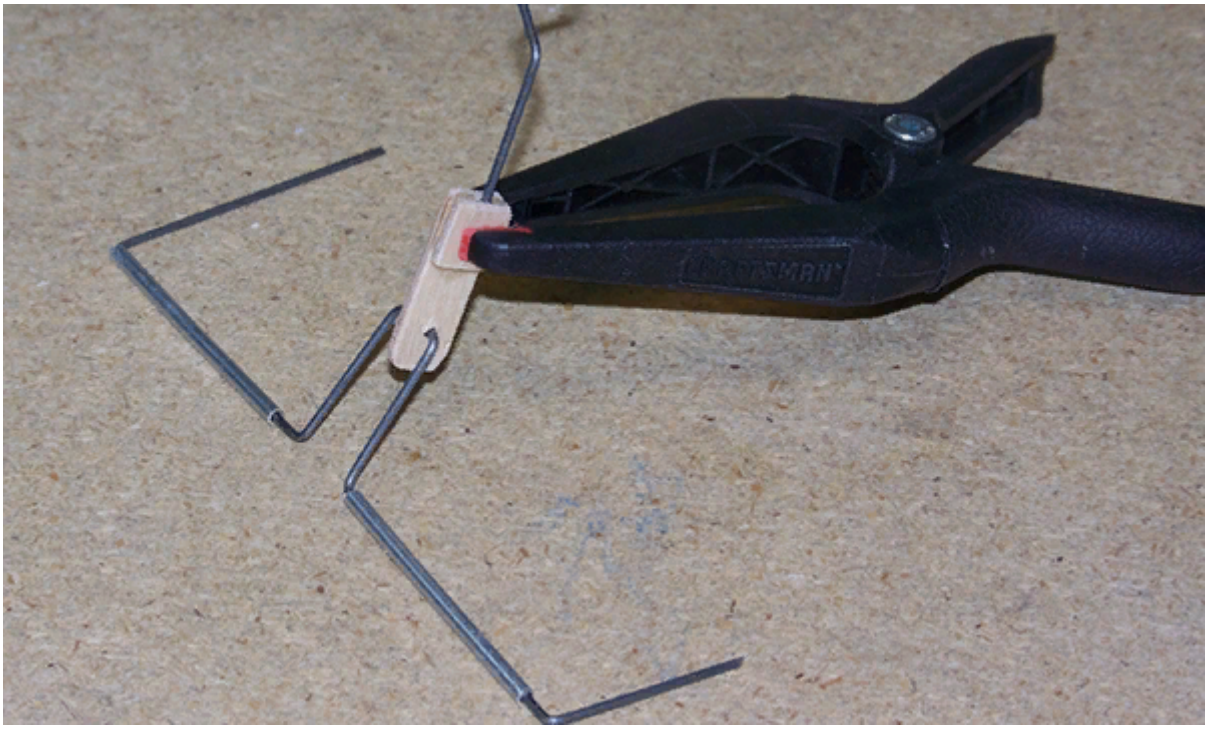
If you are not adding flaps, skip this section. The materials needed for the flap actuator are: .047 music wire, 1/16 plywood, 1/8 plywood, and 1/16-inch ID aluminum tube. Make up the 1/16 and 1/8 plywood flap connector parts as shown on the plans. Fabricate the flap actuator rod as shown on the plans. Make a Z bend in a 5-inch piece of .047 music wire.

To allow adjustment, make a V bend as shown on the plans. Insert the Z bend in one of the holes in the 1/16 plywood attachment piece. Align and epoxy the 1/8 plywood support and clamp until dry.

