Construction article

This design originated more than 30 years ago with a little sheet-balsa CO2-powered Free Flight (FF) biplane called the Prairie Duster that was published as a construction article in the May 1984 issue of Flying Models.

The impetus for that little airplane was a small park directly across the street from my home. I wanted something that could be tossed into the air when the wind was sufficiently calm, and would provide the satisfying sight of two wings circling overhead.

Throughout several years, the little airplane provided many hours of pleasure. Flights typically consisted of shallow climbing circles to roughly 75 feet, followed by a slow descent to a wheel landing when the propeller made its last few rotations as the CO2 ran out.

Today's wonderfully adaptable micro RC systems, LiPo batteries, and Depron foam all came together to suggest that it might be time to resurrect the little biplane as an RC sport flier for indoor flying or a calm morning or evening outdoors.

To provide continuity and bridge three decades, while recognizing today's technology, the airplane was rechristened the Prair-E Duster in deference to its power source. It has proven to be as satisfying as the original—and you don't have to walk after it when it lands!

General Construction Notes

The Prair-E Duster is constructed primarily from 2mm Depron foam. A single 15 x 39 sheet from RC Foam will yield parts for two airplanes. Controls and power are provided by a Flyzone brick, motor, gearbox, propeller, and a 140 mAh battery. Other control and power options would work, but you will need more power than salvaged Ember, Vapor, or similar motor and gearbox combinations will provide.

Other materials include a piece of .030-diameter music wire for the landing gear, a 10-inch length of .030 carbon-fiber rod for the two wing strut stiffeners, and a scrap of 16-inch medium balsa for the laminated landing gear mount.
Du-Bro micro control horns were used on both the rudder and elevator. Pushrod wires were formed from .025-diameter music wire. One-inch lightweight plastic wheels were salvaged from another project and painted with flat black enamel. They were held in place with the time-honored FF technique of Duco cement on the ends of the axles.

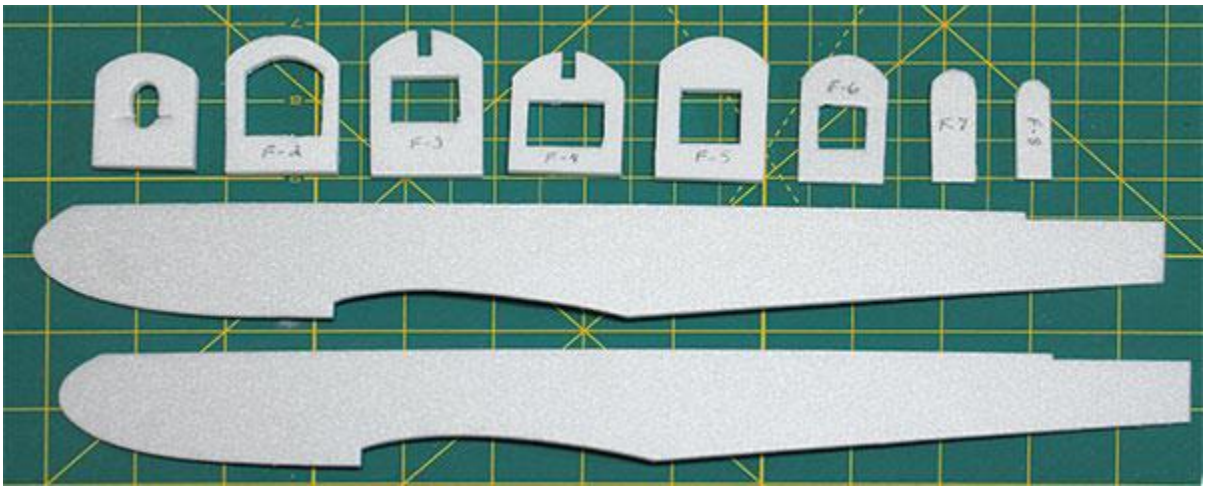
Most of the airplane was constructed with Bob Smith Industries Super Gold foam-safe CA glue. I used a hot glue gun to mount the Flyzone brick, motor, and gearbox.

