

■ Lucky



Next
Built a few kits? Want some

FOR THOSE OF YOU who have been flying Beginner Precision Aerobatics and are ready to move up to Intermediate, I suggest you take the next step: Move away from building kits and start building your models from scratch.

thing more? Step on up!

Next Step is designed to teach you several building techniques on a model that's not complicated to build. Almost everything is built from sticks and twigs, to conserve weight. Awareness of weight is something you must be concerned with throughout construction.

I'll also introduce you to a new method of finishing that saves weight. What's the purpose? To get you into the habit of thinking in terms of weight reduction.

CONSTRUCTION

Wing: I suggest you start with the wing, since it is the most time-consuming to build. To make a straight wing you need to have a straight, flat building surface. Lay out the wing plan and tape it down.

Build 10 support jigs from 1/8 balsa. The easiest way to make them is to cut a sheet two inches wide lengthwise. Mark off 2 1/2-inch widths and cut 20 pieces with a Zona saw in a miter box. Make the braces in the same manner but cut 1 1/2-inch squares. Slice the 1 1/2-inch squares on a diagonal. When finished you should have 20 triangles.

Assemble the jigs by gluing two triangular braces to the horizontal leg of the brace. Take care that the edge of the brace lines up with the edge of the leg. If all is square, set the vertical plate of the jig against the braces, align with the end of the horizontal leg, and glue. The end product is an L-shaped bracket that becomes the support jig for the wing frame.

Place two jigs on each end of the wing plan, lining up with the last rib. I suggest you place a right triangle directly over the outer rib line and butt the jig up to the vertical edge. Tape the jig in place and repeat for the other three jigs.

On the jig nearest you, make a mark two inches off the work surface. Do the same on the jig at the other wingtip. Stick a pin in one of the marks and run a thread over the other mark. Carefully measure along the thread to see if the work surface really is flat.

Let's assume that at the center of the wing, the surface is 1/8 inch lower than the tips. Then mark the center jigs at 2 1/8 inches. See how this method works? Wherever you place a jig, measure against your datum thread and mark accordingly.

Place two jigs at the centerline of the wing—one at the leading edge and one at the trailing edge. Go out about halfway on the wing and place jigs along the leading and trailing edges. Carefully set the leading edge and trailing edge balsa in place and pin to the centerline of the jigs.

Let's cut some ribs. There are two ways to do this. One is to cut a root and tip template from 3/32 plywood, stack a bunch of balsa blanks between the templates, bolt them together, and sand away. Use a Zona saw to cut the leading edge and spar notches, then unbolt and number the ribs to match the drawing.

Another way is to use a computer program to correctly size each rib. The root rib is a NACA 0015 and the tip is a NACA 0018. Print the ribs, then cut each one from the paper. Use rubber cement to glue the paper template to the balsa. Place another 1/16 sheet under the first one and carefully cut out the rib. You now have two ribs cut from one template—simple. Peel the paper off and clean off any excess rubber cement.

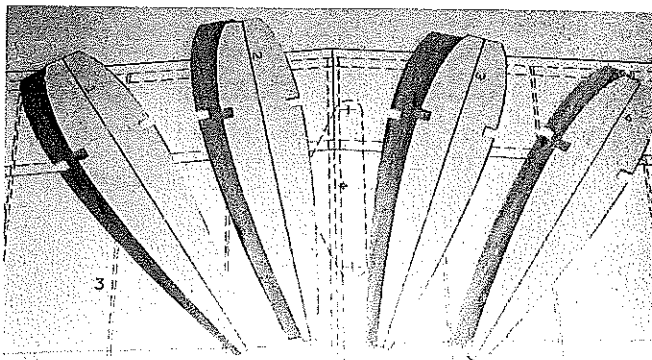
No matter which method you use, carefully remove excess from the center of the ribs, leaving about 1/4 inch around the edges.

Slide the tip ribs in place and tack-glue the trailing edge. Set the next rib in place, using a right triangle to line up the rib over the drawing and to assure that the rib is vertical. Continue until all the ribs are in place. Glue the leading and trailing edges to the ribs. Measure, cut, and lay in the top and bottom spars, then glue in place.

