



Out of the last two AMA Nationals, Tangerine Internationals, and the Florida 2-Meter Championships, my 2-meter Free Spirit has placed 3rd two times, 2nd two times and 1st one time, (not including other state meets). In each case the Free Spirit had the highest duration time. The failure to place 1st each time was always my failure to get those all-important landing points. I just do not practice like I should. The point is—my Free Spirit is carrying me. If it didn't durate so good, I would probably never place. So, if you would like to win some of those trophies or just like to have a lot of fun, build yourself a 2-meter Free Spirit. I will admit, there are several very easy to build 2-meter kits available and they fly very well, but I am convinced mine flies better.

The Free Spirit has an undercambered wing but is no more difficult to build than a flat bottom wing. One thing about this airfoil, it will not sink fast just because you might happen to build it kind of heavy. As a matter-of-fact, it will not fly as well if it is too light. It needs the weight (but around the CG) to fly the best. The secret is to keep the tail and outer wing panels light. You will probably have to add two or three ounces to the CG for the best performance.

You will notice the rather large rudder. This allows you to cut down on the rudder throw, and get good response without quickly over controlling. My Standard and Unlimited Free Spirit's have a flying stab. I have found this old stab and elevator configuration is a lot easier for me to fly, since I need all the help I can get. You can construct the stab and rudder from  $1/8$ " sheet balsa with holes in them for weight reduction, but I have found the built-up tail section has about  $1/2$  the weight and is just as fast to build. If you reduce the tail by just 11 grams, you can remove 32 grams out of the nose. That's 32 grams you can add to the CG if needed. The point is, your stall recovery and all around handling will be much better with a light tail. Keep the majority of the weight near the CG, on any plane.

Enough chit chat—lets build one.

## Construction

The first thing I do is to cut out a plywood rib of the airfoil, but don't drill the holes yet. This will be what I call my Master template. Next cut out the six ply ribs, three for each center wing panel. These will be  $1/16$ " smaller all around and  $1/4$ " shorter at the leading edge. Drill the  $3/16$ " holes as shown on the drawing in W2 first. These holes are centrally located between the top and the bottom. I always use a piece of  $3/16$ " O.D. brass tubing with the cutting edge filed like saw teeth. You will notice that  $1/3$  of the undercamber is perfectly flat. This will not only allow you to build the wing easy, but to shim the ply ribs evenly when drilling them. Align W1 and W2 together. With a piece of  $3/32$ " square stock, shim W2  $3/32$ " higher than W1 and drill W1 using W2 as a drill jig. Now align W2 and W3 together and shim W3  $3/32$ " higher. Drill W3 using W2 again as a drill jig. This should leave you with W2 drilled in the center. W1 with the holes  $3/32$ " higher, and W3 with the holes  $3/32$ " lower. With these ribs spaced  $1-1/2$ " apart, this will put the brass

wing wire tubes at  $3\frac{1}{2}$ " angle and will consequently give your center wing panels  $3\frac{1}{2}$ " dihedral. Drill the other three ply ribs from these three. That will give you a set for each wing panel. Now, clamp W1 to the Master wing template (allowing for the  $1/16$ " all around) and drill the Master. You now can build either the wing or the fuselage. I like to build the fuse first but I need that master wing template to do so.

## Fuselage and tail section

First, cut out the fuselage sides. The forward section is from  $1/8$ " ply and the aft section from  $1/8$ " balsa. You can get great  $1/8$ " light three plywood from Sig that is lower in cost and very easy to cut. In fact, I have even started to make my plywood ribs from this light ply instead of the regular  $1/16$ " ply. After the forward and aft sections are glued together, take the master wing template and lay on one fuselage side. Align at the proper position at about  $2-1/2$ ". The stab platform and about  $12$ " of the bottom of the fuselage can be used as a  $0^\circ$  reference line. With the rib in position, clamp the master rib to the fuselage side and drill the wing wire tubes. Then align both sides together and drill the second side. Cut out your bulkheads. Place two pieces of  $3/16$ " O.D. tubing through the wing wire holes and add bulkheads, C, D, and E first.

While this is drying, build the rudder and rudder fin next. You can then clamp the bottom portion of the rudder fin between the rear fuselage sides, but make sure to leave a  $1/8$ " gap under the forward part of the rudder fin for the stab to slide in. Glue in place. This is a good place to use "Hot Stuff" adhesive. You can now add bulkheads F, G, and H, then B and A last. Add the  $1/16$ " X  $1/4$ " tail doubler. This will give the stab a better mounting platform.

