PROFESSIONAL CUT

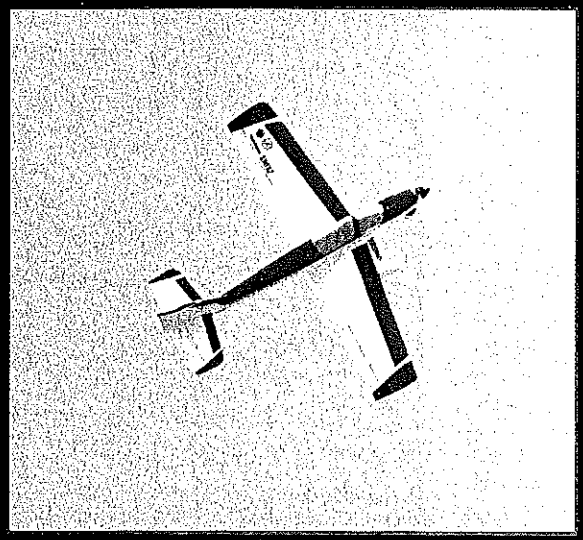
By Dick Sarpolus

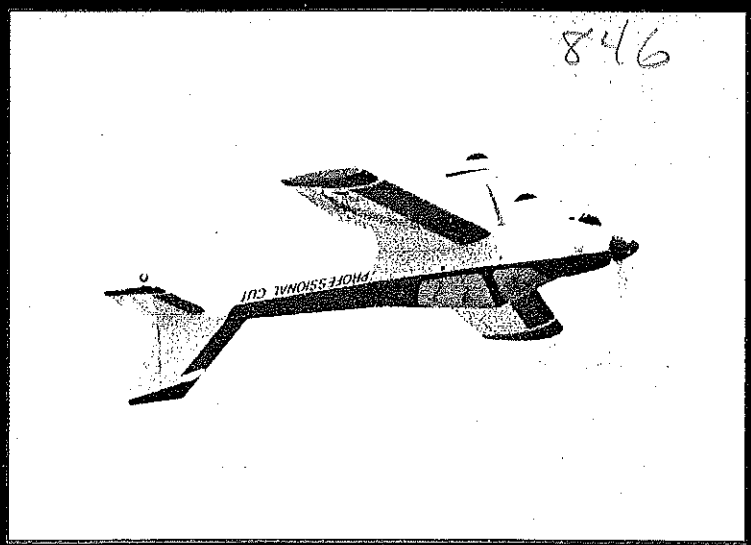
ENLARGING AN RC PATTERN design to suit a larger engine is nothing new; when a two-stroke .60 was the standard engine, modelers enlarged Pattern designs for the new .90-size engines coming out. When the larger gas/ignition engines were new on the scene, a few guys enlarged Pattern designs to suit the big engines.

As the gas engines grew in popularity and larger glow engines were introduced, most modelers went for large Scale aircraft, along with a smaller number of large sport designs. When moving up to Giant Scale size, Caps, Lasers, and Extras were built for their aerobatic fun.

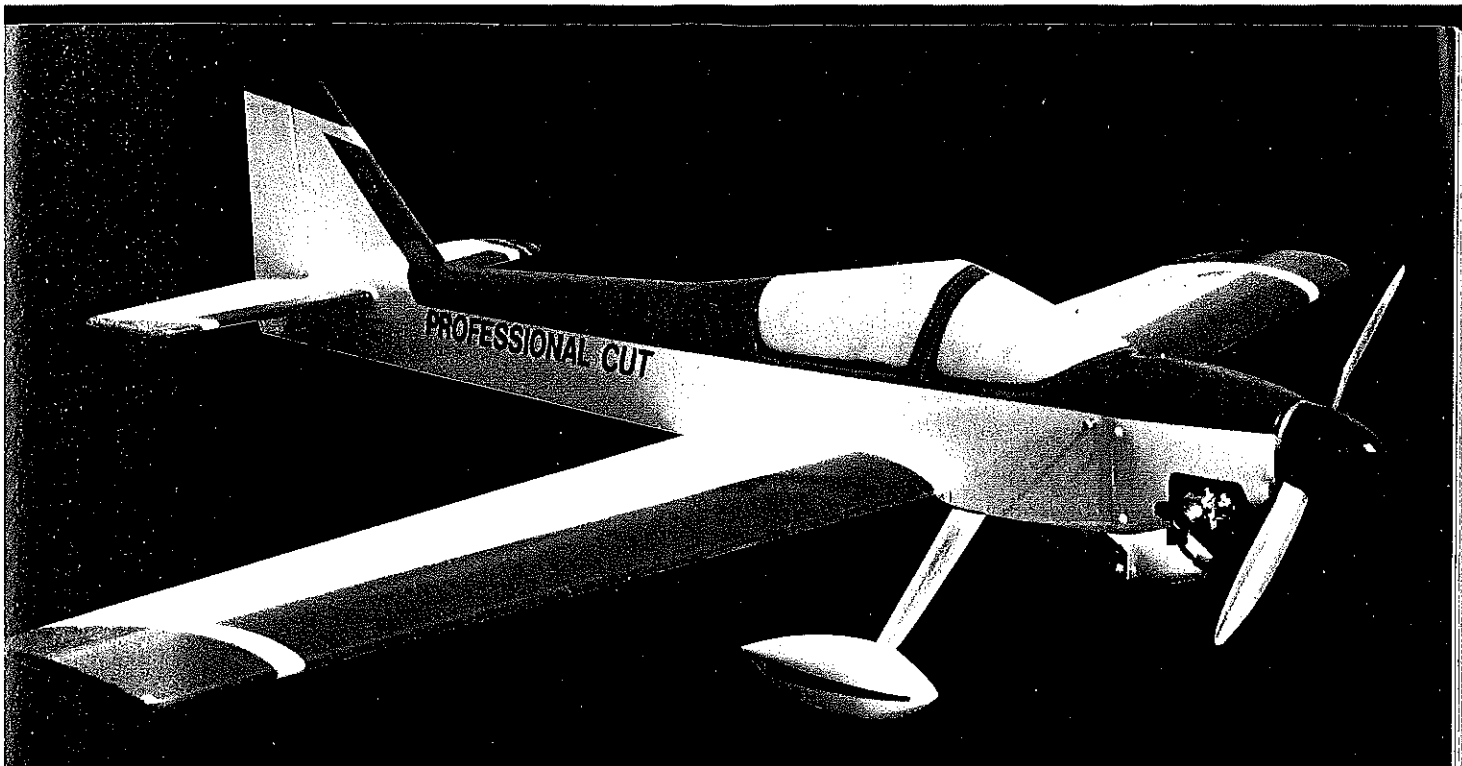
RC Pattern aircraft designs developed into the highly specialized aircraft used in that event today—not at all resembling full-scale aerobatic types.

