by Paul Vliet

A sport model sized for the big at heart is aerobatic enough for the hotshot pilot

Author/designer Paul Vliet holds his latest creation at his club field. This is a man-sized airplane!

I STARTED DESIGNING model aircraft for a kit business I had approximately 15 years ago. I produced composite kits for the advanced modeler. The fuselages were molded fiberglass and the wings were sheeted foam cores. I produced three kits at that time: an Ultimate biplane, an Extra 300, and a Sukhoi.

One day I had the idea to make something from wood that could be covered with iron-on material, thus be built by the average modeler. My youngest son Jordan, who was roughly 10 years old at the time, was good at drawing, so I enlisted his help.

I asked him to come up with a few drawings of what he considered to be a sleek aircraft. I said I would turn his drawings into working blueprints and we could build the aircraft; hence the birth of the LJ-7.

As for the name LJ-7? My wife's name is Linda and her middle initial is J. I added the 7 for good luck.

CONSTRUCTION

Fuselage: I like to start by cutting out all the parts and laying them on the plans. Cut the fuselage sides from 1/8 x 12 x 48 light plywood (poplar) and the fuselage side doublers from 1/8 x 12 x 48 aircraft plywood. The light-plywood sides are in two pieces since the fuselage is more than 48 inches in length.

It's a good idea at this time to use a 1- to 1 1/2-inch-diameter hole saw to make a series of lightening holes in the aircraft-plywood doublers. Be careful not to put any where the former notches are or

A close-up reveals a neatly cowled-in SuperTigre 2300 engine. A Bison Pitts-type muffler was used.

where the wing bolts are to go. (The lightening holes are optional.)

Cut all the formers, the firewall, and other parts, starting with the largest pieces and working your way down to the small parts. (Some of the small parts can be made from the scrap from the larger parts.)

Glue the fuselage doublers to the fuselage sides with slow-curing epoxy. Adhere the front and rear portion of the fuselage sides to the doublers at the same time, making sure to produce a left and a right side—not two lefts or two rights by accident. Epoxy the 1/8 aircraft-plywood doublers (FSDT) in place at the tail.

The key to this project, or any other, is having a straight and true building board. I use a piece of old Formica-covered kitchen countertop that I secure to my workbench and shim into alignment before each use.

Install the landing-gear plate (LGP) between formers F1 and F2 and set them in place over the side view of the plans. Make sure the F1 and F2 slots have enough slop in them to allow the plate to sit at the proper angle, as shown on the plans.

Lay one fuselage side flat on the building board and glue in formers FW2, F1, F2 (with the LGP installed between them), F3, and F4, set in place using a square. Tape the fuselage plan top view to the building board and cover it with waxed paper.

Set the assembled fuselage side, with the formers that were

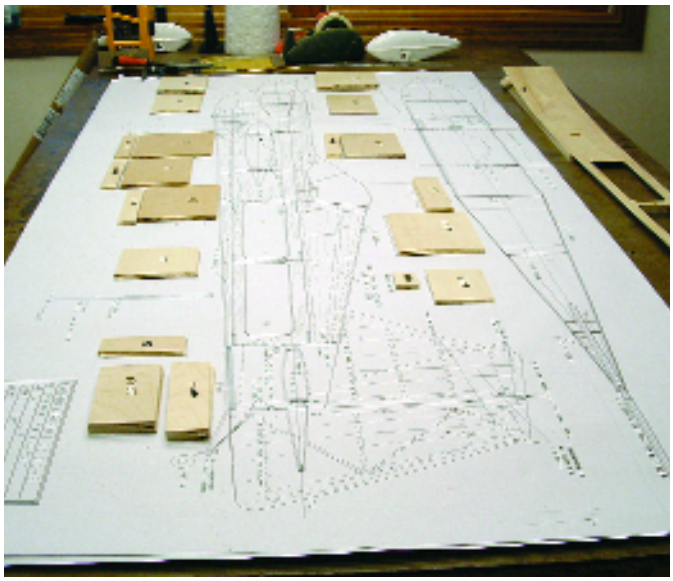
Individual servos on either side of the fuselage aft end actuate the individual elevator halves. Simple and accessible!

Right: The LJ-7 settles in gracefully for a landing. It is spirited yet easy to handle.

A bottom view of the nose area reveals the curved aluminum landing gear and the exit tubes of the Brison muffler.

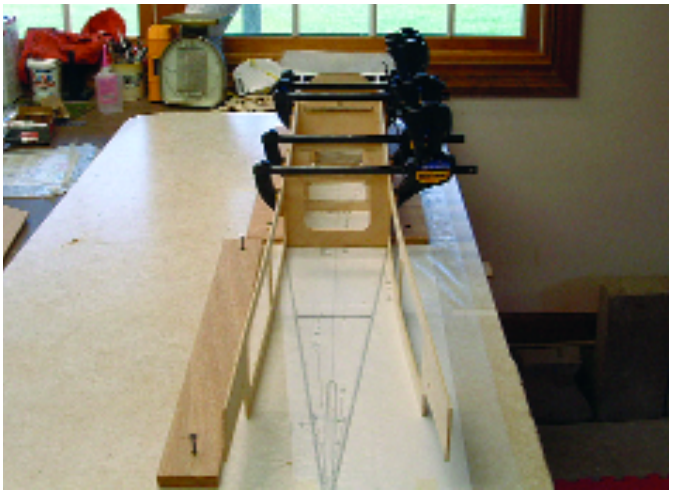
This is what the LJ-7 does best: fly! It is fully aerobatic yet it could serve as a good second model for an advancing student.