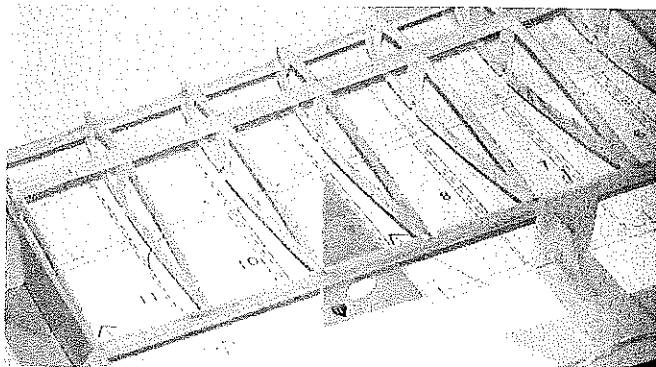
The plans call for a four-inch bellcrank to be installed, but if you want to use a three-inch, that's OK. I highly recommend using a four-inch bellcrank made from carbon fiber, because of its superior strength and light weight.

Cut 1/16 brass or copper tubing to two-inch lengths. Insert the leadout wire through the tubing, letting about six inches hang out one end. Grip the tubing in the center with needle-nose pliers and slowly bend the tubing 90°, with both ends pointing the same direction.

Insert the U-shaped tubing through the leadout hole on the bellcrank so



Computer-generated rib patterns glued to 1/16 balsa, trimmed to shape. Alternate method: stack rib blanks, sand to shape.



Wing jigs are in place. A small triangle is used to align ribs with plans and assure that they are vertical.