During several discussions on sport aircraft design for the larger engines, Dean Pappas suggested that I try today's Pattern aerodynamics in the larger size I like. I've been out of Pattern competition flying for a long time, and I was wary of the very long fuselage, long tail moment, highly tapered wing, etc., setup of the Pattern types. Dean felt that these design characteristics would result in a good-flying large-size model, even with gas/ignition power.





The author describes Professional Cut: "I built it for fun, not formal competition, and it is a pleasure to fly."

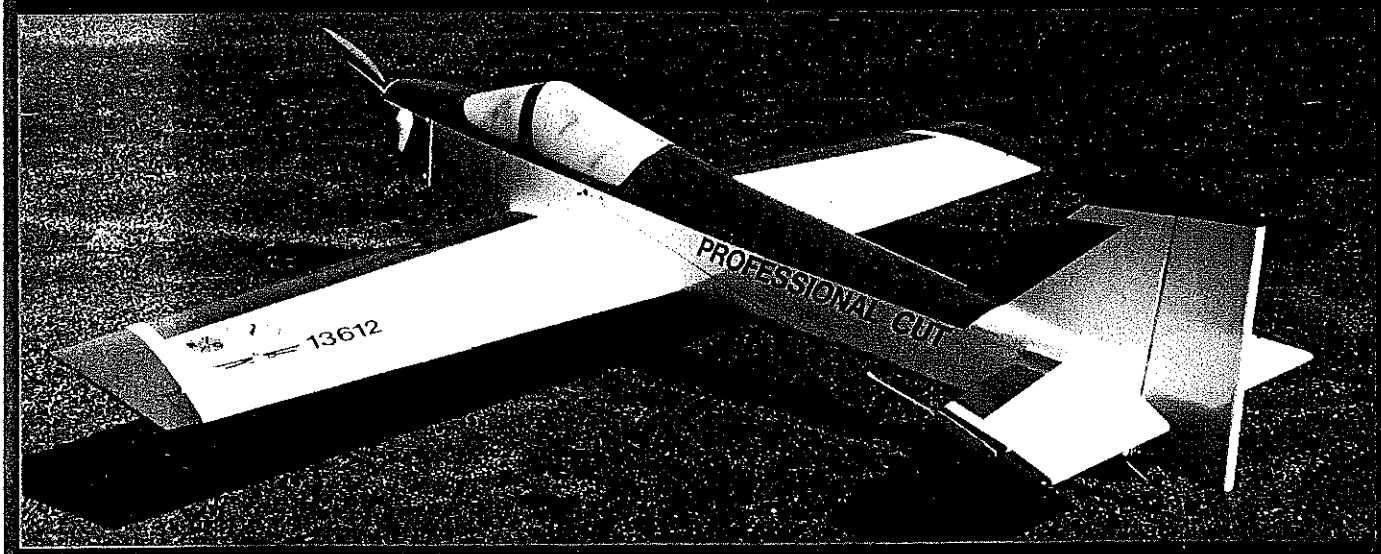


I tried to borrow the styling and proportions of today's top Pattern aircraft while accommodating a large gas/ignition power plant. I didn't want to simply enlarge a Pattern design and use a large glow engine; it would be tougher to make a large Pattern-style fuselage that would accommodate the bulkier gas/ignition engines, but that's the engine type I prefer for the larger aircraft.

I got the dimensions of a few typical Pattern designs for reference and began doing some calculating of spans, lengths, areas, loadings, etc. I like large aircraft, approximately 90 inches in wingspan; they fit without too much trouble in my minivan and fly well with the economical Quadra Q-42 class engine.

On several of my past sport designs with wingspans of roughly 94 inches, the fuselage lengths are about 67 inches, which is 70% of the wingspan. These designs handle very well for sport flying and sport aerobatics. A number of current Pattern aircraft have fuselage lengths of 90-95% of the wingspan; that's long.

Photos provided by the author



"It's a change at the flying field when compared with the Scale acrobatic aircraft seen so often in the larger sizes."

I laid out a 90-inch-span wing with a straight trailing edge and fairly high taper; it had 1,400 square inches of area. I drew up a Pattern-type fuselage that seemed very long at 80 inches in length—almost 90% of the wingspan. That was long enough for me to try. With those parameters, I worked up the rest of the Professional Cut layout.