I prepare for a project by cutting out all of the pieces before actual construction begins. I am able to move smoothly from one part of the model to another without having to stop and cut out a few more parts. In this case, I recommend copying the plans and then gluing the copy to lightweight poster board. Each piece can be cut out to make a template for tracing onto the Depron sheet. A sharp, soft lead pencil will work better for tracing than a pen. A pen leaves residue that can be hard to remove.

The 2mm Depron requires a word or two to ensure satisfactory results. It has a grain to it and two distinct sides that need to be recognized, particularly when bending or molding it to curved surfaces such as the top decking. The grain will usually run lengthwise on a stock rectangular sheet.

There will be one shiny side and a side that is duller in appearance. The shiny side will need to be placed on the bottom in any bending or molding efforts. Experimenting with scraps will serve you well. The objective is to come up with a curved top surface essentially free of creases. Keith Sparks wrote an excellent foam primer in the October 2015 issue of Model Aviation titled "Building With Foam." It will serve you well in developing techniques to work with the material.

Several pieces of the Prair-E Duster, including the first five formers and the cabane pylon, require lamination. The easiest method for cutting out the laminated parts is to glue slightly oversize blanks for each part, trace the pieces onto the foam, and then cut through both thicknesses using a sharp hobby knife or scalpel. A disposable scalpel with a #11 blade has become my standard cutting tool.



Basic fuselage components are ready for assembly. The front five formers, including the motor mount, are laminations of 2mm Depron joined by foam-safe CA glue. Formers F-6 through F-8 are not laminated.

Wing Assembly

The top and bottom wings can each be cut out as one blank and then separated at the centerline. Make sure the Depron grain direction runs spanwise. To get the required undercamber, select approximately a 3/4- to 1-inch diameter mandrel as a cambering tool. I used a 3/4-inch diameter aluminum wing joiner tube for this project.

Place the shiny side of each wing blank facing down and roll the foam blank back and forth over the mandrel using the palms and flat of your hands. Be sure and remove all of your rings from your fingers before you begin, to avoid denting the material on the top side!

After the camber appears acceptable, glue one wing rib to the center joint of each panel. To get the correct dihedral for each panel, position the center of each wing panel at the edge of your workbench, prop up the wingtip 1 inch, and sand the center rib as you would a Hand-Launch Glider wing blank.

Go at it gently because you're only working with a 2mm thickness. When angles have been sanded in each of the four panels, glue them together, maintaining the 1-inch-per-panel dihedral by blocking up the wingtips.

When the panels cure, glue the 1/8-inch doubler to each of the leading edges (LEs), then glue the outboard camber ribs to all four panels. At this point, you can cut slots in the bottom wing to accept the carbon-fiber rod reinforced struts. Note that only the bottom wings require the slots and that they are cut to the inboard side of the ribs. Rounding and tapering the wing's LE and slightly rounding all of the other edges will let you lay the wings aside until the fuselage is framed up.

After the wings are joined at the center, the LE doubler strips are added. Note the small black dots (circled in the photo) on both wings that mark the placement of the camber ribs.

Fuselage Assembly

As noted, the first five formers, including the motor mount, require lamination. After they've been cut out, it's worthwhile to stack formers F-2 through F-4 together and dress them down by carefully sanding them to exactly the same width. Being a uniform width will help ensure that the fuselage stays straight as it is formed up. Lightly mark the inside of both fuselage sides to show where the formers go.

Draw a straight reference line on your building board and assemble the fuselage over it, constantly checking to make sure it isn't developing a bow when viewed from the top. For those used to working with balsa and pinning it in place to keep it straight, you're about to embark upon a new learning curve.

Small scrap balsa blocks pinned down against the fuselage sides will help keep them straight. Work slowly as you install formers F-2 through F-4 and glue them to both of the fuselage sides, holding them in place and checking their respective alignments as they cure.