STEP NEXT

Type: CL Precision Aerobatics

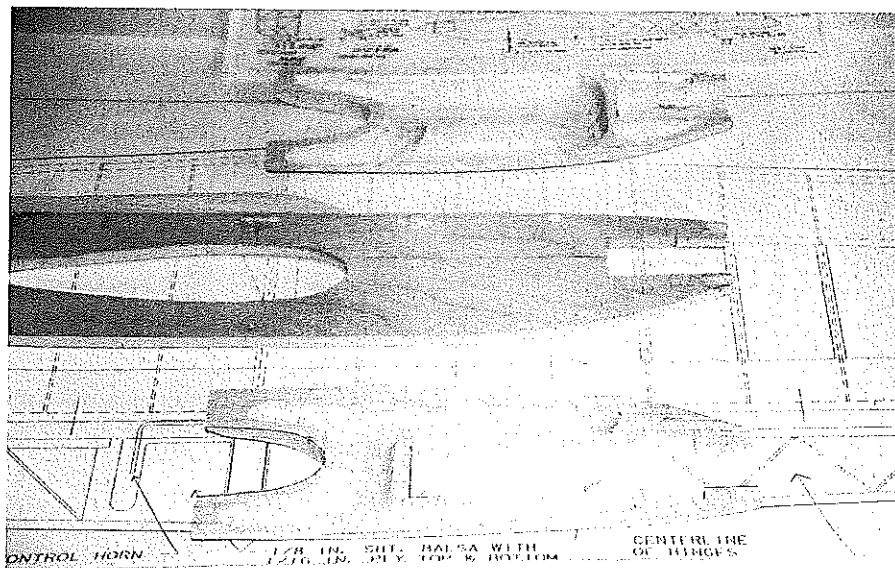
Wingspan: 51 1/4 inches

Engine: .40 -.46 glow

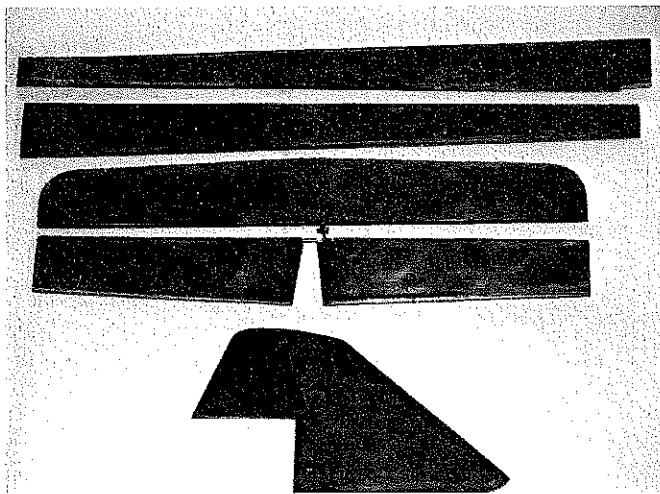
Flying Weight: 35 - 40 ounces

Construction: Built-up

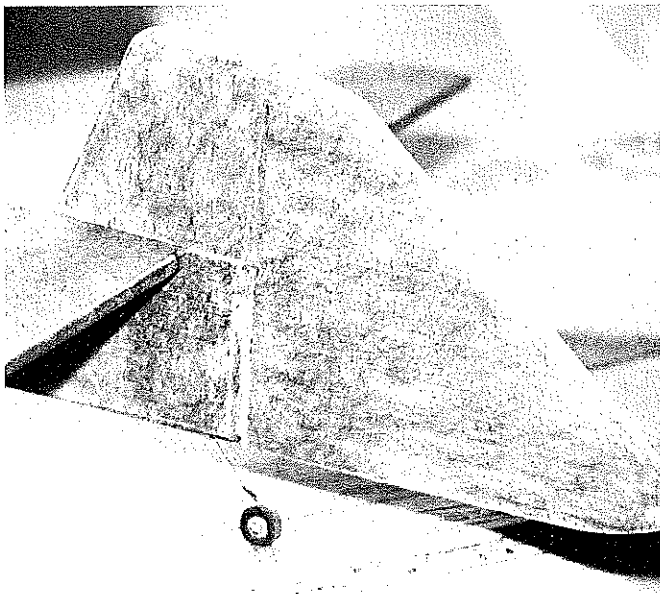
Covering/finish: Silkspan and dope



Fuselage cheek blocks are shaped and hollowed prior to final installation.



Flaps, stab, elevator, and rudder are covered with lightweight carbon-fiber mat. Adds stiffness, does not shrink.



Matte is applied with nitrate dope. Author recommends Sig sanding sealer as finish base, followed by gray dope and color.



Lucky Pyatt preps Next Step for its first flight. The author's coach, Bob Whitely, is holding the model.

the short leg is in the hole. With needle-nose pliers, come back about $\frac{1}{4}$ inch from the end of the upper horizontal leg. Carefully bend the tip down about 30° . Do the same with the lower leg, only bend the tip up about 30° . Bring the leadout wire together and wrap with soft copper wire for about $1\frac{1}{2}$ inches. Trim off the short piece of leadout wire and epoxy the wrapped wire instead of soldering it.

Here is a light-but-very-strong way to install the bellcrank in the wing: Cut two right-triangle pieces from $\frac{3}{16}$ balsa. Make the short leg one inch and the long leg $1\frac{1}{2}$ inches long. On the short leg, make a notch with a round file just large enough for the center post of the bellcrank. Place the notch $\frac{1}{4}$ inch away from the long leg. Glue the bottom wedge against the spar and the inboard root rib. Let a little of the wood hang below the rib outline for finish-sanding.

Install the bellcrank as shown on the plans, pulling the leadouts through the ribs on the tip. Center the bellcrank to the centerline of the root rib and place the second wedge in place. (Let a little stick up so you can sand to the contour of the rib.) The strength comes when you apply the top and bottom center sheeting. The pull force of flying will be distributed along the spars and the sheeting.

Cut and install the bottom trailing edge sheeting. Install vertical-grain $\frac{1}{16}$ balsa web sheeting in four rib bays left and right of the root ribs. Cut and glue the top trailing edge sheeting in place.

Temporarily install the flap control horn. Cut a piece of $\frac{1}{8}$ music wire about seven inches long and put an 80° bend one inch in from the end. File a flat spot on the leg that goes through the bellcrank. Install the pushrod and secure with a wheel collar. Make sure the setscrew tightens against the flat spot.

Cut another piece of $\frac{1}{8}$ music wire about five inches long and put a 90° bend about one inch from one end. Put the short end in the control horn. Now bring the two pieces of pushrod together and wrap with soft copper wire. Be sure that the bellcrank is square to the root rib and the control horn is vertical. Double-check everything, then solder the pieces together. Remove the finished pushrod and clean the solder joint. To be sure rust doesn't set in, brush a coat of clear dope on the solder joint and re-install the bellcrank. This time, really secure the wheel collar and place a small dab of glue over the setscrew to be sure it doesn't come off.