(Dean tells me that the very latest Pattern designs are "square" or even oversquare—the fuselage is as long or longer than the wingspan. I could have gone for an even longer fuselage, but as it is now, the airplane barely fits in the back of my minivan.)

The Pro Cut fuselage was made just wide enough for the Sachs, and with the forward canopy styling it's still fairly sleek, for that Pattern look. The fin and rudder are also larger than I'm used to, but are in proportion to that long fuselage and Pattern layout. The wing has the Pattern outline and a thick symmetrical airfoil that I knew would provide easy handling.

The plans show a retract-gear taildragger setup and a standard sheet-aluminum fixed landing gear; my prototype aircraft has the sheet-aluminum gear, mounted on the fuselage, and wheel pants. The fixed gear bolted to the fuselage is very easy, quick, and works well; the airplane would be really sleek with retract gear up, but it would mean more work, weight, and expense; your choice.

Tricycle gear, either fixed or retractable, would probably be a bad choice; the model would be heavier, and it's hard to get a really strong, rugged nose gear for an airplane of this size and weight.

The fiberglass cowl and wheel pants are available from Fiberglass Specialties (51200 Milano Dr. Suite A, Macomb MI 48042); I've used the same items before on other designs. Steve Durecki's fiberglass parts are light, adequately strong, and easy to finish.

With the styling and layout completed, I went with a very conventional, basic, and easy building structure. Balsa sheeted foam wing cores, of course. The fuselage is a basic box, with balsa sides and plywood doublers. Foam-cored fuselage top blocks are sheeted with balsa, as are the foam cored tail surfaces. The one-piece wing bolts in place beneath the fuselage, rather than using plug-in wing panels. It's lighter and easier to build, and the wing just fits in my minivan.

I felt that the Quadra 42, my usual power plant choice for a bit smaller aircraft, wouldn't do the job this time. I knew the Air Hobbies Sachs 3.2 would have the power, and the convenience of its muffler/engine mount, along with the features of an electronic ignition system with variable timing, make it a good selection.

My Professional Cut came out at 19 pounds, again making the Air Hobbies engine appropriate. That works out to a wing loading of 31 ounces per square foot—not bad for a gas-engine-powered big airplane.

Even with the long tail moment, my Pro Cut came out a bit noseheavy. I hated to do it, but I added some lead in the tail end. I also changed the plans to shorten the nose by an inch to ensure proper balance. Equipment placement, engine type, batteries used, etc., are variables that will affect the balance, and should be adjusted to suit individual flying style and preference.

Professional Cut isn't a competition machine, and it's not a Scale model, but it sure suits me for some big-airplane flying fun.

CONSTRUCTION

I'm surprised to learn that many modelers do not have handy sources for custom-cut foam aircraft construction parts; cutting foam cores is not hard and doesn't require too much equipment. I'm no expert, but I have been able to cut usable cores for many years.

For cutting, you electrically heat a stretched length of nichrome wire hot enough to melt through the foam. Any sort of electric power supply (controllable) that gets the wire hot enough can be used. I use a Powerstat—a continuously adjustable-voltage autotransformer. Use of a safety isolation transformer also is a good idea. Sig sells nichrome wire and a bow is easily made to hold the wire in tension.

Patterns for the cutting templates are shown on the plans; templates are made of thin plywood.

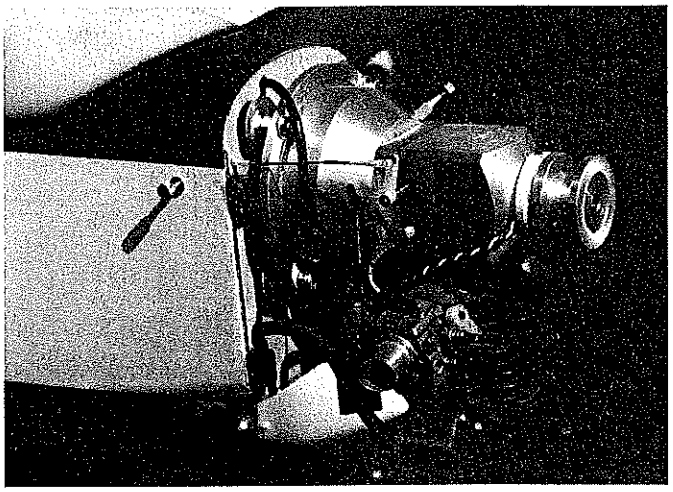
Custom foam cutters advertise in the model magazines, but if you can't find one, don't hesitate to try it yourself; foam-cutting capability sure helps scratch-building enthusiasts.

Wing: If you're using a landing gear mounted to the fuselage, not much work is done to the wing's foam cores before sheeting them. Depending on the quality of the cutting, light sanding may be appropriate. I cut the tips at an angle before applying the sheeting; this makes it easy to trim and sheet the tips later.