Photos courtesy the author

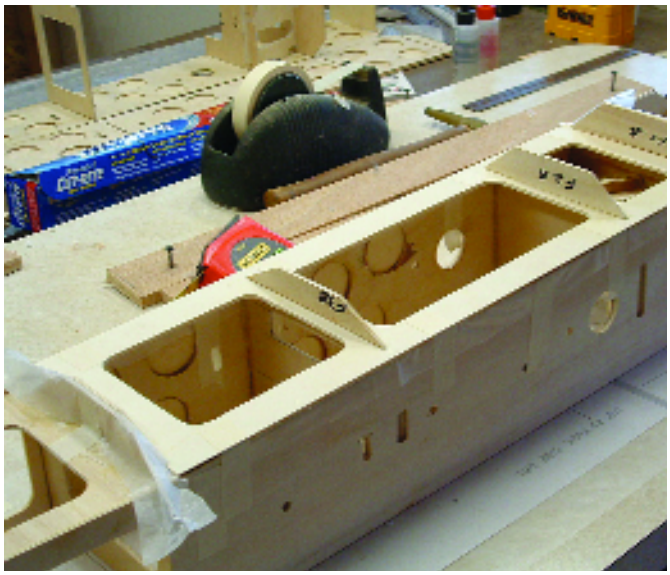


Fuselage construction begins by cutting out all the formers and checking them for accuracy over the plans.

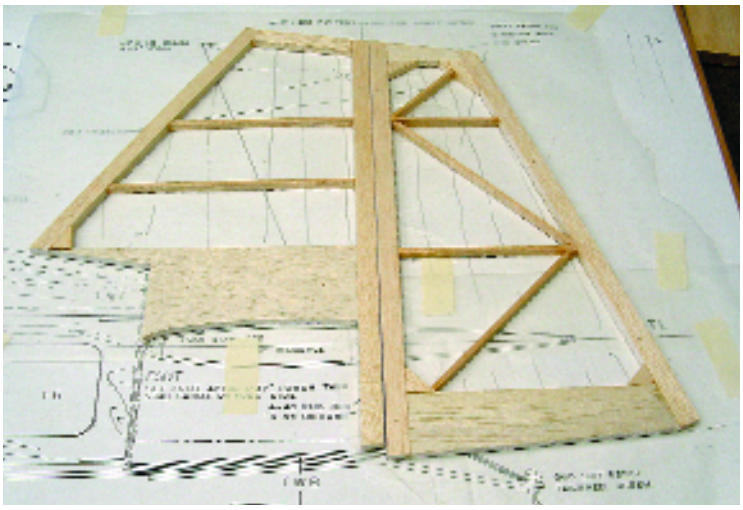
Formers F1, F2, F3, F4, and the landing-gear plate (LGP) are glued in place and set with a square.



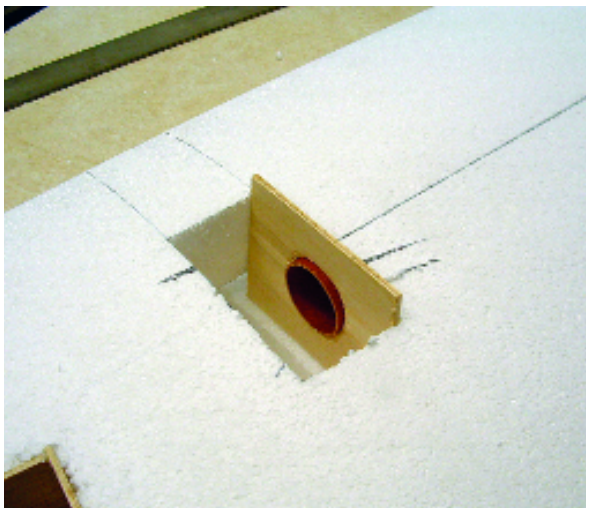
The parallel forward section of the fuselage is joined over the plans with formers FW2, F1, F2, F3, F4, and the LGP in place.



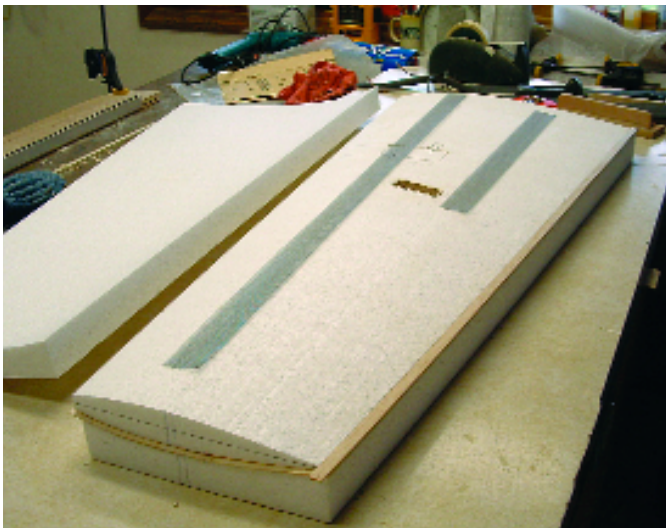
The belly pan with formers F1B, F2B, F3B, and F4B glued in place.