Now is the time to go ahead and glue the leading edge sheeting to the top and bottom spars. Lightly mist the sheeting and watch it curl down to the leading edge. There is no great trick here; let the water stress-relieve one side of the sheeting. Gently pull the balsa to the leading edge and glue in place.

After all four pieces have been glued in place, put the wing back in the jig and check for warps. It is really important that the wing be free of any twist.

As soon as you are sure everything is straight, cut and install the paneling that covers the last two ribs. Do the bottom first, since it will be the most difficult. When this is done, install the center section sheeting and the capstrips.

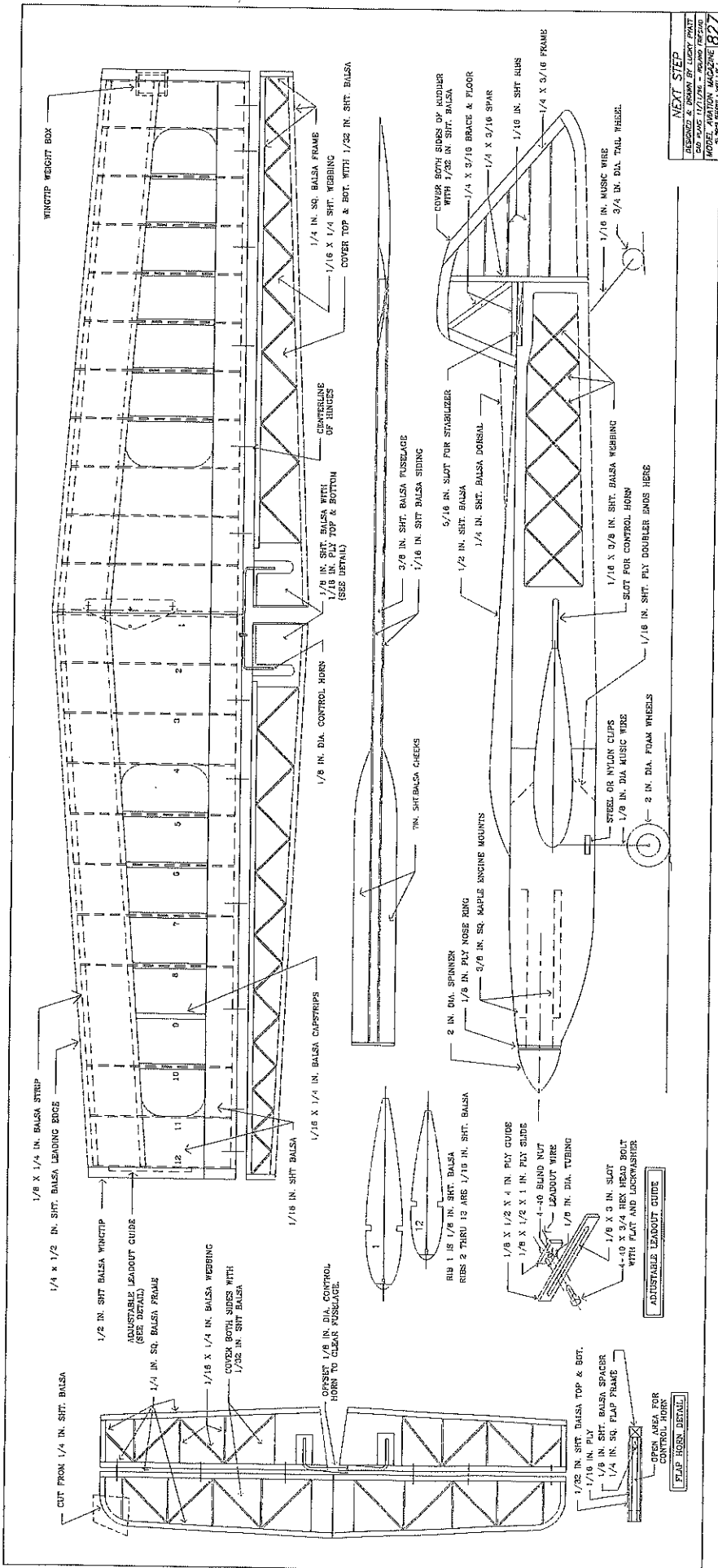
Remove the wing from the jig and finish the bottom center section and the capstrips. Congratulations! You just finished a strong wing that is free from warps.

The flaps are completely built-up. Notice the area where the flap horn attaches to the flap; it is a box, and the horn is *not* glued in place on final installation.