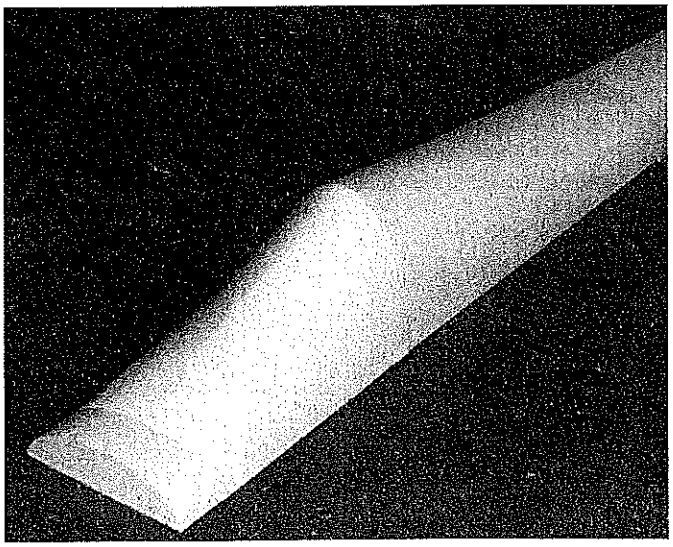
If you opt for a retract-gear installation, I believe the plywood spar, ribs, and hardwood mounting rails shown on the plans will provide good support for the retract units. The foam can be cut as shown and patterns made from the foam cores for the plywood parts; the plywood stub spar and the ribs are notched to interlock, and the ribs are cut to accept the mount rails. The plywood spar, ribs, and the hardwood mounting rails are epoxied into the foam cores before they are sheeted.

The wing panel cores are sheeted with medium 3/32 balsa, edge-glued as necessary for the width. The toughest part of edge-gluing the sheeting is getting a tight fit between the individual sheets; most balsa doesn't have good, straight edges. I use a long sanding straightedge made from a piece of aluminum right-angle stock. On a severely warped sheet, I cut a new straight edge with a long steel measuring ruler and a sharp modeling knife.

I like the aliphatic-resin type wood glues for the joining; I think they are easier to sand for a smooth joint. Edge-glue the sheeting by taping the joints together with masking tape to make up the size of sheet needed; then flip the wood over, open the taped joints one at a time over the edge of the workbench, and apply the glue to the edges of the wood. With the sheeting flat on the bench, scrape the excess



Routing of fuel line past muffler/mount was changed to keep line away from muffler, so heat cannot melt line.



Fuselage top foam blocks are cut in sections, trimmed to fit, sheeted with balsa, and glued atop basic fuselage.

glue off each joint with a putty knife and weight the wood until the glue dries. Remove the masking tape and use the taped side as the outer surface of the sheeting.

I sand the inside surface of the sheeting with rough sandpaper to speed up the work, and use fine sandpaper to finish off the outer surface. I strongly recommend Dave Brown's Southern Sorghum contact cement to apply the wing sheeting; I have used it for years. Alternatives are thinly applied epoxy, some spray can cements, or whatever you prefer; but be sure it works.

With the core sheeted top and bottom, trim off the leading edge and block sand it square. Add an oversized balsa leading edge strip and plane and sand it to shape. Cut and sand the sheeting to match the cutoff tip angle, and add the tip sheeting; round the edges slightly.

The ailerons are cut from the sheeted wing and trimmed down to allow for the balsa edging, which is glued in place and sanded to shape. Hinge the ailerons along the centerline, using large, sturdy, freely moving hinges of the type you prefer. Keep the gap between the aileron and the wing as tight as possible while still permitting free movement of the aileron. Don't glue the hinges in place now; that will be done after the covering has been applied.

Recesses are cut into the lower wing surface for the aileron servo mounting. Epoxy plywood mounting pieces in position to suit your servos, having them protrude from the wing surface just enough for hookup of the aileron pushrods. A hole is needed through the foam core from the root to the location of the aileron servo, for the servo extension cable. To melt a tunnel, I heat the end of a ¼-inch metal rod with a propane torch and push the hot end through the foam.

A plywood wing mounting tongue is used at the leading edge to position and retain the wing. It is reinforced by a plywood rib installed at the root of the wing cores. Done this way, the contact area of the fuselage bulkhead retaining the wing mount can be trimmed or shimmed as necessary to get the correct wing-to-fuselage fit.

Sand the root ends of the wing panels to fit tightly together with the tips blocked up at the dihedral angle; I used 1½ inches under each tip. I've found that modelers are very opinionated about dihedral; if you believe in more or less or want the top surface of the wing flat with dihedral angle in the bottom, fine; do it your way.

Butt-glue the wing halves together, then wrap the center joint of the wing with heavy fiberglass cloth and epoxy. Use double layers of cloth in the center. I've been using nine-inch-wide strips of glass cloth, overlapped in the center to give a five-inch-wide double layer. I brush on a coat of epoxy, position the fiberglass cloth, and brush on additional epoxy to be sure the cloth is saturated. For a good, smooth appearance without too much sanding, I squeegee off the excess epoxy, leaving enough so the cloth is saturated for strength, but is smooth and level.

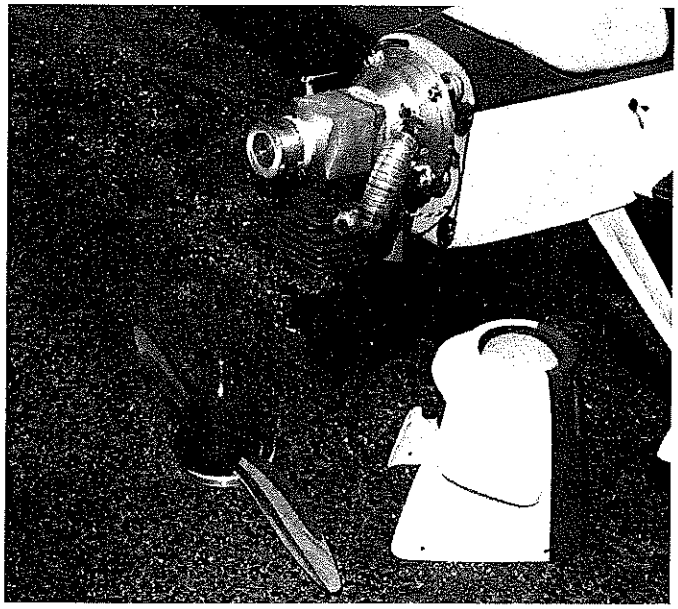
Fuselage: Select firm-to-hard balsa for the sides, edge-gluing and splicing as necessary to get the size required. Glue the 1/16 plywood doublers, ¼ plywood landing gear block doublers, balsa wing saddle pieces, stab saddle doublers, and balsa rear edge strips to the two fuselage sides. I like to use a ⅜ plywood firewall for mounting these large engines, laminating ¼ and ⅛ plywood.