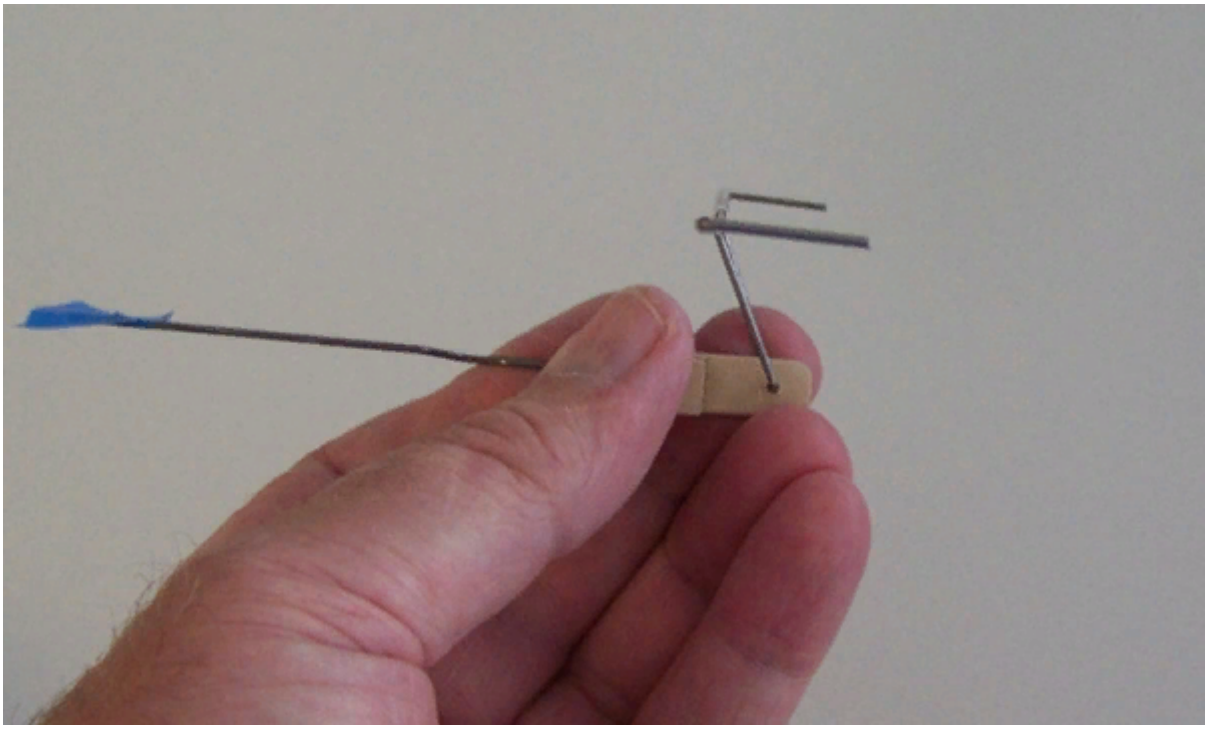
To make the flap torque rod, cut a 10-inch length of .047 wire and start by bending it into a 1/4-inch wide U shape. Install the plywood and wire flap actuator to the center of the U. See the plans for clarification of flap/torque-rod fabrication, steps, and dimensions.

Cut two pieces of 1/16 ID aluminum tube 2-1/4 inches long. The easy way to cut this is by rolling it on a flat surface with an X-Acto knife. The aluminum is soft and cuts easily. Install these aluminum “bearings” on the torque rod arms. Note the relationship to the U portion of the assembly. Don’t worry if this isn’t exact, each flap will be a custom fit. The flap actuator has a slight V that will align with the dihedral of the wing.