To build the box, start with a sheet of $\frac{1}{8}$ balsa cut as shown on the plans. Cover the top and bottom of the opening with $\frac{1}{16}$ plywood about $\frac{1}{8}$ wider than the opening. Finish the trim with $\frac{1}{16}$ balsa on the sides of the plywood. Insert this box in the flap framework and finish building as shown. Cover the entire flap with $\frac{1}{32}$ balsa. Cut and notch the slots for the hinges. Sand the leading and trailing edges to a clean half-round shape.

Adjustable leadout guides are simple to build, and are a must-have item. The drawing gives you all the information needed to build the guide and the wingtip weight box. All I recommend is that you take your time building these two items.

To install the adjustable leadout guide, draw the wingtip outline about $\frac{1}{8}$ inch oversize, cut to shape, then cut the wingtip in half lengthwise. Tape the two pieces together and place the guide on the inside of the tip. Draw the outline, separate the pieces, and carefully carve out the guide seat about halfway through the tip.



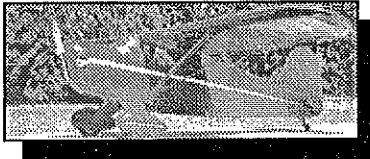
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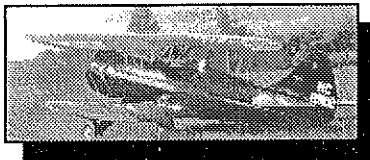
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Tape the halves together again and place the guide in the new seat. Draw the 1/8 slot, separate the halves, and cut the smaller slot for the leadout wires. Put the two pieces together and insert the guide again, this time looking at the alignment of the slot opening. Fix anything you don't like, then move on. Separate the two pieces again.

The area where the leadout wires exit the wingtip can become notched over time; let's fix that now. Cut two pieces of 1/4 plywood about 3/16 wide and long enough to fit in the leadout slot. Now the wires will rub against a hard surface instead of soft balsa.

Fit the weight box in the outboard wingtip sheet. Place the tip sheet against the outboard rib and trace the outline of the rib. Cut the wingtip a bit larger than the outline so you can finish-sand once the sheet is glued in place.

Tail Surfaces: Building the stabilizer, elevators, and rudder is a straightforward process. Use the flap horn detail when you build the horn box for the elevators. Be sure to shape the edges and cut the slots for the hinges.

After you are through constructing the flaps, stab, elevators and rudder, brush on a coat of nitrate dope to help keep the moisture out.

Fuselage: Select a piece of 3/8 balsa that is as light as possible. Strength and stiffness in balsa sheeting can mean greater weight, so choose a very light piece. The fuselage is a box, and when finished, a very strong box indeed. Use a long straightedge to scribe a line along the top edge of the sheet. This is your reference line.

Draw the centerline of the engine down the length of the fuselage. Lay out the spacing of the engine mounts and mark them; do the same for the wing and stabilizer locations. Be careful here, since this is all part of the straightness of the finished model.

Finish marking the excess area behind the wing, then cut it all out. Use a razor plane to trim the excess wood off the top of the sheeting. When you are finished, measure everything again and correct any alignment problems now. Cut the 1/16 plywood doublers as shown on the plans, but don't glue them in place just yet.

Lay the fuselage sheet over the plans and mark out where the balsa webbing will go. To cut the half-notches where the webbing

intersects, use a file that is 1/16 wide with cutting teeth on the edge. Glue the webbing in place and the inboard plywood doubler.

Install and glue the engine mounts in place. Place the outboard plywood doubler on the fuselage, but do not glue yet. Mark and remove the plywood where the engine and mounting lugs will be, then glue in place.

Cut and install 1/16 aluminum pads that are slightly larger than the mounting lugs on the engine. Glue the pads on the maple engine mounts, lay out the mounting holes for your engine, and drill the holes. Install the 4-40 blind nuts on the inboard side.

Bolt the engine in place and install the prop and spinner. With a pencil in hand, follow the top curve of the spinner and draw it on the top part of the fuselage side. Use the pattern from the plans to get the bottom curve in place. Remove the engine assembly and cut off the excess wood.