With one fuselage side flat on the workbench, add the firewall and the next three bulkheads, installing them perpendicular to the side. Glue the second side to those bulkheads; the sides are parallel from the firewall to the wing trailing edge position. Add triangle stock and heavy fiberglass cloth behind the firewall to reinforce its junction with the sides; I also put several small screws into the firewall through the fuselage sides.

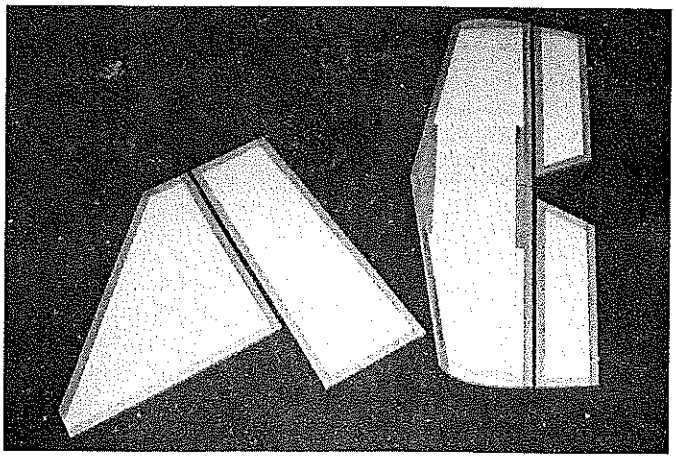
Add the ¼ plywood wing bolt plate, then pull the tail end together, installing the rear bulkheads. Be sure that the fuselage sides taper in a straight line to the rear, so the straight-cut foam rear top block will fit correctly. Trial-fit the block as you install the bulkheads; they can be trimmed or moved so the block fits well.

There are four top fuselage foam blocks to get the design shape. Before sheeting the foam blocks, check to see that when sheeted they will line up flush with the lower fuselage assembly. The foam can be sanded as necessary for proper alignment.

Sheet the fuselage foam blocks as was done with the wing cores. Trim the sheeting and glue the top blocks in place on the fuselage.



Exhaust side of engine. Pipe leads exhaust from cylinder into muffler/mount, covered by "lump" in fiberglass cowl.



Foam-cored tail surfaces with balsa edging added before sheeting was applied. Easy, quick, practical.