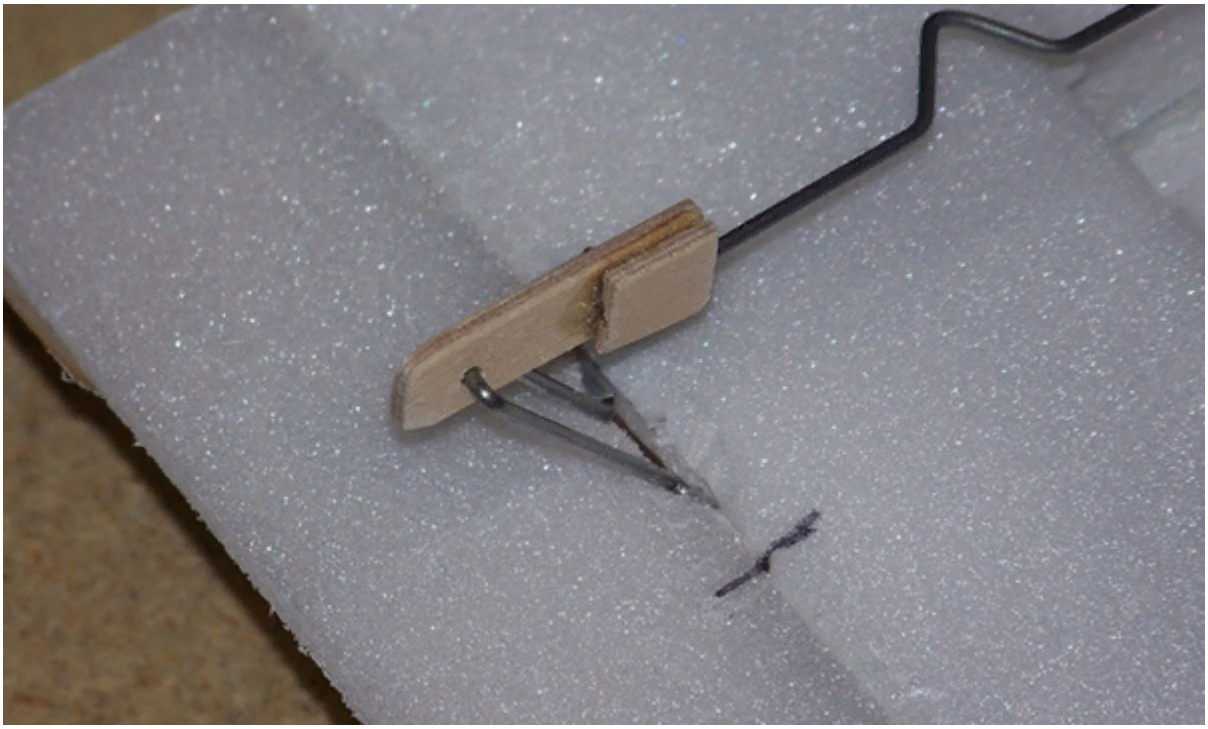
Test fit your flap/torque-rod assembly to the wing. You will have to cut a V groove in the wing to get the pivot point even with the wing TE. When you are satisfied with the fit, epoxy the aluminum tube portion to the wing. Take care not to get epoxy on the wire part of the assembly so that it will move freely. Secure it with tape until cured. To fit the 1-1/8 x 4-inch center TE, cut a V to allow it to fit over the flap torque rod assembly and epoxy it in place.