Rough-cut the 3/4 balsa cheeks to shape and tack-glue in place (use just a few drops of glue; you must be able to remove the blocks to hollow them out after the rough shaping is finished). Mark the location of your fuel tank on the outboard cheek. Give yourself about 3/16 excess clearance for tank adjustment. Remove the cheeks, cut out the area for the fuel tank, and grind out all the excess balsa. Glue the 1/16 balsa siding to the fuselage and trim out the area for the wing. Glue the cheeks in place and finish-sand to shape.

Finish: Look over all the pieces of your model. If you are satisfied, apply a coat of nitrate dope to all parts. Let it set for a couple of hours and apply a second coat. Let this set overnight, then sand with fine-grit paper.

The wing can be covered with several different products; one is 000-weight silkspan.

To finish with silkspan, sand the wing with 400 wet-or-dry paper. Cut the silkspan to size, dampen, and place on the outboard-bottom wing panel. Use nitrate dope thinned 50% applied around the edges of the silkspan. Gently smooth out the wrinkles as needed.

Turn the wing over and apply the silkspan the same way on the outboard-top wing panel. Overlap the silkspan about 1/2 inch along the leading edge. Use a mister to prevent the bottom from drying too soon. Allow to dry, and watch the trailing edge for warps. If you see one creeping in, use the mister to dampen the

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ide that is pulling. Repeat the process for the aboard panels.

After everything has dried and the warps have been corrected, apply a coat of thinned nitrate dope to the wing surface. Allow to dry or a couple of hours, then sand lightly to remove any "fuzz." Apply one more coat to the open bays of the wing panels. This area is a bit more porous and requires a second coat to seal better.

On to the other parts: Instead of using silkspan I recommend you get two square yards of 1/2-ounce carbon-fiber mat. This product has no grain and will not shrink. I also recommend you cut out exactly the size needed for each part.

Start with the flaps. Use the thinned nitrate to apply the mat. Start at one end, and brush on until finished. Remember, this stuff does not shrink, so you can let one side dry before applying the other side.

Finish off the stab, elevators, rudder, and fuselage up to the line where the cheeks end. The cheeks get done after the wing and cheeks are installed. Sand all parts down with 320 wet-or-dry paper (used dry). Be careful not to sand rough along the edges. Use your hand to check for smoothness over all the matted surfaces.

When the roughness is gone, you can apply a sanding sealer. I recommend using Sig brand because it takes less to get the job done. Apply the sealer to all of the surfaces, including the wing. This is a butyrate dope, so watch for any cracking when the paint dries.

Let the first coat of sealer set overnight. Sand it with 320 wet-or-dry paper. Don't get too aggressive sanding; all you want to do is take off the powder from the sealer. It's much easier to apply the finish to the model when it's in parts.

Apply the second coat of sealer and let it dry overnight. This time, use small sanding blocks to take off the sealer. This is how you get a flat surface back to flat after the sealer has been pushed on.

Hold the sanded surfaces up to a light source and look for shiny spots. This indicates areas not sanded. If you see very flat, non-reflective spots, you have sanded through to the wood. Rub the shiny spots away and apply sealer to the flat spots. Keep sanding until every piece has a level shine and smooth texture.

Assembly: Now all the parts are pretty much

finished. Did you find it easier to work on the model while it is still in pieces? I hope so.

Install the landing gear to the fuselage and bolt in place. Set the fuselage upside down on your workbench. Make sure the sides are vertical and brace it in place, since you will be moving the wing in and out a few times.

Turn the wing over and insert into the fuselage. Brace the wing and check for level across the wing and fuselage. Keep moving things around until you are sure the wing is in perfect alignment with the fuselage. Check again, then check *again*. If you can, get one of your flying buddies to help out. Once you are absolutely sure everything is straight, glue the wing in place.