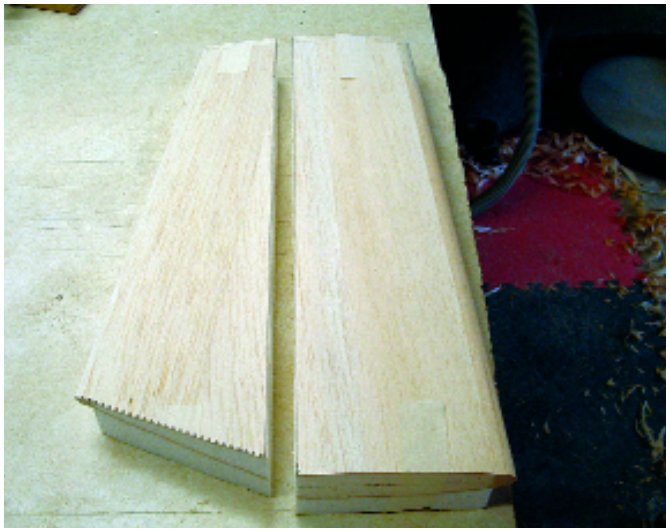
The rudder and vertical stabilizer are built over the plans, which are protected by a sheet of waxed paper.



The aluminum wing-spar tube socket is set in place with the 1/8 poplar plywood capture plate in place over tube.



Strips of reinforcing fiberglass screening are glued to the wing-core panels as the wings are sheeted.



One of the elevator and horizontal stabilizer halves separated and capped at the LE and TE.

Control-Surface Deflection

Initial flight:

Ailerons: 3/8 inch
Elevator: 3/4 inch
Rudder: 2 inches

Later flights:

Ailerons: 3/4 inch
Elevator: 1 1/2 inches
Rudder: Keep 1/8 inch away from elevator when at maximum deflection

*All of the preceding were used with exponential set at 15%.

previously installed, over the plans and fixture in place using strips of 1/2 plywood screwed in place to the building board and alongside the fuselage to hold it in place.

Install the opposite fuselage side. Snap it in place over the formers and fixture it in place with plywood as you did with the first side. Glue the second side in place to the formers by using thick cyanoacrylate glue. Hold the bottom of the fuselage together with bar clamps until the glue sets.

Install a 1/4 x 3/8 aircraft-plywood beam to the underside of the LGP, running in a fore and aft direction and into the notches in formers F1 and F2. Epoxy these in place.

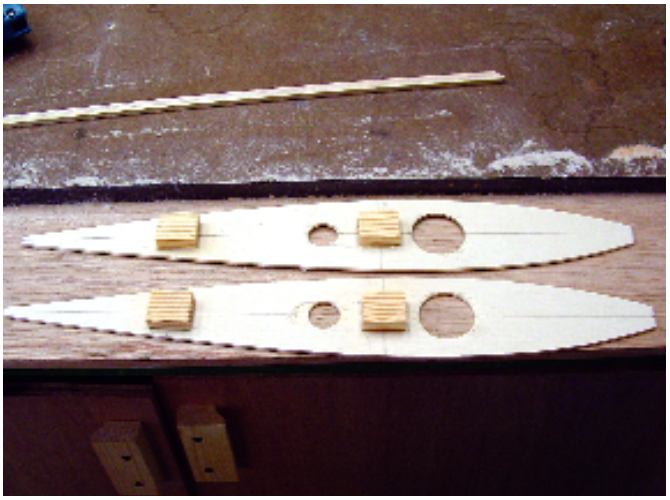
Pull one fuselage side behind former F4 in at a time onto the lines on the plans and fixture in place with 1/2 plywood. Use a scrap piece of 1/4 aircraft plywood to make a fixture that is 90° to the table and set it between the two sides where the vertical stabilizer post will be later, to maintain the 1/4-inch space between the fuselage sides at the rear. Glue formers F5 and F6 in place over the plans. Remove the clamps from the fuselage after the glue sets.

Cover the bottom of formers F2-F4 and the exposed fuselage sides between the two formers with waxed paper and set the belly-pan base (BPB) in place. It is necessary to bevel the sides of the BPB to later accommodate the belly-pan sheeting.

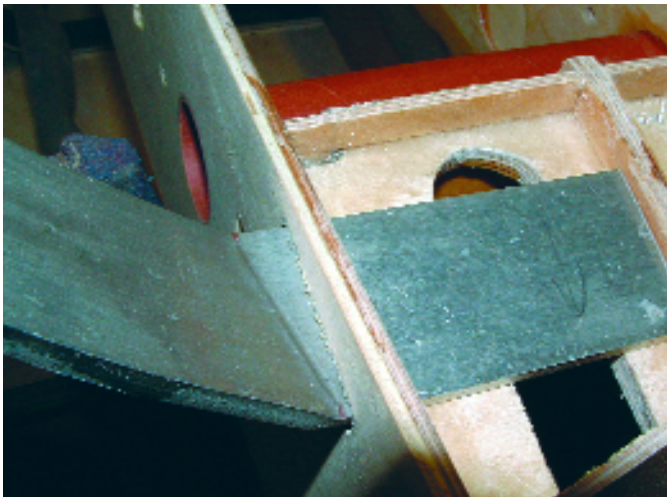
Tape the BPB in place to the fuselage with masking tape. Make some belly-pan rail material from 1/8 x 3/8 aircraft plywood. Install the belly-pan rails with thick cyanoacrylate on the inside of the fuselage against the underside of the BPB and against the inside edge of the fuselage sides. (The belly-pan rails are in three sections that run between the formers F1 and F2, F2 and F3, and F3 and F4.)