After formers F-2 through F-8 are in place, the laminated mounting rails for the Flyzone brick can be installed. The receiver unit is glued in place with hot glue at its four corners, using the tabs that stick out.

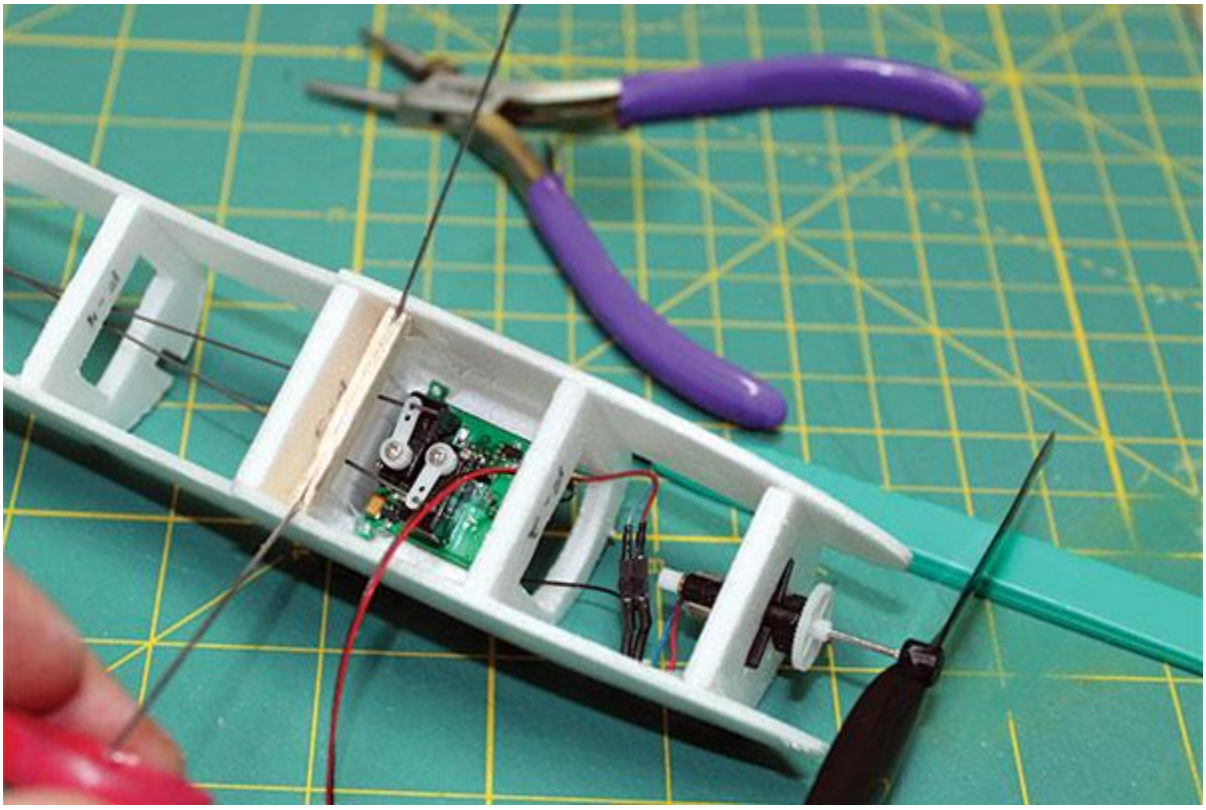
I found that I did a neater job by setting my glue gun to its “hot” position, squeezing out a small puddle of glue, then using a toothpick to put the glue in place over the tabs and let it set up. Sticking the glue gun nozzle into the fuselage cavity was entirely too messy and nearly impossible to control.

Likewise, hot glue is the medium to use for mounting the motor into the motor mount. Because of the motor and gearbox profile, I was able to cut and file a hole in the motor mount to accommodate the unit, and then cut anchoring slots into the mount to accept the flanges on the side of the gearbox.

After the motor unit is seated to your satisfaction in the motor mount, remove it and glue the motor mount into position, drawing the fuselage sides together squarely during the process to eliminate any bowing of the front. After it cures, reinsert the motor into its cavity, making sure there is clearance between the propeller and the front of the nose.

