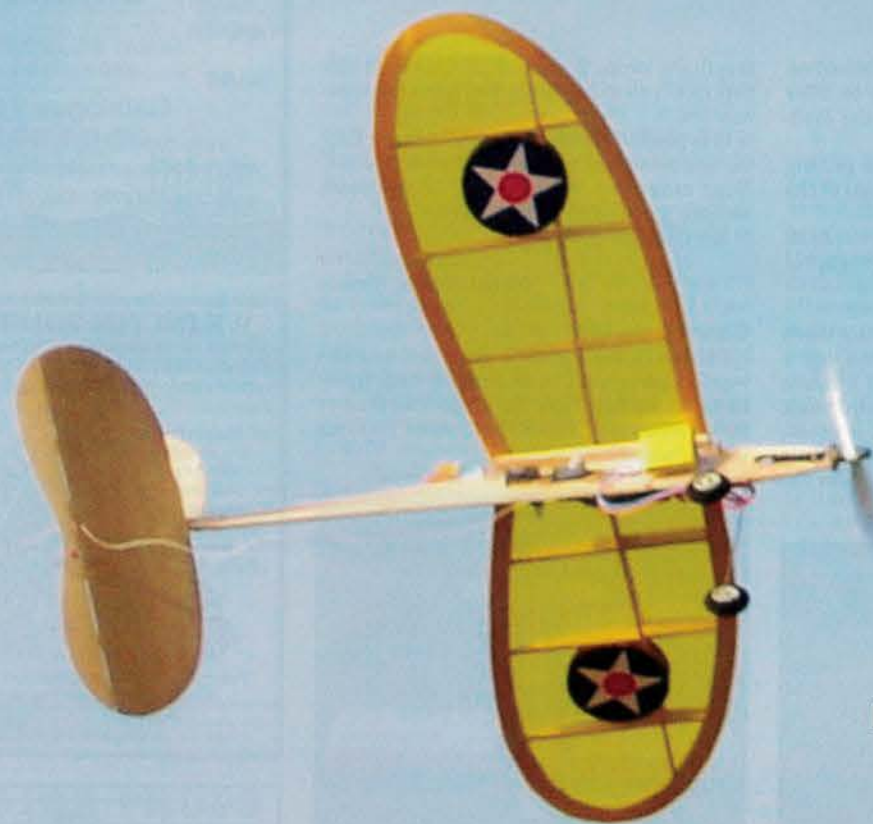


# Mini Zephyr



By Jim Zare

Although over 70 years old in design, the Zephyr adapts well to today's small e-power.

The original Zephyr was a 12-inch wing span rubber powered ROG model designed by Abe Bergman. It appeared in the December 1936 FLYING ACES and was revived in July 1979 Model Builder. When I saw the plan I was intrigued with the elliptical wing and stabilizer planform. This is right out of the 1930's streamlined era and very appropriate for a nostalgic 21st century electric backyard flier.

Zephyr was designed specifically for the Astro Firefly Coreless motor. This motor is a high precision 9-watt gear motor that is virtually silent in flight. The tiny 22-inch wing span Zephyr weighs in at a mere 3.5 ounces ready to fly. Powered by a two-cell 250 mAh Li-Po pack the Zephyr draws less than one amp and will fly for 20 to 25 minutes per charge.

The Zephyr has some unique design features including:

- A flat bottomed elliptical swept back wing
- A lightweight laminated fuselage for strength, durability and easy R/C installation
- A unique method of mounting landing gear

- Laminated sheet balsa rubber stabilizer and rudder with integral Mylar hinges
- Pull-pull control system
- A nifty simulated pilot and insignias using paper cutouts

The Zephyr is very easy to build in just a couple of evenings. It flies slowly, is rock steady in the air and is responsive to rudder. It has a great climb rate and will do loops and nice rudder rolls. It is fun to build and a joy to fly.

## Construction

**Wing:** The wing uses an unusual swept back elliptical planform. Cut out the wing ribs, leading and trailing edges and other wing components from 3/32-inch balsa. Pin down the leading edges and trailing edges of the wing panels and glue the W-5 wing tips in place. I highly recommend using Great Planes Pro Wood Glue sandable white glue for building the wing. It is strong, light weight and very easy to sand.

Add the lower 3/32-inch square spar and ribs W-2, W-3 and W-4. You should bevel the front of ribs W-3 and W-4 to accept the leading edge reinforcement before you begin the assembly.

Next glue the W-6 shear webs in place. Finally add the W-1 ribs at the centers section making sure they are angled to match the shear web. At this point glue the top spar in place. Note that the top spar stops at rib W-4.