You can reach through the openings in the BPB and hold the rail material in place until the cyanoacrylate sets. The waxed paper keeps the rails from being glued to the fuselage sides while being glued to the BPB.

Glue formers F1B, F2B, F3B, and F4B in

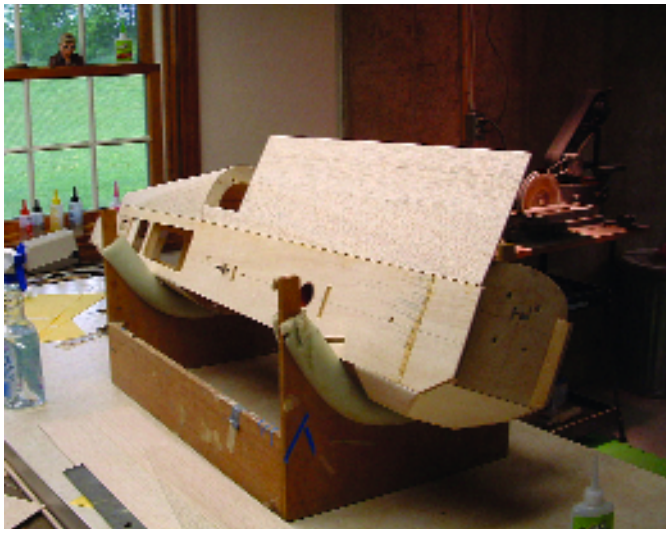


Install 1/4 x 3/4 x 3/4 aircraft-plywood wing-bolt blocks to the 1/8 poplar plywood root ribs as shown.



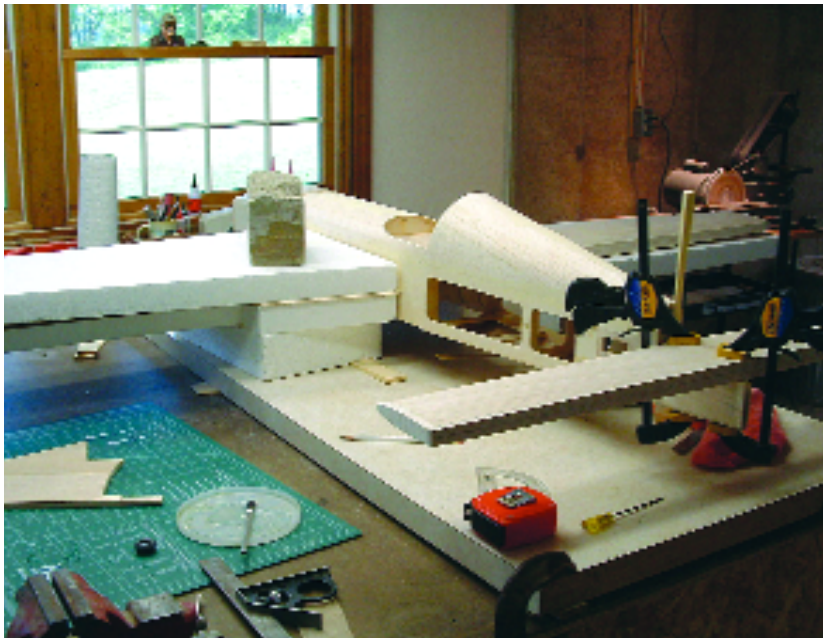
The plug-in landing gear is test-fit and marked with arrows indicating forward. Note the fit against the center support.

Formers F4T, F5T, and F6T have been glued in place with 1/4 square balsa turtledeck stringers installed.



The foredeck sheeting is ready to be bent over the fuselage formers. See text for the details of this operation.

The engine mount is bolted to the firewall after careful alignment has been executed.



Install wings in foam cradles, set the assembly on the building board, and weight it in place so the horizontal stabilizer can be installed.

Type: International Miniature Aircraft Association-legal sport aerobat
Pilot skill level: Intended for advanced pilots
Wingspan: 84 inches
Wing area: 1,042 square inches
Weight: 14.5 pounds
Wing loading: 32 ounces/square foot
Length: 67 inches
Engine: 1.40-2.10 (two-stroke), 1.80-3.00 (four-stroke), or 38-50cc (gas)
Radio: Four channels (minimum), five heavy-duty standard-sized servos, one standard servo for throttle
Construction: Foam-core wings and stabilizers with balsa sheeting, light-plywood-and-balsa fuselage, built-up fin and rudder
Covering/finish: Hangar 9 UltraCote, and Hangar 9 UltraCote Paint

place. Set the fuselage assembly and belly-pan assembly aside until the wings are ready to be installed.

Wing: Obtain foam wing cores from the supplier listed at the end of this article or cut them yourself. Lightly sand the cores' surfaces, being careful not to change their shape.

Build two servo boxes from 1/16 sheet-balsa stock. Make the boxes approximately 1/8 inch taller than the thickness of the wing at the forward side of the core. See the wing top view for the location. Make the boxes the proper size to accommodate the servos you will be using. Install 1/4 x 3/8 aircraft plywood servo-mounting rails in the boxes.

Cut a hole in the foam core at the location indicated on the plans that is the size of the boxes you just made. Cut the hole completely through the wing core. Dry-fit the boxes in each wing.