Now build the stab and elevator. They are very simple and fast. Drill the elevator halves for the .045" wire connector and make sure everything is square and aligned. Add the stab to the fuselage but make sure you leave a  $1/8$ " gap between the stab and the rudder fin. This is necessary for the wire elevator connector to pass through the fuselage and rudder. Add the bottom of the fuselage. Install the push-rod tubes and exit the fuselage sides without any sharp bends. The Su-Pr-Rods seem to be less affected by temperature change. Add an extra tube for the radio antenna and exit from either side. Once all of the rods are in, add the top of the fuse-

lage, rudder dorsal fin, elevator wire connector, two little  $1/8$ " square spacers on each side of the rudder fin between the elevators, nose block and canopy cover. Use four small pieces of  $1/8$ " square stock under the canopy block as keys to keep the canopy from sliding around. I also use a rubber band to hold the canopy in place.

The only major item left is the two wing fairing blocks. Cut from  $3/8$ " bass wood and drill holes from the master wing template. Lay the two fairing blocks side-by-side (inside up) and plane at a taper till the leading edge is a little over  $1/8$ ", leaving the trailing  $3/8$ ". Keep both planed surfaces parallel. Every so often slide the fairings on the brass tubing against the fuselage sides and check for alignment. I use a caliper to make sure the width across the fuselage and fairings are the same width at the leading edge as the width at the trailing edge. Before gluing the fairings into place, plane the outside face  $3/2$ " where the wings butt against the fairings. You can, if desired, leave the fairing square on the face and tilt wing rib W1  $3\frac{1}{2}$ ". In any case, these little fairing blocks are more trouble to most people than any part of the model, but they are important as they align the wings properly. The only thing left on the fuselage and tail section is sanding. I usually sand all corners of the fuselage about  $1/16$ "

PHOTOGRAPHY: LEON KINCAID



The author says that the Free Spirit is a design that can make an average pilot look good. A launch on the winch takes place (opposite page).

# Free Spirit

by Leon Kincaid

This 2-Meter sailplane placed second at the 1980 Nats. It's easy to build and fly.

## Free Spirit

radius. Sand and contour the rear of the fuselage down to  $\frac{1}{8}$ ", as shown on the drawing.

### Wings

I have a seven foot building board, so I can build a complete 2-meter wing at one time. I have also used a sheet of  $\frac{1}{4}$ " balsa 48" long, and constructed  $\frac{1}{2}$  of a wing at a time. In any case, lay the drawing over your building board, and cover with Saran Wrap. Only the  $\frac{1}{3}$  flat section of the airfoil will be assembled directly on the board. No shims required. On my drawing I show the basic steps of assembly. Bottom sheeting first, bottom spar, leading edge or ribs, top spar and then the webs. Be sure to align the ply ribs W1, W2, and W3 properly as these will align the brass wing

tubes. When cutting the balsa ribs, use one of the ply ribs as a template and cut all ribs, including one for each of the tip ribs. Then select 14 ribs (seven for each tip). Lay each tip rib over the drawing and align the rib with the bottom spar. Cut the rib to proper length at the leading and trailing edge, and mark the rib as to its position. Now cut the smallest tip rib out completely to shape as shown on the drawing. Using a scrap piece of  $\frac{1}{8}$ " X  $\frac{1}{4}$ " balsa, stack or align all of the tip ribs in order, using one of the ply ribs as a guide on one side and the small tip rib on the other end. The contour or shape of the undercamber does not change, so lay all ribs on the flat section of the airfoil on building board and carve, plane and sand the top of the tip

ribs to shape. The tapering of the tip ribs will require you to re-cut the top spar slot. All ribs are now ready for assembly.

With the undercamber remaining the same contour all the way to the tip, the smaller tapered tip ends up with almost no undercamber. This results in the cord line having about  $\frac{1}{2}$  wash-out built into the wing. However, you may wish to add a little more. I find that about  $\frac{5}{32}$ " gap under the trailing edge seems to be about right.