PROFESSIONAL CUT

Type: RC Sport

Wingspan: 94 inches

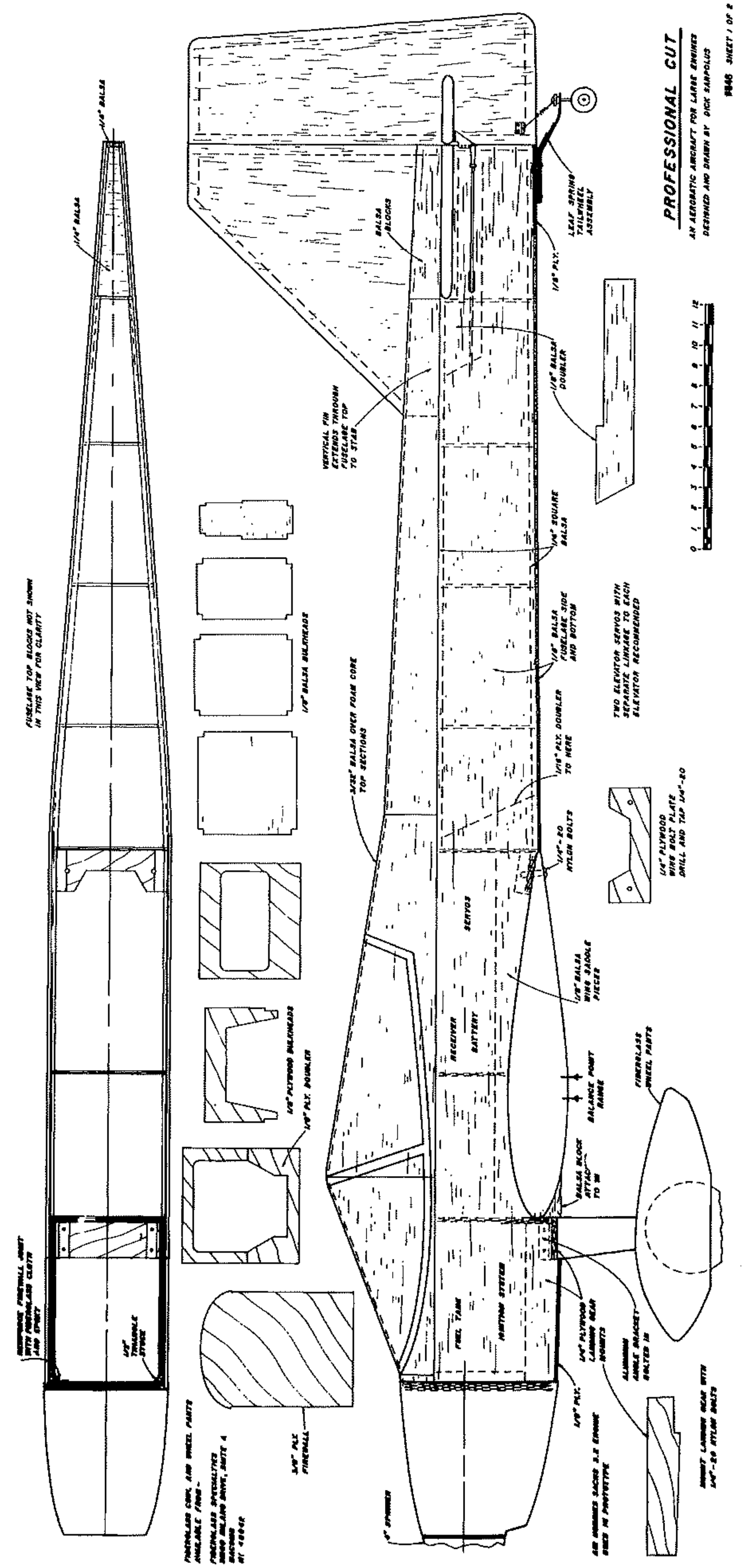
Engine: Sachs 3.2

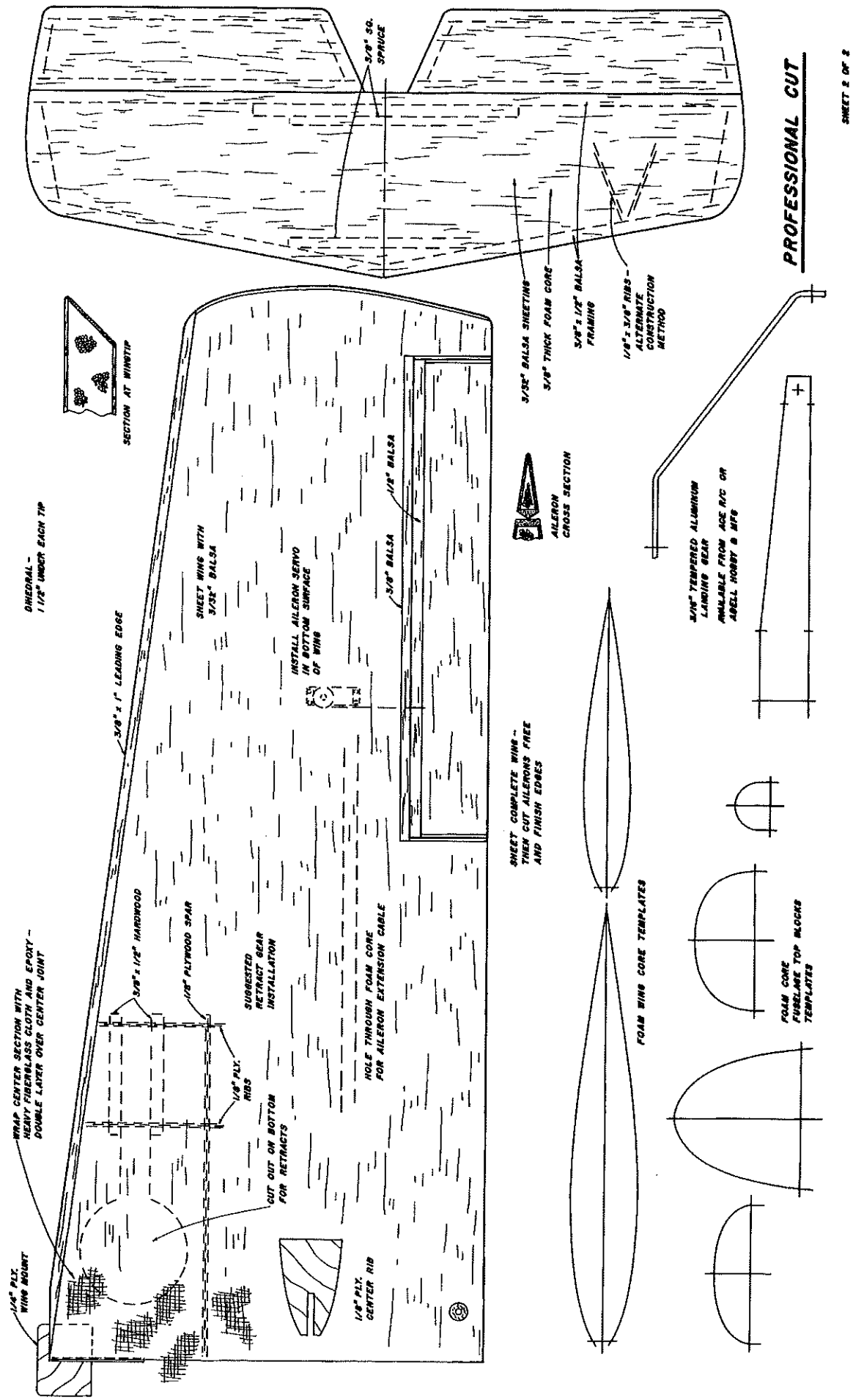
Functions: Throttle, elevator, rudder, ailerons

