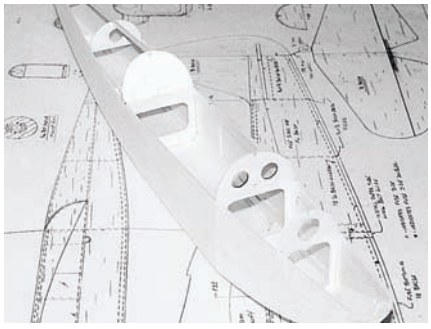
BY PAT TRITLE

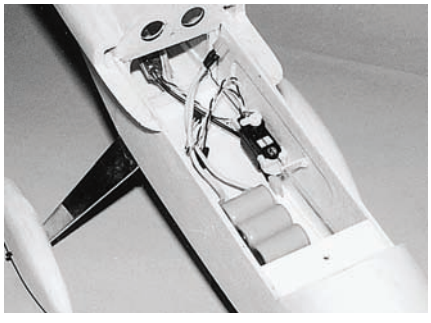
THE SHOESTRING RACER

A scale backyard pylon racer

FREE PULLOUT PLAN IN THIS ISSUE!



The Shoestring fuselage is fairly easy to assemble. The tail surfaces are sheet balsa. The elevator is hinged with UltraCote after the tail pieces have been covered.



Use the battery as ballast to properly adjust the CG. The battery is held in place with Velcro.

THE YELLOW AND RED SHOESTRING has always been one of my favorite airplanes and over the years, I've built several free-flight and U-control versions, all of which were great flyers. A few years ago, I started thinking about building a small RC Shoestring in a Speed 400-size. With the growing popularity of brushless motors and LiPo battery technology being what it is, I decided to forge ahead.

I designed the Shoestring so it could be built and flown by modelers with intermediate building and piloting skills while still being a good representation of the full-scale Shoestring. The result is a very stable, reasonably fast, all-sheet balsa model that's a pure joy to fly! I've tried everything I can to make the airplane "snap" out of a turn and determined that it just won't. Its stall is more of a "mush" and it still maintains aileron control all the way down the speed range.

The model was designed around the 6V Speed 400 motor and is controlled by only elevator and aileron. Hand-launching is easy, as there is plenty of fuselage to hold. Landings are done 3-point, so the fixed tailwheel keeps a good straight line during the short rollout; if you're flying onto grass, just plop it in! Though the model has a good roll rate, the aileron input isn't twitchy at the center at all. Even with the CG balance point moved aft, the elevator never gets "goosey." When the CG is moved too far aft, the model just doesn't come up on step. All in all, it's a good, solid, honest airplane that I recommend to anyone who's entering the wonderful world of little airplanes.

BUILDING THE FUSELAGE

As always with a model of this type, it must be built light. I built my prototype using hand-selected balsa, but using the contest-grade stuff will only help if you're really serious about building a lightweight airframe. Start by cutting and shaping the vertical and horizontal stabs. The elevator will be hinged with UltraCote after the surfaces have been covered.

Build the fuselage next. Start by cutting the fuselage sides and doublers, following the triangular marks on the plans, then, cut the formers and former doublers, assembling them as you go. Glue the doublers to the fuselage sides and add the balsa tri-stock and ⅛-inch-square balsa lower longerons. Glue formers F-3 and F-4 to the right-hand fuselage side, using a triangle to align them. Now glue the left-hand side of the fuselage to the formers. Glue the tail post pieces together and add formers Fl, F2, F5 and F6 and the 1/16x⅛-inch crosspieces. Now you can add the ⅛-inch-square top stringer, ⅛-inch balsa bottom sheeting and ¼-inch balsa chin block.

Before adding the top sheeting, be sure to install a Sullivan no. 507 guide tube for the elevator pushrod. Now is a good time to shape the balsa tail-fairing blocks and add the lite-ply landing-gear plate and balsa triangle and lite-ply wing-bolt plate. Using a

SPECIFICATIONS

MODEL: Shoestring

TYPE: electric sport-scale

WINGSPAN: 30.5 in.

LENGTH: 28.5 in.

WING AREA: 165 sq. in.

FLYING WEIGHT: 16 to 18 oz.

RADIO REQ'D: 3-channel (throttle, elevator and aileron)

POWER: 6V Speed 400 motor with Sprite XLR BEC controller, 500AR 7-cell battery and Aeronaut 6.5x4 prop

CONTROL THROWS

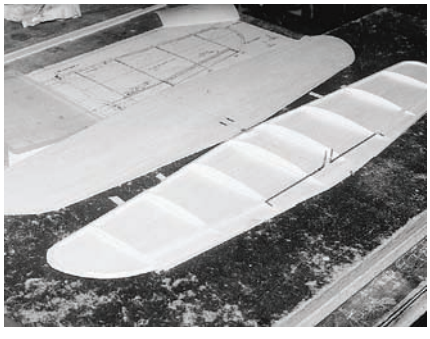
ELEVATOR: ± 5/16 in.