Soak the leading edge reinforcement (3/32-inch square x 20 3/8-inch balsa) in hot water for about five minutes and glue it to the leading edge bottom in front of the wing ribs with the wood glue.

When everything has dried, sand the leading edge and trailing edge to the profile shown on the side view and glue the two wing halves together using CyA or epoxy.

**Wing covering:** The wings of the original models were all covered with Solite. This is an acronym for Solarfilm Lite. This is a strong synthetic material, which is airtight, waterproof, and heat shrinkable. It is very light with a weight of .6 ounces per square yard. For the 110 square inches of the Zephyr wing this translates to about .101 ounces of total covering weight. I don't think you can cover a wing with tissue and match this weight and strength combination.

I have been able to cover both the top and bottom of the Zephyr wings with one piece of Solite each. Make sure that you are careful

when heat shrinking this material because you can actually apply too much heat and shrink the material right off the leading or trailing edge.

The nice thing about iron-on covering is that you can correct warps or add washout after the fact. I have added about 1/8 inch of washout to the trailing edge at each tip on the Zephyr prototypes.

For indoor flying I have made a separate wing with only the top surface covered. This single surface airfoil really slows down the model for flying in small gyms.

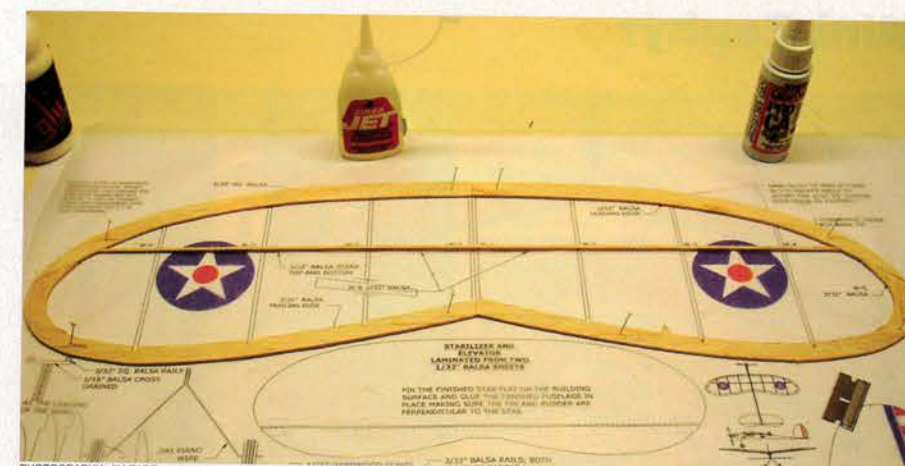
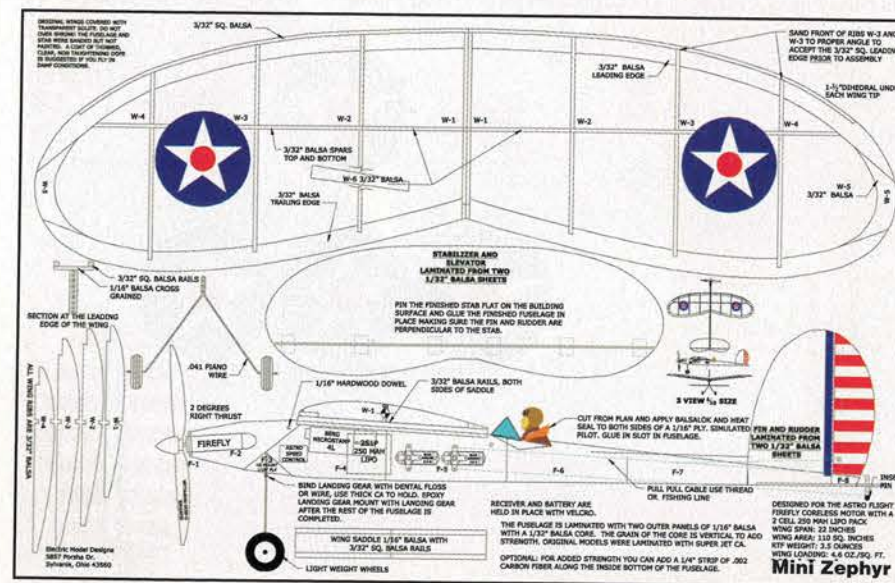
**Rudder and stabilizer:** Many small models have 1/16-inch sheet balsa rudders and stabilizers with Scotch Crystal Clear tape for the hinges. This is quite effective and is very easy to build. However, I found that after a number of flying sessions the tape tends to loosen with a pull-pull system and the balsa often warps. The laminated control surfaces used in the Zephyr have embedded Mylar hinges that are designed to give reliable long term warp free service.