**Note the aluminum tube “bearings” on the flap torque rod assembly.**



**The completed flap torque rod assembly.**



**Flap torque rod at the wing's center section. Cut a clearance to allow the actuator to move forward.**

## Without Flaps

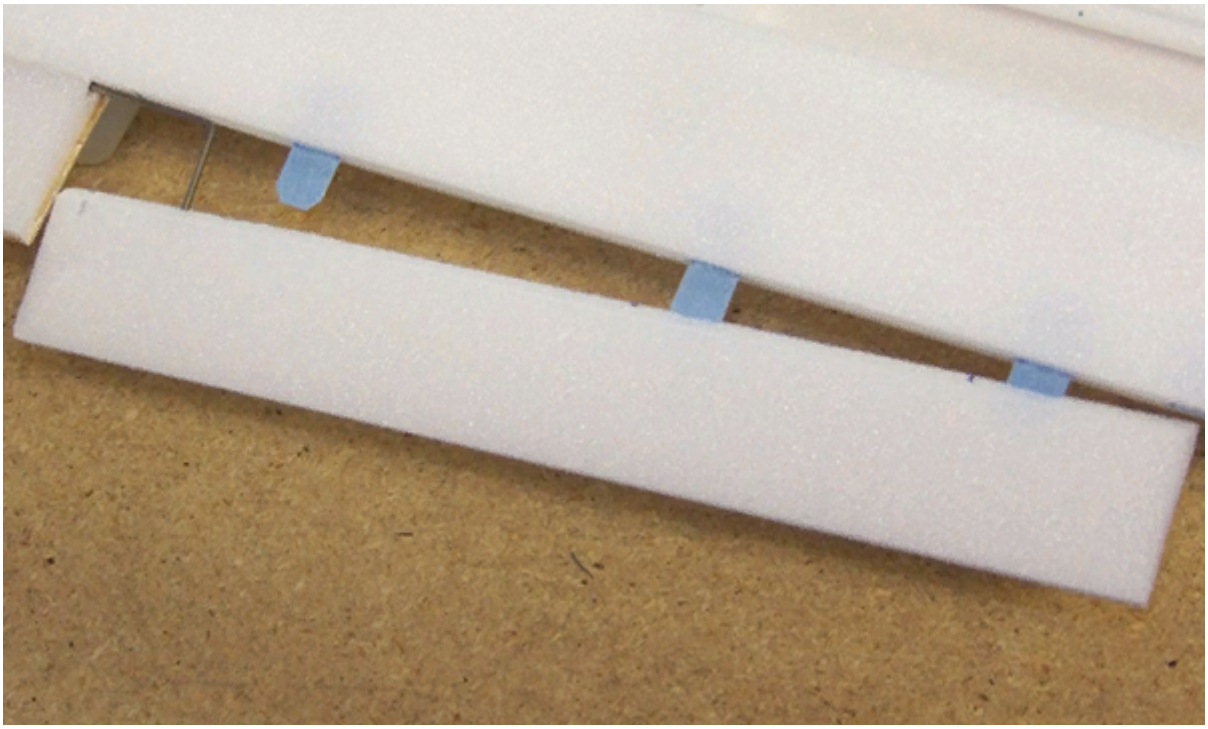
Cut two strips of 6mm foam, 1-1/8 x 10 inches long for the ailerons. Cut two more strips 1-1/8 x 9-3/8 long. Mark the hinge locations on the edge of each control surface and slot with a hobby knife. If you are going to taper the control surfaces, it is easier to do so before cutting out the control surface. Lay it out on the 6mm foam, mark the TE with two lines about 1-1/2mm from the top and bottom surface and sand to shape to the lines (see plans). When satisfied, cut the control surface from the main piece.

Mark the hinge side of each control surface and lay out the hinge locations using the hinges on the wing. Make a cut roughly 1/2-inch deep for each hinge. Make the cuts twice as wide as each hinge to make it easier to install. Sand the hinge side of each aileron to a sideways v shape.

## Installing the Flaps

Cut out the flaps as shown on the plans. Mark the torque rod location on each flap. Using a 1/16 drill, drill a hole to accept the torque rod arm. For the flaps, you only need to sand the bottom at a 45° angle because the flaps will only go down. Temporarily fit the flap panels and check their operation. It is best to fasten one panel at a time. I recommend a dry run because it can be tricky.

The arm will be glued with epoxy and the hinges with foam-safe CA. When you are happy with assembly process, mix a small amount of epoxy and use a short length of the same wire used for the torque rod to feed epoxy into the hole in the flap. You don't need much. Put a little epoxy on the arm too. Now apply CA to the hinges, both sides, and quickly install the flap. Allow it to dry and check for proper operation and bond strength. Install the other flap in the same manor.