Now it should be angled 5° down and 3° to the right of the centerline. Using the hot glue and a toothpick, glue it in place and hold it until the hot glue sets up. You can finish the nose area by adding the nose doublers and an additional bead of CA on the backside of the motor mount.

Laminate the 1/16-inch scrap balsa landing gear sandwich and glue it in place as shown on the plans. Now is the time to form and add the Z-bend pushrods for the elevator and the rudder, connecting them to the servos in the Flyzone control unit.



The scrap balsa landing gear sandwich is installed at an angle with the top of it butting against F-3. Be sure that no glue runs down onto the receiver circuit board during the installation process.

Note that they cross within the fuselage. You will need to fire up your radio to find out which servo controls what. Keep the ends of the pushrods generously long and unformed at this point. The required Z-bends at the aft end will be formed as the stabilizer and rudder are installed. Test-fit the laminated cabane pylon to make sure it is seated in F-3 and F-4 and the top of it is at 0° relative to the model's centerline.

With the bottom of the fuselage remaining open, it's time to put the curved top decking in place. Following the guidelines for the grain of the foam outlined in the construction notes, create two curved blanks for the front and rear of the fuselage by wrapping them around the mandrel previously used for the wing camber, and taping them in place using blue painter's tape. I kept the foam blanks taped around the mandrel overnight to let them set.

After removing them from the mandrel, cut one straight side on each blank and begin the process of cutting and fitting the decking a little at a time before gluing. Taping the straight side of either the front or rear decking to the top edge of the fuselage will allow it to bend over the formers.

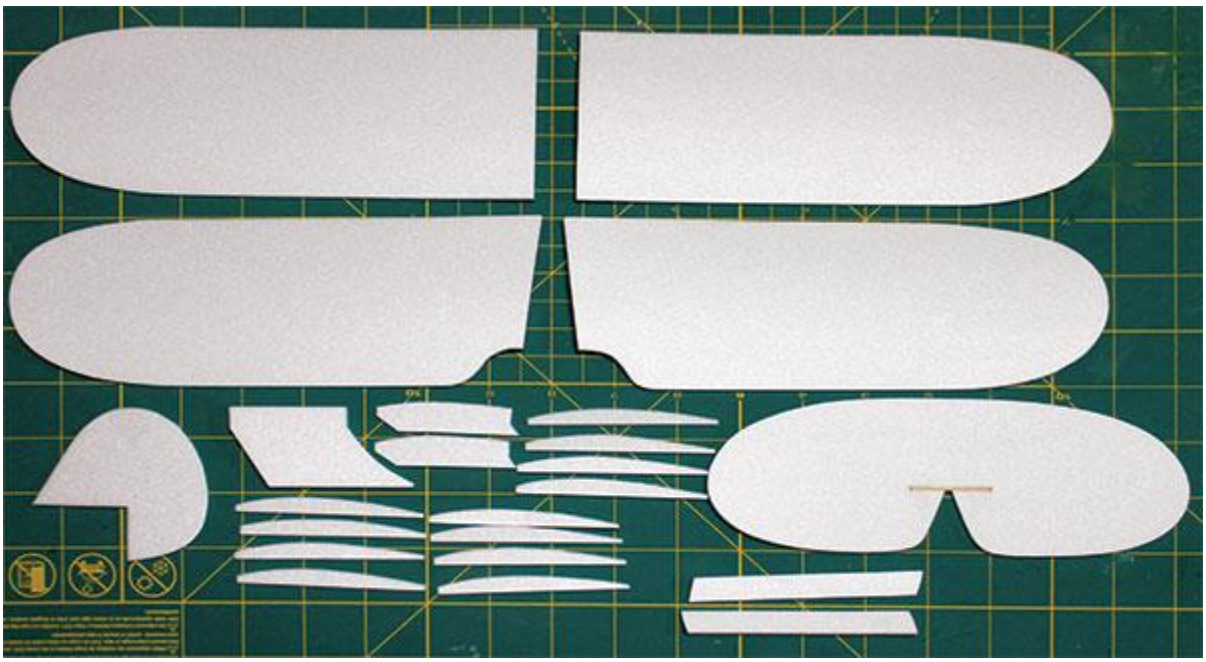
Trim a little at a time until you have a straight seam on both sides. A narrow bead of CA glue on one side will allow you to attach the other side and hold it in place as it is glued. Gluing the decking to the formers can be done from inside the fuselage and doesn't require much adhesive. Be sure to keep the adhesive out of the radio unit and the motor!