The Mylar is sold in 8 1/2 x 11-inch sheets and can be found in stores that provide materials for drafting and engineering reproduction.

Begin by stacking two layers of 1/32-inch balsa and pin or tape them together while you cut out the fin, rudder, and stabilizer and elevator sections. Pin down the stabilizer and rudder over the plan and use thick cyanoacrylate to position the Mylar hinges. Make sure you leave a gap between the movable surfaces as shown on the plan. Hold each hinge in place with your fingers over a small piece of wax paper until it sets up. Use a cyanoacrylate glue (CyA) for the stab, rudder and fuselage laminations on this model. Note: do not use water soluble glue for these components. They will warp and will be unusable.

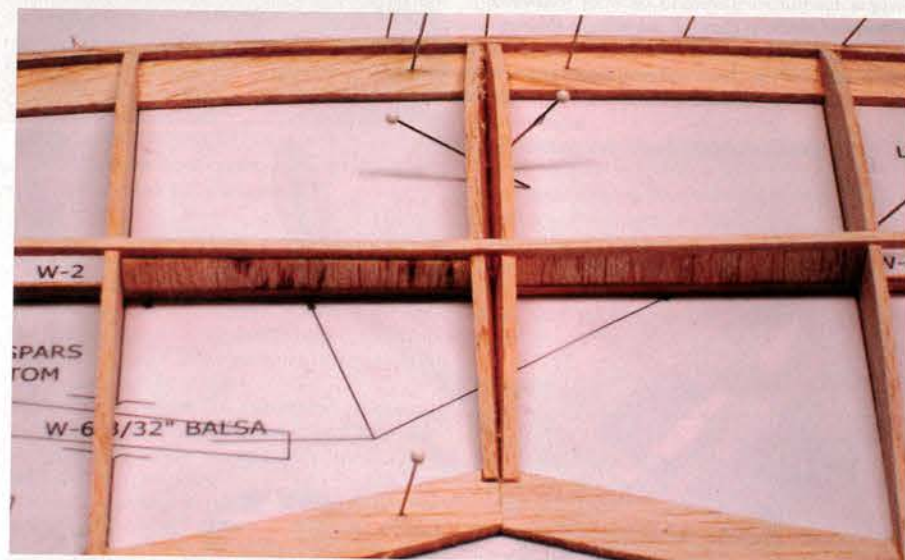
Remove the pins from the elevator and run a bead of thick CyA about 1/4 inch from the perimeter with a few strokes in the middle where the pull-pull device will be installed. Go easy on the CyA. Push down for 30 seconds and the elevator is complete. Complete the same lamination process for the stabilizer, fin and rudder.

You are now ready to finish these components by sanding them to a streamlined shape with 220- and 400-grit sandpaper.



PHOTOGRAPHY: JIM ZARE

Begin wing construction by gluing the leading edge and wing tips (above) and cementing the lower spar in place over waxed paper on the plan. Shear webs in place (below) with the leading edge and top spars assembled. Note the dihedral angle of the center ribs with the shear webs as a guide.



**Fuselage:** The fuselage is laminated with three layers of 1/16-inch balsa augmented with the selective use of 1/16-inch plywood at the nose. The middle fuselage core is cross grained for strength. Cut out the fuselage components and pin down the right fuselage side over the plan.

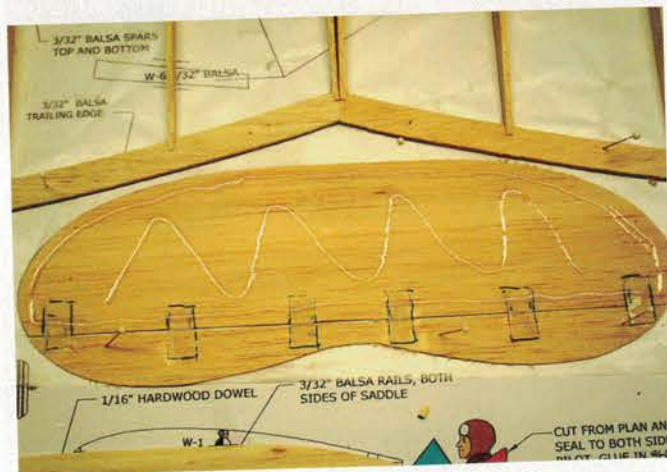
Optional: for added strength you can add a 1/4-inch strip of .002 carbon fiber along the inside bottom of the each fuselage side with the cyano. I have been using this technique for about five years in similar models and have never broken a fuselage in the vulnerable area between the wing and stabilizer.