Mark the location of the servo-wire channel on the side of the servo box using a 1/2-inch-diameter dowel rod with a piece of 1/2-inch-diameter brass tube fastened to it. Remove the box and cut the hole for the servo wire.

Glue the boxes into the wing-panel halves using white glue. Be sure to let approximately 1/8 inch of the box protrude above the surface of the wing core at the forward part of the wing to allow it to be sanded flush with the core's surface after the glue sets. Be sure to mount the servo boxes with the servo rails facing the bottom surface of the wing.

Locate the outboard end of the aluminum tube spar. Cut a hole in the wing that is approximately 4 inches front to back and 2 inches wide, with its inboard side centered on the end of the tube-spar socket. Save the foam scrap to be reinstalled later.

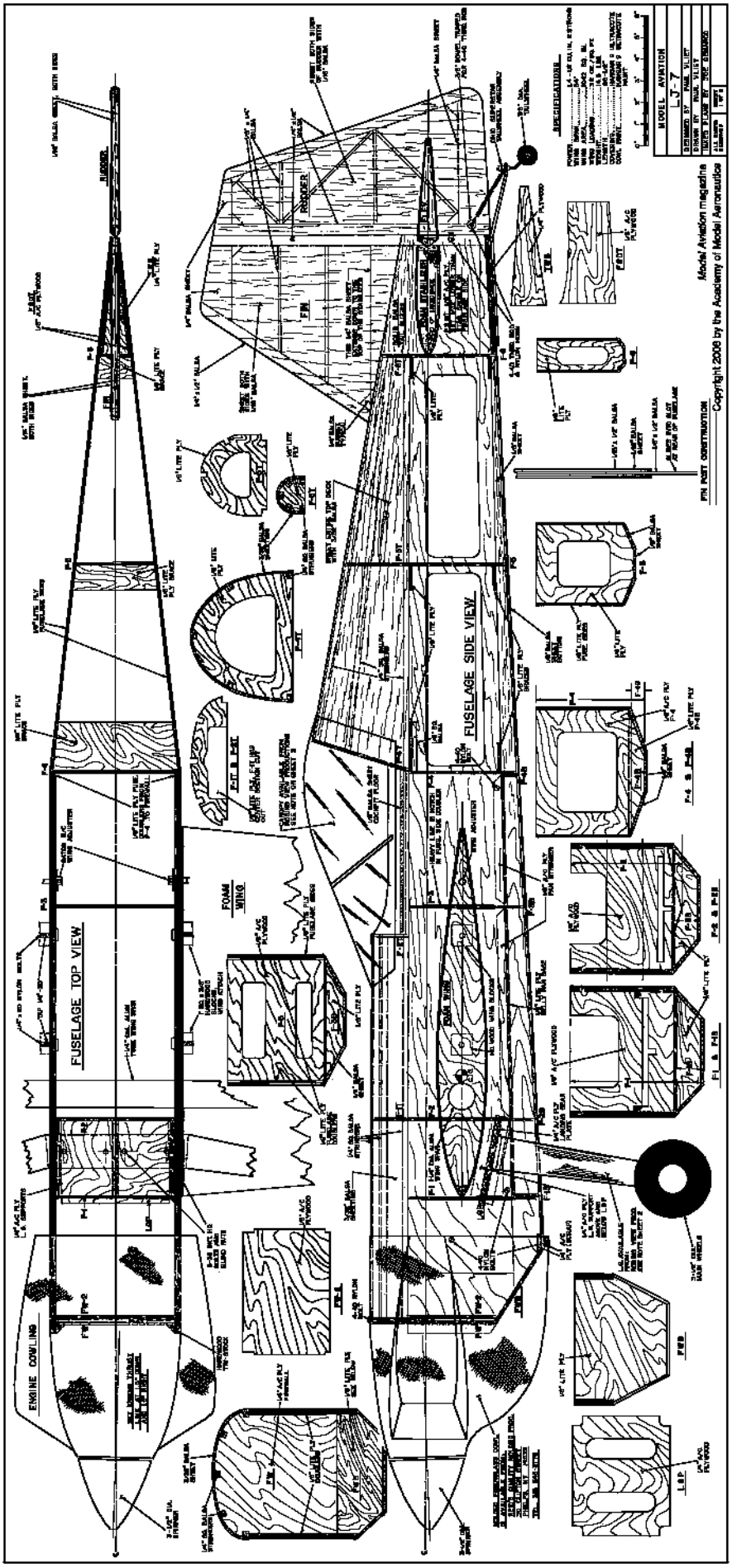
Slide the tube-spar socket in place and make a capture plate from 1/8 poplar plywood that is 4 inches long and as deep as the core is thick at its thickest point along the 4-inch hole. Drill a hole in the capture plate the size of the tube-spar socket and slip the plate into the wing and over the tube-spar socket. Mark the wing-surface contour on the plate top and bottom surfaces, remove, and sand to shape.

Glue the tube-spar socket into the wing and glue in the capture plate. Leave enough tube-spar socket protruding past the root of the wing core—approximately 3/16 inch—so it will pass through the light-plywood root rib later.