AILERON: ± 3/16 in.

Sig 1/16 x l x l0-inch landing gear blank, drill and shape the gear as shown on the plans. Drill and tap the plate for the 8-32 bolts and attach the landing gear. Now cut out, assemble and shape the wheel pants to complete the basic fuselage.

BUILDING THE WING

Building the wing really isn't difficult, but the dihedral is built into the bottom skin, so use the dihedral/washout jigs shown on the plans to ensure proper alignment. Start by joining together five, 1/16x3x32-inch-long balsa sheets. Cut out the lower skin to the size shown on the plan. The top one should be slightly oversize to compensate for the curvature. Cut the ribs out of the scraps. Using the plans, mark the position of all the ribs and the aileron spars.



The dihedral is built into the bottom wing skin by using the jigs shown on the plans. The ailerons are controlled via the torque tubes; be sure they fit well before you glue them into place.

Using a sanding block, taper the top of the lower trailing edge (TE) to the contour shown on the rib templates. Now carefully score the skin under ribs Rl, and gently "crack" it to form the dihedral. Cut the balsa leading edge (LE) and glue it into place. Next, cut the 1/16-inch balsa R5 and R6 tip doublers and glue them into place. Add ribs R2 and R4 and glue the 1/8-inch balsa hinge spars into place followed by R3 and the aileron ribs. Build up a left and right washout jig using the patterns on the plans, and position them under rib R4 and align them to the TE. Using scrap balsa, shim the LE so it doesn't bow when the upper skin goes on. Now glue the Rl ribs into place. Add the balsa filler in the center section at the LE and TE.

Slip the 3/32-inch aluminum torque rod tubes over some 1/16-inch music wire, and bend the torque rod wires to shape. Cut down Du-Bro 2-56 threaded couplers and solder them to the tops of the torque rods. Spend a little time fitting the torque rods to ensure smooth, non-binding operation before you glue into place. Locate the outlet slots for the vertical parts of the torque rods and cut them into the upper skin. Carefully align and test-fit the skin to the wing. When you're sure that everything fits properly, lay the skin aside while you use a pin to poke holes around the aileron outline through the bottom skin. This will make cutting the aileron out of the wing a lot easier later.

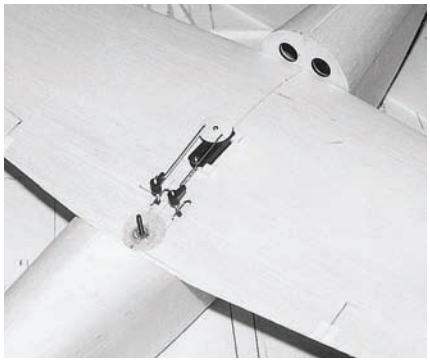
Finally, inspect the wing assembly one more time before gluing the upper skin into place with medium CA. After the glue has dried, remove the wing from the board and sand it to shape. Carefully cut the ailerons, and shape them for hinging.

ATTACHING THE WING

Find and mark the centerline of the wing

and align it to the fuselage. Using a piece of 1/8-inch O.D. brass tube, reach into the front opening of the fuselage and mark the LE through the dowel hole in F-3. Remove the wing, drill a 1/8-inch hole at the mark and glue the dowel into place. Glue the plywood blind nut plate to the wing, and drill a 1/8-inch hole through the wing. Reinstall the wing on the fuselage and with the wing properly aligned, drill a 3/32-inch hole into the bolt plate. Remove the wing again and, with a piece of music wire in the hold-down plate hole, punch through the fuselage bottom. Open the hole to 1/4 inch and line it up with the bolt plate using a paper tube.

Now reinstall the wing, push the 3/4-inch-long 4-40 bolt through the wing, add a blind nut and turn it until it's just snug. Note that the blind nut won't be aligned with the upper surface of the wing. Use a dab of 5-minute epoxy to glue the nut and fill the gaps.



The aileron servo is attached to the center of the Shoestring wing, which is attached to the fuselage with a 3/4-inch-long 4-40 bolt and blind nut.

Now it's time to install the aileron servo and linkage. Make sure that the aileron installation is correct before you close the model up, as it becomes inaccessible when the model is finished. I'm not crazy about doing it this way, but the torque rods on the bottom won't allow adequate battery clearance. When you're satisfied with the installation, glue formers F3A, B and C into place along with the 1/8-inch-square centerline stringer. Remove the wing from the fuselage and sheet the center section with 1/16-inch balsa. Build up the cheek cowls from light 1/4-inch thick balsa, and rough-shape and hollow them before you glue them into place. I used Micro Fill to feather everything after assembly.