## AT A GLANCE

Type:	R/C electric parkflyer
Construction:	balsa stick and sheet with some plywood
Wing span:	22 inches
Wing area:	110 sq. in.
Airfoil:	Clark Y
Weight:	3.5 ounces
Wing loading:	4.6 oz./sq.ft.
Motor:	Astro Firefly
Prop:	Günther 5-4
Battery:	2S-250 Li-Po
Radio:	three channels rudder, elevator, motor controls
Servos:	two sub-micros



## Mini Zephyr



**Unique laminated stab and elevator (above left):** The Mylar hinges are outlined in pen and glued to the bottom 1/32-inch lamination of the stab. The bead of thick CyA can clearly be seen. To finish the stab press the top 1/32-inch balsa lamination in place and hold firmly in place for 30 seconds. Repeat to add the top of the elevator. The completed wing, stab fuselage, wing saddle



and landing gear with all of the electronic components (above right) shown with another assembled Zephyr fuselage. It is now that you want to take care of covering the wing. The wing saddle and wing hold down dowels were assembled and the fuselage is glued to the stab making sure all of the components are properly aligned (below).



mount with landing gear into the slot at the bottom of the fuselage and make any necessary adjustments. Use 5-minute epoxy to secure the landing gear making sure it is properly aligned.

To complete the fuselage glue F-1 in place for mounting the Firefly. Note that this should be sanded on so that there are enough threads available to securely mount the motor. Select the lightest wheels you can find. I used Hobby Lobby "LYT" 1-inch wheels with .080 brass washers soldered to the landing gear for retainers.

The fuselage and tail surfaces are not covered. As a precaution against warping apply a couple of coats of clear dope to seal the surfaces. Sand these with 400-grit paper after each coat.

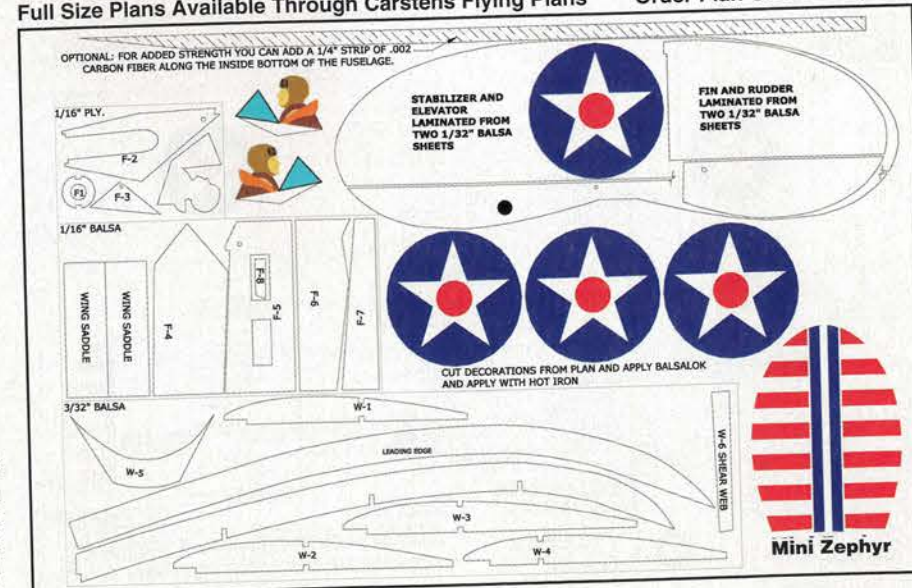
**Windshield and profile pilot:** The optional profile windshield and canopy is merely a piece of 1/16-inch plywood cut to the pattern shown on the plan. It was covered with the colored paper cutouts that come with the plan set. Before you cut them out, paint the rear of these with Bal-

Use a perimeter bead of thick cyanoacrylate and glue in place F-2, F-4, F-5, F-6, F-7 and F-8. Sand the entire assembly and apply a bead of the cyano along the top and bottom of the entire side and glue the left fuselage side in place to complete the sub assembly. You can now sand the fuselage with 220- and 400-grit sandpaper. Glue the fin in place and hinge the rudder using a few drops of the CyA.

The next step is to assemble the wing saddle by cutting out the 1/16-inch saddle and adding two lengths of 3/32-inch square balsa sticks. Mount this on the fuselage and add the 1/16-inch wing hold down dowels in place.