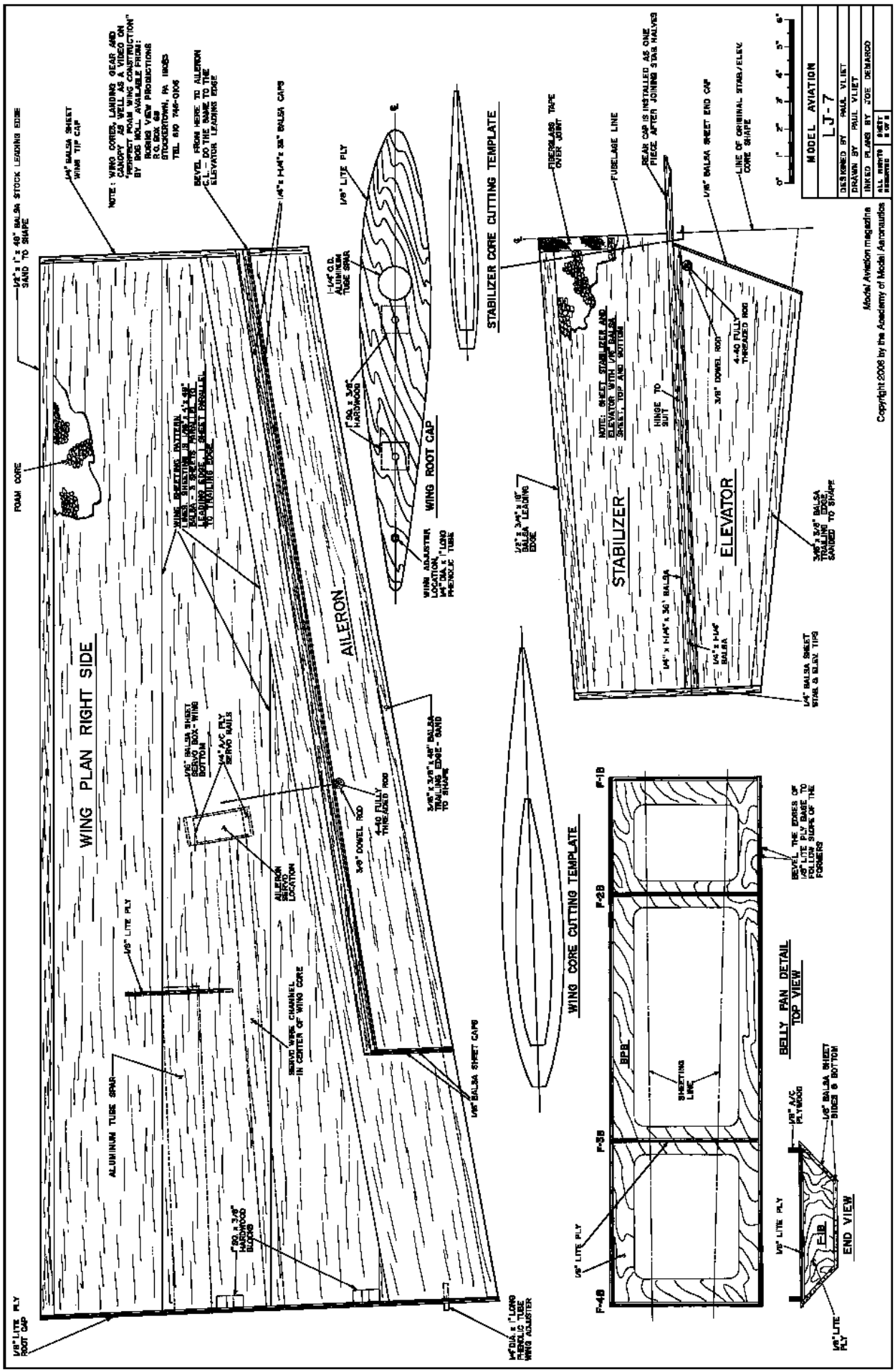
After the adhesive sets, glue the scrap piece of foam from the 4-inch hole back into the wing core. You will have to remove 1/8 inch from it to allow for the capture-plate thickness.

Fabricate the root ribs from 1/8 poplar plywood and install the wing mounting-bolt blocks along the centerline at the locations indicated on the plans. (Blocks are 3/4 x 3/4 x 1/4 aircraft plywood.) Be sure to oversize the root ribs slightly and then sand them flush to the core after they are installed.

Slide the aluminum spar into the socket on your wing core and slide a piece of socket over it. Slide the root rib over the spar and



See page 183 for Full-Size Plans listing



socket and up against the core with the wing-bolt blocks touching the wing core. Line up the outside of the root rib with the surface of the wing core and press down firmly on the root rib to indent the foam core with the wing-bolt blocks.

Remove the root rib and remove the foam from the core in the impressions left by the wing-bolt blocks to a depth of 1/4 inch. I use my Dremel with a router base for this.

Glue the root rib in place with epoxy or white glue and adhere in place with masking tape until dry. Using a sanding block, sand the root rib flush with the surface of the foam core. Repeat this process on the other wing core.

Prepare the wing sheeting from 1/16 x 4 x 48 balsa. Edge-glue three sheets together with the grain running parallel to the wing's LE and then glue one sheet with the grain running parallel to the TE. Make two right panels and two left panels.

Make two 1/8 x 3/8 balsa strips for the wing TEs. Glue these strips to the inside TE of both bottom wing skins. Set the bottom wing skins in place in the bottom foam cradle for each wing half and place the wing core on top of them. Sand the strips to the slope of the wing core while putting downward pressure on the wing core with everything sitting in the cradle.