Flying Weight: 19 pounds

Construction: Built-up with foam cores

Covering/finish: Heat-shrink film and epoxy paint


PROFESSIONAL CUT
AN AEROBATIC AIRCRAFT FOR LARGE ENGINES
DESIGNED AND DRAWN BY DICK SARPOLUS


PROFESSIONAL CUT
SHEET 2 OF 2
3/8" SQ. SPRUCE
3/32" BALSA SHEETING
3/8" THICK FOAM CORE
3/8" x 1/2" BALSA FRAMING
1/8" x 3/8" RIBS - ALTERNATE CONSTRUCTION METHOD
SECTION AT WINGTIP
AILERON CROSS SECTION
DIHEDRAL - 1 1/2" UNDER EACH TIP
3/8" x 1" LEADING EDGE
SHEET WING WITH 3/32" BALSA
INSTALL AILERON SERVO IN BOTTOM SURFACE OF WING
1/2" BALSA
3/8" BALSA
3/16" TEMPERED ALUMINUM LANDING GEAR
AVAILABLE FROM ACE R/C OR ABELL HOBBY & MFG
WRAP CENTER SECTION WITH HEAVY FIBERGLASS CLOTH AND EPOXY - DOUBLE LAYER OVER CENTER JOINT
3/8" x 1/2" HARDWOOD
1/8" PLYWOOD SPAR
SUGGESTED RETRACT GEAR INSTALLATION
1/8" PLY. RIBS
CUT OUT OR BOTTOM FOR RETRACTS
HOLE THROUGH FOAM CORE FOR AILERON EXTENSION CABLE
1/4" PLY. WING MOUNT
1/8" PLY. CENTER RIB
SHEET COMPLETE WING - THEN CUT AILERONS FREE AND FINISH EDGES
FOAM WING CORE TEMPLATES
FOAM CORE FUSELAGE TOP BLOCKS TEMPLATES

The plywood landing gear mount is epoxied into the fuselage, and you can add some hardwood blocks inside where the holes will be drilled and tapped for the nylon gear-retaining bolts to provide more wood for the threaded bolt holes. I also use an aluminum right-angle bracket on each side of the gear mount, bolting it to the gear mount and through the fuselage sides. With an airplane of this size and weight, I believe that epoxy alone won't hold the gear mount in place during a rough landing. We want the nylon gear-retaining bolts to break when necessary—not pull out a section of the fuselage!

After the engine mounting is done and the holes are drilled through the firewall for the fuel tubing, throttle linkage, and ignition wiring, the plywood forward bottom piece can be glued to the fuselage and the fiberglass cowl trimmed to fit. I made provision for a removable hatch section in the bottom plywood; this makes it easier to install the engine mounting bolts, fuel tank and its lines, and the ignition system.

I leave the rear fuselage bottom planking off until the tail surfaces are added, so I can cut the holes in the bulkheads for the elevator and rudder pushrods.

Tail surfaces: Built flat on the workbench, the 3/8 thick foam cores are cut to shape, with 3/8 x 1/2 balsa edging and spruce reinforcing added, then sheeted with 3/32 balsa as with the wing cores.

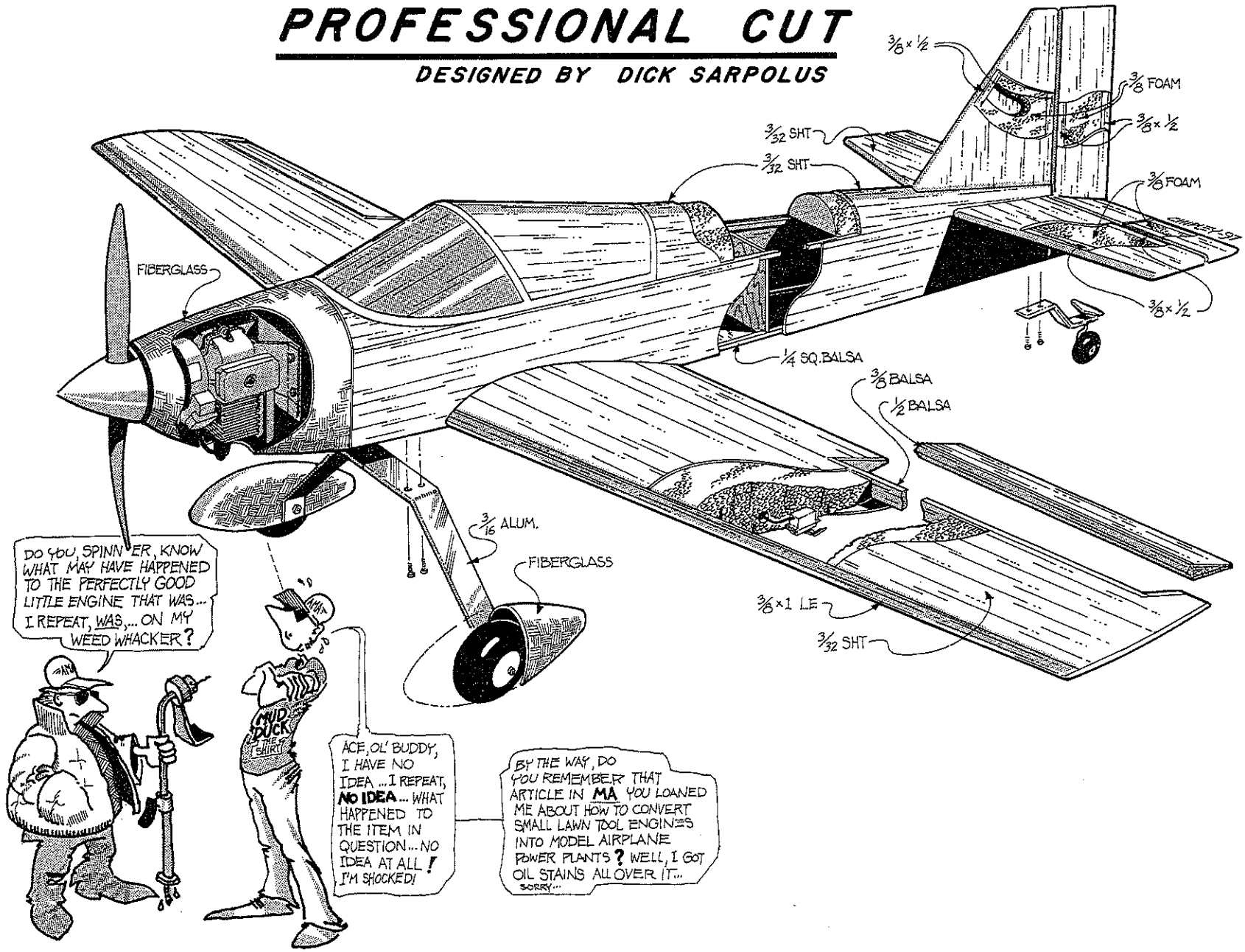
Note the 3/8 square spruce internal stub spars on the stab. Although they're not in my prototype and I've had no problems, I think they should be there for the added strength.