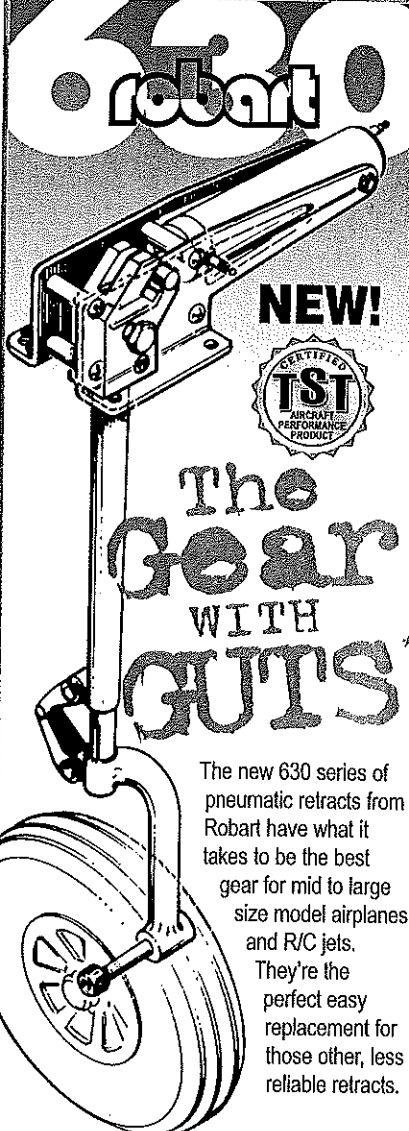
Before installing the stabilizer, you need to turn the model over and brace it so the wing is level in both directions. The Robart leveling tool is made just for this.

Once you have the wing and fuselage well braced, put a long level on the top of the fuselage. The bubble should be reading level. Place the stabilizer in the slot and put a level on it spanwise. Measure the distance from the trailing edge of the stab at the tip to the trailing edge of the wing. Shift the stab until the sides are equal. Tilt the stab until the bubble reads level, then tack-glue the stab in place. Double-check everything and glue in place.

When installing the rudder, make sure the fuselage is vertical. Use a right triangle to check the rudder placement, then glue in place. Glue the fuselage cheeks in place and finish with the mat and sanding sealer. Cut and glue the 1/2-inch sheet used to form the canopy and long turtledeck. Do the same for the rudder dorsal fin. Apply the finish when you do the cheeks.

Fillets: Ah yes, fillets. Here is one method that really works. Prepare the work area by surrounding it with 1/2-inch-wide masking tape about 3/16 inch away from the joint that gets fillet material. Use Sig Epoxolite and mix as directed. Place in the fillet joints and press down to be sure to get all the air bubbles out of the mixture.

The tool that makes it all work is a chrome-plated socket. Use the 1/4-inch socket for small fillets and the 1/2-inch socket for those that are slightly larger. Put the socket on a six-inch extension to start the final shaping. Start at the back of the fillet, holding the socket at a 45° angle off the fuselage and 45° forward. Apply a bit of pressure to the socket and pull toward



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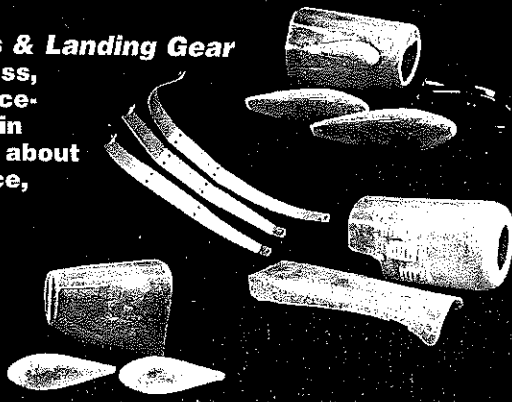
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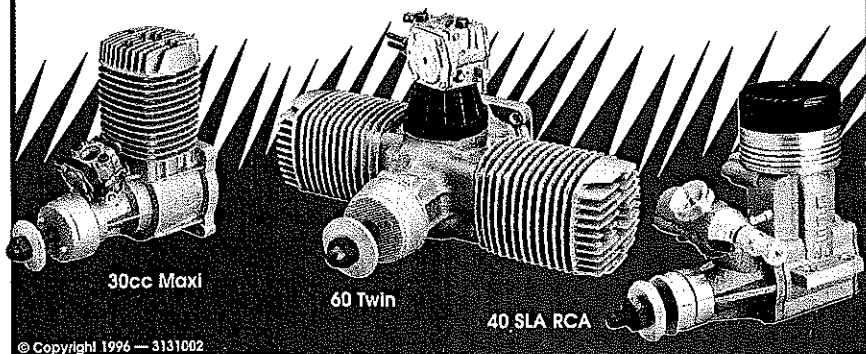
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you. When you are satisfied with the look of the fillets, remove the tape.