**Test fit each flap.**

## Installing the Ailerons

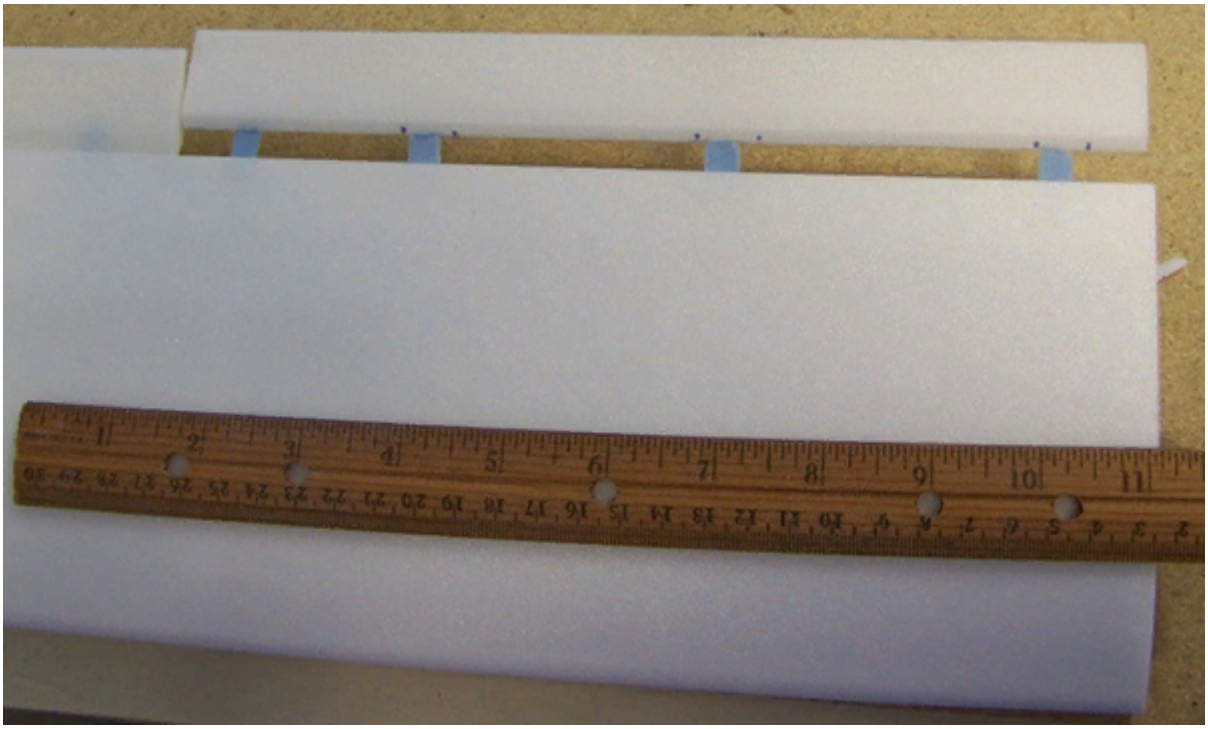
Install the ailerons by first starting the control onto the four hinges. Just get it started so that each hinge is into its slot approximately 1/16 inch. Apply a small drop of foam-safe CA to each hinge and on both sides and carefully slide the control surface all the way onto the hinge and flex the surface up and down.

Make two pieces of 1/16 plywood 1 x 11/2. Epoxy these to the wing's TE where the rubber bands will go over the edge to the wing dowels.

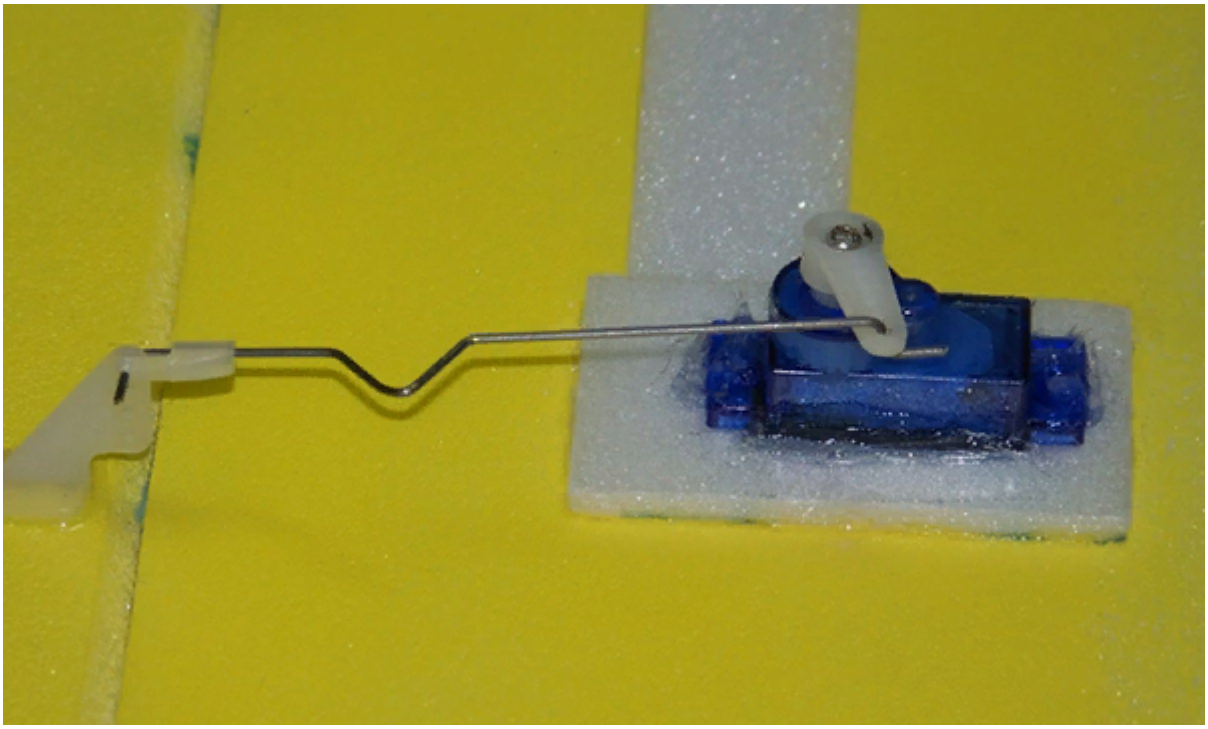
Install the aileron servos and servo tray onto the wing. Use RTV silicone to install the servos. Install the flap servo by gluing it to the bottom surface of the wing. Let them dry overnight.