You are ready to install the wing skins to the cores. Purchase slow-cure laminating resin for this purpose. Mix the resin according to the directions. For extra wing strength, purchase some carbon-fiber strips or buy some fiberglass screening from a hardware store. (Yes, the type used in window screens.)

Cut the screen into 1 1/2-inch strips. Place one strip directly over the wing spar from roughly 1 inch in from the root and take it to approximately 2 inches from the tip. Place another roughly 16-inch-long strip 1 inch in from the root end and ending near the servo pocket. The aft edge of this strip will be approximately 1 inch aft of the rear side of the servo box.

Do this to the top and bottom of each wing. Glue the strips in place with laminating resin just prior to gluing the wing skins.

Apply the laminating resin to one of the bottom skins of one core. *(Do not apply the resin to the foam core!)* Place the glued-up skin in its corresponding bottom wing cradle and set the core on top of it. Glue up the top skin and set it on top of the core.

Set the top cradle in place and weight the entire assembly down with heavy objects. I use concrete blocks—enough to cover the entire wing panel. This whole process takes place on your straight and true building board.

As soon as everything is in place, measure from the wing LE and TE centerline to the surface of the building board. The measurements should be the same all over. If they are not, shim the wing where needed to make them the same. Repeat the entire process for the other wing panel and for the horizontal stabilizer/elevator piece.

After the laminating resin has set, cap the LE with 1/2 balsa stock and carve/sand it to shape. Cap the wingtips with 1/4 balsa stock and sand to shape. Repeat this process on the horizontal stabilizer/elevator.

Mark the aileron hinge line on both wing panels. Put additional lines 1/4 inch on either side of the hinge line; these are the actual cut lines. It pays to mark all these lines on both sides of the wing; then you can cut halfway through from both sides. Slice between the cut line and the hinge line, and block-sand down to the actual cut line after the aileron has been removed from the wing.

Cap the aileron LE and the wing TE with 1/4 balsa stock. Put a hinge line on the center of the aileron LE and block-sand the LE to a bevel from the rear side of the 1/4-inch cap material at the aileron surface to the hinge line. Do this from the top and the bottom to the hinge line.

Install a piece of 7/16-inch-diameter dowel into the aileron for installation of the control horn. See the wing top view for the location of the dowel.

Mounting the Wings: Mark a line on both sides of the fuselage, in pencil, 2 1/2 inches down from the thrustline (if the fuselage is upside-down on the table, the line is 2 1/2 inches up from the table), and return the fuselage upside-down to the building board. Weight it in place to keep it from moving. Slide the aluminum tube spar in place in the fuselage.

Install your wing-mounting kit in both sides of the fuselage. Place a piece of 1/2

plywood on the table that is approximately the length of the spar and the width of the wing panel. (This acts as a shim while setting the wing panel.)

Place the wing panel in the top foam wing cradle. Tape the cradle fast to the wing panel, making sure the LE of the cradle is 1/2 inch back from the capped LE so it is in its original position with relationship to the foam core.

Slide the wing panel onto the spar and push it up close to the fuselage. Check to see if the centerlines on the LE and TE match up with the line drawn on the side of the fuselage. If they don't, adjust them with the wing-mounting kit adjusters.

When in alignment, slide the wing away roughly 1 inch and place a 1/4-inch-diameter dowel center (available at most hardware stores) in each of the fuselage wing-bolt holes.

Press the wing panel against the dowel centers to mark the location of the wing-bolt holes in the panel. Remove the wing panel and drill and tap the wing-bolt holes in the wing for 1/4-20 nylon bolts. Repeat this process for the other wing panel.

It's time to complete the stabilizer/elevator. Mark the hinge line on each stabilizer half according to the plans. Mark an additional line 1/4 inch on either side of the hinge line on each half of the stabilizer. These second lines are your cut lines to separate the elevator from the stabilizer.

Cut the elevators from the stabilizers. Place the stabilizer halves in their respective bottom cradles with approximately 1/2 inch of the root hanging over the cradle. Glue the stabilizer halves together with slow-setting epoxy. Tape across the joint until the epoxy sets.

Cap the LE of the elevators with 1/4 balsa stock. Mark a center hinge line on the LE and taper the edge to a bevel from the surface of the elevator to the hinge line. Cap the TE of the stabilizer with 1/4 balsa stock that is a continuous piece from one side of the stabilizer to the other.

Completing the Fuselage: Install the landing gear. It has to be split in half at the center. Each half is slipped through its respective side through the slot provided in the side of the fuselage.

After inserting the gear, you must remove additional aluminum so that the end of the gear ends up against the center support beam on the bottom of the LGP and the forward part of the angled mark on the underside of the gear just touches the outside of the fuselage.

Drill the gear for two 8-32 socket-head bolts each. Mark the bolt holes in each landing-gear half and install blind nuts in the LGP from the top side.

Glue all the top formers into their respective positions and then install the 1/4-inch square spars. Install the cockpit floor made from 1/8 balsa, with the grain running from side to side. Cover the turtledeck and foredeck with 3/32 balsa sheet and then sand to final shape.

It is suggested that you soak the turtledeck and foredeck balsa sheeting in a solution of ammonia and hot water before trying to bend it. This technique makes the wood more pliable.

Install the 1/8 balsa sheeting to the bottom side of the aft fuselage and sand to final shape. Install former Firewall Bottom (FWB). It is necessary to bevel this former where it meets the firewall. Install 1/8 sheeting between FWB and F1 and sand to final shape. Sheet the belly pan with 1/8 balsa and sand to final shape.