Here is the way I usually complete my wing panels. Complete the basic steps for each panel. Leave out the ribs at the poly break and the top sheeting. Remove from the building board and sand poly break  $4\frac{1}{2}^\circ$  on each panel. This will give you an included angle of  $9^\circ$ . Join the panels keeping the flat sections parallel. When dry, install the  $\frac{1}{4}$ " basswood brace, or use a hard  $\frac{1}{4}$ " balsa brace and add a  $\frac{1}{32}$ " ply brace over the balsa brace and spars. Cut a wing rib from  $\frac{1}{8}$ " sheet balsa and install at poly break. Add top sheeting and  $45^\circ$  wing tip, contour top of tip and sand. Add a little epoxy all around the poly break about  $\frac{1}{2}$ " wide and smooth away excess with your finger.

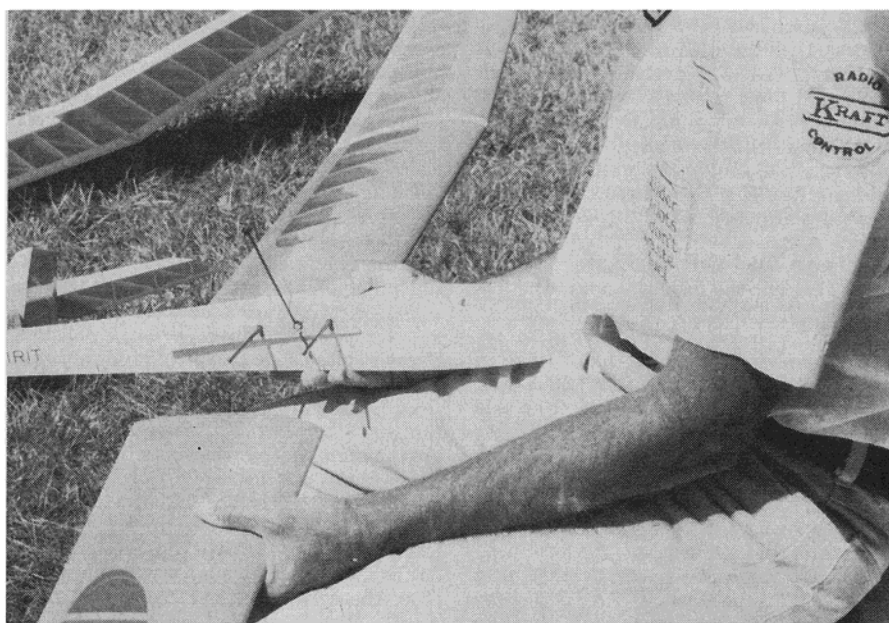
I show an optional wing construction on the drawing. If you don't like to fool around with cap strips or sheet trailing edges, you can cut the ribs from  $\frac{3}{32}$ " balsa and use the standard  $\frac{3}{16}$ " X  $\frac{3}{4}$ " trailing edge stock, but do yourself a favor, be sure to notch the T/E about  $\frac{3}{32}$ " deep for each rib to insert. It only takes a minute to notch and it gives a much stronger joint. Of two sets of wings I have constructed, there is only a difference of three grams, but the cap stripped wings are a little more rigid.

Finish sanding all parts and do a good job. Sanding is what makes the difference between a nice looking plane and a junker. Make a small template and sand the wing leading edge properly. This is the most important part of the airfoil as far as I am concerned. Don't forget to decide what kind of rudder and elevator hinges you want to use. I have used Goldbergs thin Klett hinges, Monokote<sup>TM</sup> tab type, and am now trying the 3M plastic repair tape as hinges. The big difference is sanding the correct clearance on the leading edge of the control surface. If you use the Klett type you will have to sand a slight radius on the leading edge. If you use the Monokote<sup>TM</sup> tabs, sand to a diamond shape (two  $30^\circ$  angles) with the point in the middle. If you use tape or straight Monokote<sup>TM</sup> type, sand the edge at a  $30^\circ$  angle.

Cover with Monokote<sup>TM</sup>, install radio and tow hook. Balance on the spar or slightly in front. You can move the CG forward but don't move it back.

### Flying

What can I tell you about flying? For years I have been flying with the tow hook too far forward. Now I fly with the hook right under the spar (thickest part of the airfoil) it will climb straight up with hands off the controls. Just don't give it too much extra up until flying speed is well achieved, or you will pop-off of the tow line. The large rudder will keep it straight and easy to control. Oh yes, don't hesitate to fly it in Standard Class. It doesn't know it isn't suppose to fly as well as the bigger sailplanes.



Leon is assembling the wing panels to the fuselage (above). Typical music wire and brass tube method is used here. The Free Spirit is being guided in for a perfect spot landing (below). Its easy to fly.