Bend the aileron pushrods out of .032 music wire and attach them to the servo with a Z bend. Add a V bend in each pushrod to allow for length adjustment. Attach them to the control horn with an L bend and Du-Bro micro E/Z links. Note that the servo arm is angled forward to provide aileron differential—more up than down. Aileron differential is used to counteract adverse yaw. The flap pushrod is attached to the servo with a Z bend.

Install the Y harness to the aileron servos then glue the access panels in place. You will have to trim the length of these panels and add a clearance hole for the Y harness exit at the wing's center. The wing is now complete.



**The aileron is ready to apply glue.**



**I use RTV silicone to install servos on park flyers.**

# Painting

If you want to paint your Coyote E, there are several choices available. Acrylic craft paint, plastic model spray paint, and craft spray paint are some of the choices. Acrylic craft paint is

inexpensive and the color choices are almost endless.

Spray paint for plastic models is another choice. If you go this route, apply the paint in light coats and test it on a piece of scrap Depron. Krylon makes craft paint called Short Cuts. This works well, but color choices are basic. Whichever paint system you choose, first wipe down the parts with alcohol.

## Flying

The results were better than I had expected. Ground handling with the steerable tail wheel was excellent. As I advanced the throttle to three-fourths on the maiden flight, the tail came up and with a touch of up-elevator, the airplane lifted off the ground as pretty as could be.

In the air, the Coyote E is responsive without being touchy. The model only requires half throttle to fly, which gives you reserve power for vertical maneuvers. The aircraft is not a powerhouse, but it will loop from level flight.

As expected with a flat-bottom wing, rolls and inverted flight require some elevator input. The flaps are effective and require up-elevator to counter the downward pitching moment and throttle to overcome the added drag.

Landing is a treat! Just reduce throttle, add a notch or two of flaps if you like, and control the descent with throttle. I have seen no tendency to bounce on landings.

The biggest surprise was how the model handles the wind. It seems to fly like a much-larger airplane. I had complete control and the Coyote E wasn't getting kicked around by the wind like some of my other aircraft. Don't bother with the flaps in windy conditions or you may be landing backward.

## Control Throws and Dual Rates

| | |
|---|---|
| Aileron | LOW: up 1/4-inch, down 3/16-inch<br>HIGH: up 1/2-inch, down 5/16-inch |
| Flaps | 0: neutral<br>1: 1/8-inch down<br>2: 3/8-inch down |
| Elevator | LOW: up/down 5/16-inch<br>HIGH: up/down 3/8-inch |
| Rudder | LOW: right/left 3/8-inch |

| | |
|---|---|
| | HIGH: right/left 1/2-inch |

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| | |
|---|---|
| | 0: neutral |
| Flap to elevator mix | 1: 30% up |
| | 2: 45% up |

## Flight Photos

**The author/designer with the Coyote E**

# Free Plans

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