The slot for the cabane pylon can now be carefully cut in the front deck sheeting using a straightedge to keep the slot in a friction fit. After you are satisfied with the fit, you can glue the pylon in place. A thin bead of glue applied to the pylon/decking joint on the top side will ensure a neat installation. The joint at F-3 and F-4 should be glued from the inside.

Tail Surfaces

Both the rudder and the stabilizer can be cut out as single units. The stabilizer requires an elevator joiner. In this case, a round toothpick cut to length serves well. Glue the toothpick joiner into its slot, and after it is dry, carefully cut the elevator free. Sand the rear of the stabilizer to a chisel-shaped 45° angle so that the unit can be hinged on the top side with no joint showing. I found 1/2-inch Blenderm tape to be perfect for the job.

The rudder is treated in the same way. Separate it from the fin with a 45° flex angle sanded into the joint line and reattach both pieces with Blenderm tape.

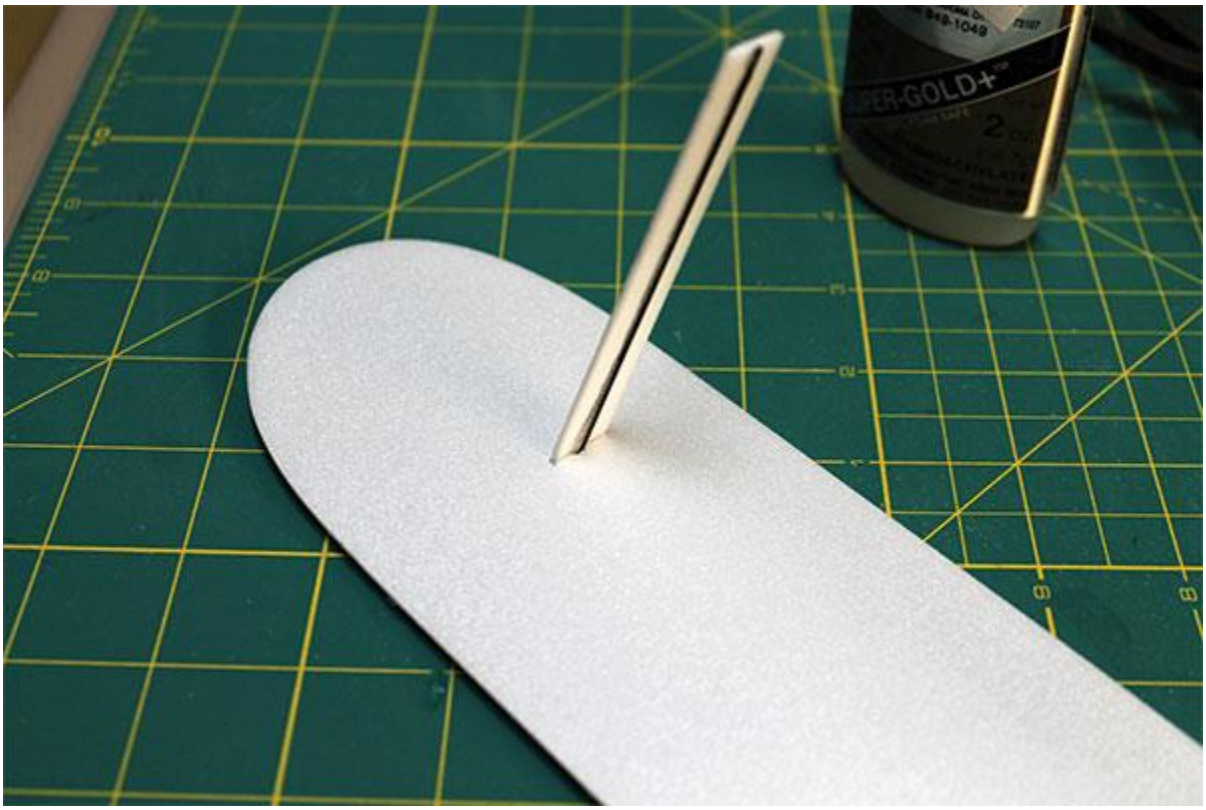


The wing and tail group are cut out of 2mm Depron. Preparing all parts before beginning construction makes the building process more efficient and lets things move along smoothly.

Final Assembly

Test-fit and glue the bottom wing to the fuselage and tack-glue the top wing to the cabane pylon. Check everything to make sure it is straight from the front and from the top view. If it is to your satisfaction, finish gluing the top wing rib/pylon joint and add the pylon doublers to each side.

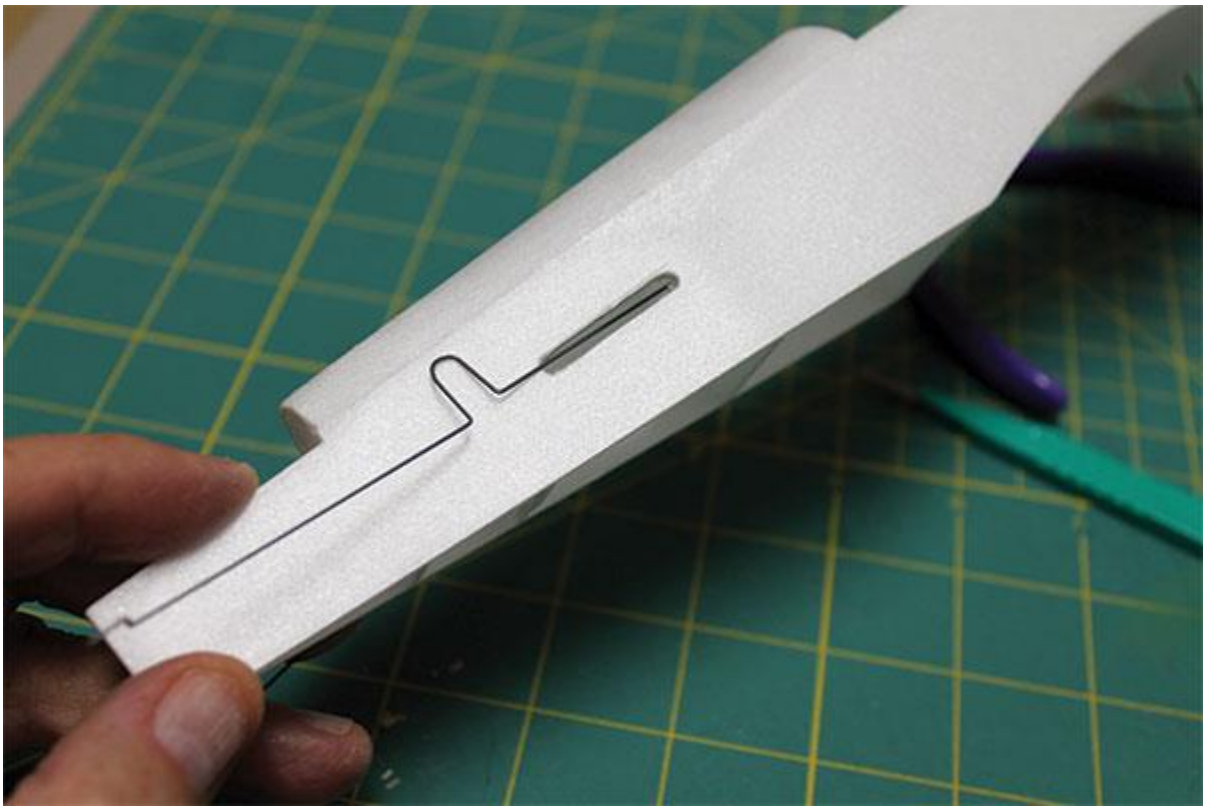
The reinforced struts can be fitted into position with the carbon-fiber rods to the inside. The struts are overly long on purpose and will need to be trimmed at the bottom when the assembly is complete. Check the strut angle and the wing alignment before gluing them into position. After they are dry, cut the remaining rib blanks to fit as caps on the inside of the camber ribs, butted up against the struts on the front and back.