As soon as the Epoxolite starts to warm up and harden, apply water to your finger and smooth out the fillets. Don't press hard—just steady pressure. This will knock down any "edge" left by the tape and really blend the final fillet shape. Let everything cure for 24 hours, then sand with 320 wet-or-dry (used dry) just to roughen the surface a bit so paint will stick.

Every part of your model is now ready for final inspection before the first color coat. Look every surface over carefully. Make sure the rough areas and shiny spots are gone. Wipe everything down with a damp cloth to remove any dust. I recommend you use Sig Gray as the first color coat. Apply just enough to cover the model—no more. Let everything dry, then inspect all of the surfaces. Here is where the flaws show up. Fix the flaws and sand all the color off.

The next step is optional: Spray another coat of gray on (to make the base coat even).

From here on I can't help you much. The final color choice and design is completely up to you. A few suggestions, though:

Use 1/8 or 1/4 plastic automotive trim tape for your hard edges. If you are using butyrate dope, spray a light coat of clear along the edges and let dry for 1/2 hour. This prevents any bleeding of a color under the tape. When you remove the trim tape, pull it back over itself to cleanly cut the paint edge. If you use the epoxies, as I do, be sure to let everything set for a minimum of 24 hours before removing the paper and tape.

Assemble the flaps and elevator. Install the pushrod, engine, tank, and all the accessories to turn this into a flyable Stunt model.

Trimming: There is nothing more frustrating than having a poorly flying model and not knowing how to trim for stability and predictability. Let's start the trim process *before* the first flight.

Pick up your model by the canopy and see where it balances. If the balance point (Center of Gravity or CG) is very close to the front of the wing, the model is nose heavy. Add weight until the model balances just over the spar location on the wing. This is critical.

Extend the CG perpendicular to the fuselage, out to the inboard wingtip. Adjust the leadouts so they are 1/2 inch behind that line.

First Flight: What do you look for during the first flight? Wings level? Sound of engine when flying inverted? Pull of the model? How even is the control input from your hand?

Let's start with "wings level." Have someone watch the model for level wings. If the outboard wing is constantly up or down, twist the outboard flap in that direction to compensate. If the outboard wing is low in both directions, remove 1/4 ounce wingtip weight. Keep working on this problem until the wings are level right-side up and upside down.

The sound of the engine needs to be steady in both directions. If the engine goes "fat" when inverted, you will have to raise the tank 1/8 inch

each flight until the sound is the same both ways. Be sure to try several different types of propellers and different blends of fuel to get to the best running performance. If you are not clear in this area, get with one of the expert fliers and ask for help.

The pull of the model on the handle tells you if the model is tracking properly. If the pull is very light and the model does not respond to control input, check to see where the engine is pointing. You may have to add a little engine offset to gain line tension. Check again on the location of the leadouts. Make sure they are behind the model's center of gravity. Do the opposite if the model seems to be pulling much too hard—look at the engine offset and the leadout location.

The most important part of successful Precision Aerobatics flying is the balanced input of control from your hand. The pull on the handle must be the same for the inside and outside loops. Again, up control and down control must be equal. If you find the inside maneuvers require a goodly amount of input and the outside stuff is too quick, adjust the elevator kwik-link to fix. Keep using this adjustment until the turning of the model feels fairly equal. To fine-tune the turning, use the adjustments on the control handle. You might want to work with an expert in this area also, just to make sure you don't do things backward.

The whole purpose of learning how to trim a model is to allow you to practice Precision Aerobatics with a model that will do exactly what you want. You want to practice—not fight or worry if the thing will stay in the air. It is my belief that when properly trimmed, Next Step will help you through intermediate and on to Advanced, and possibly Expert. →

Lucky Pyatt
9629 Hazard
Garden Grove CA 92644

Sources:

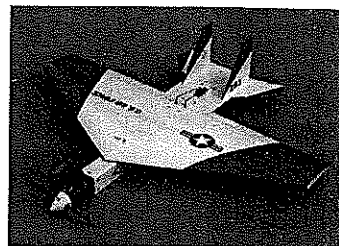
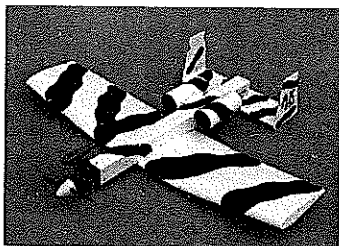
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