Glue in the 1/4 aircraft-plywood tail-wheel block with epoxy. Sand to shape.

Mounting the Horizontal Stabilizer: With the landing gear removed, install the wings and bolt them in place. Tape the bottom wing cradle to each wing. Shim the entire cradle up off the table at least 2 inches on both sides and weight it down so it can't move. The wings should now be at 0° incidence.

Draw a centerline on the horizontal stabilizer's TE. Set the stabilizer in its saddle. Go to the forward end of the fuselage and stick a pin in the center of the top 1/4-inch square stringer at the firewall. This will be your measuring reference point.

With the stabilizer in its saddle and set to 0° incidence, go to the TE and measure down to the table from the centerline you drew. Measurements should be the same on both sides.

Measure from the pin at the firewall to the rear outboard corner of the stabilizer on both

sides; these measurements should be the same. Sometimes it is necessary to trim the saddle on one side or the other to get the proper dimensions. When all the measurements are the way they should be and the incidence is zero, epoxy the horizontal stabilizer in the saddle.

Tail Blocks: Make a sanding fixture from 1/4 balsa stock that is the shape of the balsa tail blocks from front to back, and sheet it on both sides with 1/16 balsa except where it goes into the vertical stabilizer post slot.

Tack-glue this sheet in place and tack-glue the rough-cut tail blocks to it. This allows you to shape the tail blocks without having the vertical stabilizer in the way. After shaping, remove the blocks and set them aside for now.

Installing the Vertical Stabilizer: Dry-fit the vertical stabilizer by slipping its post into the slot between the fuselage sides. It should sit down all the way to the 1/4 plywood tail-wheel plate and be in full contact with the horizontal stabilizer and former F6.

When you have accomplished this, epoxy the vertical stabilizer in place. Epoxy it to the fuselage sides, horizontal stabilizer, and former F6. Remove any excess glue. Set a square on the table and make sure the vertical stabilizer is perpendicular to the table and the horizontal stabilizer. Epoxy the tail blocks in place.

Final Assembly: You are ready to install all hinges on all the control surfaces. I like to install 4-40 fully threaded rods into the dowels that I previously installed in the control surfaces. I leave approximately 1 inch sticking above the surface and thread in enough rod to almost cover the length of the dowel. Then I attach a Du-Bro E/Z Attach Horn Bracket for the clevis to affix to.

Mount your engine with the 1 1/2° right thrust and set your cowling. I mounted the cowling with 4-40 nylon screws. I mounted the belly pan with a 1/4-inch dowel through the rear F4 former and glued it to former F4B. Then I ran two 4-40 nylon bolts through the fuselage and into the aircraft plywood rails of the belly pan just forward of the landing gear.

I used the new Goldberg steerable tail-wheel assembly. I also used the Du-Bro light foam tires.

Engine: Power is provided by a SuperTigre 2300 with a Bison Pitts-type muffler. It all fits well into the cowling. The exhaust tubes from the Bison muffler were a perfect length and needed no extension.

The aircraft was designed around the old SuperTigre 3000, which was fitted with a cast-aluminum J'Tec muffler. This engine setup was considerably heavier than the setup I'm currently using. It also had less horsepower.

However, this created a problem when it came to balancing. I had to use a 2200 mAh battery pack strapped to the firewall to make the aircraft balance properly. For this reason I suggest that you keep everything as far forward as possible.

Test Flight: Before test-flying the LJ-7 I had run two tanks of fuel through the new engine, so it was run on the rich side during the test flights. I used the recommended 18 x 8 propeller and the engine turned a respectable 7,800 rpm.

Takeoff was uneventful, with the model tracking straight down the runway with only a bit of pressure on right rudder. When up to speed, a little gentle backpressure made the airplane lift off gently and climb out with ease.

Once at altitude the LJ-7 needed only one click of up-elevator trim to fly hands-off. After several level loops around the circuit I decided to throw everything on high rate and see what this model had. I pulled the nose straight up and it climbed until I decided to pull the throttle back. Power was not a problem even with the rich setting.

I rolled the model to inverted flight, and it didn't seem to care if it was right-side up or upside down. Little down-elevator was required to make it fly level—just a little pressure on the stick. Snap Rolls were crisp and fast. I even tried a Lomcevak, and the LJ-7 did it with no problem. I let go of all the controls and it recovered nicely. Knife-edge flight was held for as long as I wanted it.

Landing went as smoothly as the flight. On final I reduced throttle to approximately one-third and held that all the way to the

flare, cut the throttle all the way, let the mains touch down and the elevator go to neutral until some speed bled off, started feeding in a little up, and voilà! It couldn't get any better.

I love flying this airplane. Flight characteristics are wonderful and the engine puts out plenty of power. I feel that it is capable of flying almost any pattern, so build one for yourself and enjoy! MA

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Sources:

Wing cores, landing gear, canopy, *Perfect Foam Wing Construction* video by Bob Noll:
Robin's View Productions
Box 68
Stockertown PA 18083
(610) 746-0106

Cowling—molded fiberglass:
Reid's Quality Model Products
30 Clifton St.
Phelps NY 14532
(315) 548-3779

Wing spar and wing-mounting kit:
Gator R/C
2100 Old Mill Rd.
Brookline MO 65619
(417) 725-7755
www.gatorrc.com