Pin the stabilizer to your building board and glue the fuselage in position while aligning the wing and fin. Use a pair of needle nose pliers to bend the landing gear from .041-inch piano wire. Lightly sand the top of the landing gear mount to make insertion easier. Place the landing gear over the slot of the 1/16-inch plywood landing gear fairing and bind the landing gear to it with dental floss or thin wire. Trial fit the landing gear

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Jim Zare with the Astro Firefly powered Zephyr sport model designed for indoor and outdoor R/C flying. The profile Zephyr weighs in at 3.5 ounces and uses conventional off-the-shelf R/C components.

saloc and let them dry. Cut them to size or use your covering iron to attach them to the plywood. Place a blank piece of paper over the cutout to protect it while being heated. There is a slot in the fuselage top for the profile pilot.

### Installing motor and radio

The Astro Firefly was introduced in 2002 by Astro Flight. It features a coreless motor, a 4:1 gear drive and special speed control designed specifically for the system. The motor draws .9 amp at full throttle and turns the Günther 5-4 propeller at about 6,500 rpm. The speed control is actually designed to cap the amperage at 1 amp. It is a reliable system and as mentioned earlier it is extremely quiet. I have tried a number of other propellers but I always seem to get the best performance from the Günther 5-4 or the

fiberglass "Zagi" prop clones that can be found at any hobby shop.

I used the Berg Micro Stamp 4L four-channel double conversion receiver for this model to insure that I minimize interference. This neat little receiver weighs in at an incredible .14 ounce.

Two Blue Arrow 3.6 sub-micro servos operate the rudder and the elevator. These servos are relatively inexpensive and weigh only .13 ounces each.

Cut the servo openings to match your equipment using a sharp X-Acto #11 blade. The servos were mounted with #0-1/4 inch machine screws on hardwood rails made from a stirring stick as shown on the plan. The receiver and speed control were mounted with adhesive backed hook and loop fastener.

The pull-pull control system consists of

only a couple of components. The first is a loop of lightweight Spiderwire fishing line and the second is a plastic tube. The line is threaded through a 3/32 x 1-inch plastic tube just behind the rudder and elevator hinge lines. I used the discarded nozzle tube from a WD-40 aerosol can. Apply a drop of CyA to position these and secure one end of the line to the servo output arm. Again, a small drop of CyA will help you secure the knot.

Thread the line through the plastic tube and back to the other side of the output arm. Pull the line taut but make sure you don't actually bend the fuselage by applying too much tension. Tie a knot and use a dab of CyA to secure the line at the servo output arm. Note that you don't place CyA on the line that goes through the plastic tubes until you are ready to center the servos. I suggest that after the model is assembled that you turn on the radio and center the servos and the rudder and elevator. When satisfied with the position place a drop of CyA on the line at the end of the plastic tubes to secure the setting.

Landing on rough surfaces outside, such as asphalt or concrete, will eventually shred the lower fishing line making down elevator inactive. I thought about adding a tailskid but instead decided to glue a cut-off round head pin to the plastic tube while I centered the servos. This acts as a skid, protects the line, and only adds the weight of the pin itself.

### Flying

Check out the balance, then the radio with the motor off and on. The Zephyr will ROG in about 15 feet and will climb at a nice pace. The model will maintain level flight at about one-third throttle.

Indoors, I like to fly around the gym at about four feet and listen to the propeller sound which sounds just like a rubber model. The model is very responsive and will turn a very tight radius without a tendency to drop a wing tip. This is essential for success in a small gym. I use a click or two of power to regulate my height, just like a real airplane.

Outside the Zephyr can be flown in low to moderate wind conditions. I fly mine in the backyard, in the street in front of my house, or at the Junior High School soccer field. The Zephyr will climb to an amazing height in three or four minutes. It is also a blast to fly low and slow. The Zephyr loops well with a little down trim and does spectacular, almost axial rudder rolls.

I always have two or three packs charged and ready to go for those calm summer evenings. I love to toss the Zephyr in the air on the back patio and sit back on a lounge chair for a twilight flying session.

The Zephyr is truly a modern, electric powered ROG model that would put a smile on Abe Bergman's face.

Since the Zephyr was designed and built, a number of new micro brushless motors such as the E-flite Park 180 Brushless Outrunner and the 10-gram Dualsky motor have been released. These motors will easily power the Zephyr. You will need to eliminate the motor slot and fabricate a firewall to be glued to the front of the fuselage.