An alternate method would be to use 1/8 x 3/8 balsa ribs for the internal structure, but I believe the foam cores provide a more-rigid structure and are just as easy. The edges are shaped as appropriate.

Cut the slots or drill the holes along the center lines of the surfaces for whatever hinge type you're using, and notch the control surfaces as needed to permit a close fit of the surfaces to the main structure, allowing proper movement. I use 1/4 plywood for control horn mounting, recessing and epoxying the plywood into the elevators and rudder. The horns are mounted with self-tapping screws.

PROFESSIONAL CUT

DESIGNED BY DICK SARPOLUS



I prefer to fit the wing to the fuselage next, adjusting the fit of the wing mounting tongue as necessary through the fuselage bulkhead, and drilling and tapping the wing mount plate for the two ¼-20 nylon bolts that hold the wing in place.

With the wing mounted, I add the horizontal stab, aligning it with the wing. The stab/fuselage joint is important; it's a good idea to add a narrow strip of fiberglass cloth and epoxy on the outside of the joint.

The vertical fin is added, perpendicular to the stabilizer. A ⅛ plywood section on the bottom rear of the fuselage is used to mount the leaf-spring tail wheel assembly.

The tail wheel steering is tied to the rudder with small springs. The linkage from the servo to the rudder can be done with a pushrod or a twin-cable pull-pull setup. I use ¼ plywood for the servo mounts in the fuselage, and the larger 4-40 threaded rods and clevises for all linkages.

Fiberglass tube pushrods are used for the elevator linkages. Using separate servos for the elevators, each with its own pushrod, allows the pushrods to be straight.

A lengthy Y-harness is needed for the two aileron servos mounted in the wing. I use a 1200-mAh battery pack for the radio, wrapped well with foam and located close to the foam-wrapped receiver.

A 600-mAh pack is used for the electronic ignition supply, located up forward near the ignition package. Your equipment placement can be varied depending upon the engine used, its weight, whether or not it has a separate battery pack, the muffler, etc. Two switches to be mounted on the fuselage side, and two battery packs to be charged.

The Air Hobbies Sachs 3.2 comes with a muffler/mount arrangement, and a shock mount setup. That's exactly what I used, and it's been working well. The two exhaust pipes point down behind the engine cylinder from the muffler/mount.

The fiberglass cowl must be trimmed to clear the cylinder, carburetor, exhaust, etc., and is held in place with four nylon bolts to the fuselage. I cut a hole in the cowl to clear the Air Hobbies exhaust pipe leading from the cylinder back to the muffler, shaped a balsa block to serve as a mold, and laid up a fiberglass smooth "lump" molded to the cowl to cover the exhaust pipe. Not too much work, and it looks okay—a lot neater than a hole in the cowl. Depending on the engine you use, do whatever works with the cowl trimming.

A four-inch spinner is required; I used a CB unit. The fiberglass wheel pants were mounted to the axles on the aluminum landing gear with Sig's brackets.

Covering/Finish: I used the usual iron-on plastic covering for a finish, trimmed with the aircraft name and AMA license number in computer-cut vinyl by Vinylwrite Custom Lettering—a good and helpful outfit.

To highlight the canopy area, I masked that section off and airbrushed it with epoxy paint; that sticks very well to the plastic covering. The fiberglass cowl and wheel pants were painted with spray cans—quick and easy.

Flying: I didn't expect any flight problems, and I didn't have any. The test flight was a pleasure, with the Sachs providing plenty of power and the airplane handling great. The biggest surprise was the rock-solid flying quality; it felt like the airplane was on a rail and flying super-smoothly. After a few flights, I was comfortable with the response and really enjoyed the air time.

Professional Cut is agile—it'll snap and spin as desired. I like the looks of the maneuvers I can do with this airplane. I like the way it looks in the air, and I am very comfortable flying it.

There's no competition for an aircraft like this, but I wasn't looking for that; I'll get my kicks doing the Pattern maneuvers I want to do with this large Pattern-*looking* airplane. I think it's a good way to enjoy flying a large, gas-engined aircraft. ✈

Dick Sarpolus
32 Alameda Ct.
Shrewsbury NJ 07702