The wing struts slip into a slot in the bottom wing with the .030 carbon-fiber rod stiffeners to the inside of the wing. They are not glued in place until both wings are installed.

If you haven't done so, bend an adjustment kink into the elevator and the rudder pushrods aft of where they exit the fuselage. Neutralize the servos to make sure you will have equal movement

in all directions, and then put a Z-bend in both pushrods precisely parallel to the end of the fuselage. You will need a horizontal Z-bend for the stabilizer horn and a vertical bend for the rudder horn. Clip off any excess and make sure the control horns can be threaded onto the Z-bends.



Both pushrods require an adjustment kink, as shown here, to fine-tune the elevator and rudder to make sure they are neutral and have equal movement in both directions.

Test-fit the stabilizer and lightly sand either side of the mounting slot to make sure the stabilizer is square with the wings when viewed from the front and the rear. If it is, glue it in place and then glue the control horn with the pushrod attached in position.

Do the same with the rudder and then check to see that both the elevator and rudder are neutral when the radio is switched on. Make any required adjustments using the adjustment kinks of the respective pushrods.

If everything looks good, you can close up the bottom of the fuselage with 2mm sheeting. Note that the sheeting between the motor mount and former F-2 is a laminate, with one piece fitting inside the opening and the other on the outside. That was done because over time, the need to mount and remount the battery on its hook-and-loop strip creates stress on that area.

The last pieces to be added in the construction process are the tapered headrest, the tapered fill pieces between the fin and the fuselage, and the tail skid. All are laminations of two pieces of scrap foam sanded to shape. Depron sheet is amenable to sanding, so if there are rough spots, joints that are not quite right, or other anomalies that could be helped with some judicious sanding, now would be the time to do it.

The cockpit area shows the sheet fill on the fuselage sides sanded to arrive at a rounded cockpit entry, and the laminated headrest sanded to a taper and mounted on the turtledeck sheeting.

This model's trim scheme was done with MonoKote trim sheet and lettering from Callie Graphics. The Prair-E Duster offers limitless possibilities as an all-white canvas for decorating.

Flight Notes

Shifting the battery on the hook-and-loop strip on the bottom of the fuselage should balance the model on the center of gravity noted on the plans. If you need to add some weight to get it to balance, use a small piece of modeling clay.

For hand launches, apply approximately half power and launch the airplane level with a reasonable forward motion. It will fly straight ahead and give you time to find the sticks to put it under your control. My first flight required only a click of down-elevator and two clicks of left rudder.

Rise-off-ground takeoffs--either outdoors or indoors--required only an incremental increase of power to get it smoothly off the surface and into a comfortable flight mode. The model, principally because of its FF heritage and light wing loading (34 grams without the battery), is a stable platform.

Because of its FF heritage and light wing loading (34 grams without the battery), the Prair-E Duster is a stable platform.

Landings are fun by simply reducing the throttle and flaring the airplane out approximately 6 inches above the landing surface. The large wheels and forward placement of the landing gear make it resistant to tipping over.

The model is intended for indoor and outdoor flight in permissible conditions, and has met that goal well. Just as the original sheet balsa Prairie Duster FF model had hundreds of satisfactory

flights, I hope this updated version provides the same sense of satisfaction for you--all without requiring a single jaunt to retrieve it!

—*Larry Kruse*
aircats@att.net