Bob Downey runs up the Shoestring Racer's engine in preparation for the next heat. (Photo courtesy of the Air Age Media archives)

RODNEY'S RACER

Rodney Kreimendahl, the designer of the full-size 'Shoestring" racer, made his home in Westfield, Massachusetts. As a young man, Rodney was an avid modeler and greatly influenced by the exploits of Charles Lindberg. He loved airplanes, but never became a pilot. After high school, he did not attend college (even though he won a scholarship to Northeastern University) and later became a draftsman for Chance-Vought. Prior to WW II, he was recruited by the Lockheed Aircraft Corporation, as a structural designer where he worked on the boom design for Lockheed's YP-38 project.

Before the War, the Cleveland Air Races was the biggest event for aviation enthusiasts. In 1947 a new class of air racers was started called the Goodyear class. Often referred to as the "midget class," this class as an alternative to the very expensive Unlimited race class. The new class had specific airframe requirements and a max engine displacement of 190ci. With its 188ci displacement, the 85hp, 4-cylinder, air-cooled Continental engine was the engine of choice and it quickly became the standard Goodyear powerplant.

Lockheed started a design team to develop a plane for this class, which eventually became known as "The Cosmic Wind." Since there was plenty of interest in race planes at the time, Rodney started another team where he did most of the design work for a new racer. Rodney's wife was asked to name his new midget racer and she came up with "Shoestring"—since the airplane had been built on a shoestring budget. Each of the design team's members chipped in a dollar each week during the plane's construction and it was eventually finished minus the single most expensive item—the engine. The Shoestring made its first flight in 1949, powered by a loaner engine acquired from race pilot Bob Downey. After the Shoestring project, Rodney went on to work on other Lockheed projects including the X-7 (an unmanned test bed for ramjet engines) the F-104 Starfighter, the vertical takeoff XFV-1 Salmon fighter and the U-2 spy plane, the project he was working on when he was killed in a plane crash.

In 1965, an airline pilot named Ray Cote bought the original Shoestring aircraft and with the help of Carl Ast and Paul Jones, he started an extensive modification program for the plane. The Shoestring was Ray's first racer and in his 16 years of ownership, he won 41 races (including nine national championships!) before he retired the plane to the San Diego Air Museum in 1981. The colors of the original Shoestring were Cadillac Chartreuse and Chinese Red.

The highly modified 1970s-era Race 16 Shoestring as owned by Ray Cote.

INSTALLING THE MOTOR

Cut the motor mount out of 1/16-inch-thick ply and glue it to the front of the fuselage. The spinner you use will determine how thick a balsa ring you'll need to glue to the front end to fair it in. Again, use Micro Fill to feather it all in.

My prototype was powered with a 6V Speed 400 motor and a Sprite XLR BEC controller. The system was hard-wired using a Deans connector for the battery. An S-80 servo was mounted to the right-hand fuselage side; my older 72MHz receiver was mounted on the other side. As always, I removed the case from the receiver for an additional weight savings, but there are now plenty of micro 2.4GHz receivers that will save even more space and weight. Finally, install the elevator control horn and Z-bend the 0.025-inch diameter music wire pushrod at the servo end and clip it extra long at the back end.

COVERING AND FINAL ASSEMBLY

Sand the airframe to remove any bumps or boo-boos. I used EconoKote to cover and trim my model. The markings are decals from the old Carl Goldberg 42-inch-span Shoestring U-control kit. The canopy, landing gear and wheel pants were painted with dope.

With all covering and trim completed, align and glue the tail section into place—don't forget the tailwheel! Trim, fit and install the Sig 7-inch canopy, install the wheels on 4-40 bolt axles, and epoxy the wheel pants to the gear. Bolt the landing gear to the fuselage with two 8-32 nylon bolts. Using the battery location for ballast, balance the model as shown on the plans. Use a two-inch strip of Velcro to hold the battery in place. I used a 500AR 7-cell battery in a three over four stack. There is also plenty of room for any 3S 11.1V LiPo pack.

FLYING THE SHOESTRING

Before your first launch, check the control throws. Install a fresh battery, run the motor up to full throttle and briskly hand-launch the model. It will lose about three feet of altitude while building up speed, but will soon settle into a nice groove. The best-looking turns are banked about 45 degrees, but knife-edge turns are great using just enough elevator to maintain altitude. Rolls, loops and stall-turns are great, even without a rudder. To get the stall turn, just pull up gently into the vertical line. As the airplane slows down, torque will take over and pull the nose around. As the plane breaks over the top, reduce the throttle and the nose will fall right through. It takes a little practice, but when you get it figured out, it works every time.

After much testing, I've found the best balance between performance and duration was achieved using an Aeronaut 6.5x4 prop. Static current draw is 13.2amps for about 110 watts on 7 cells. Duration is around 3 ½ to 4 minutes using the 500AR cells. Of course, a brushless motor system and LiPo battery pack will provide more power and longer flight durations.

Good luck and good racing!