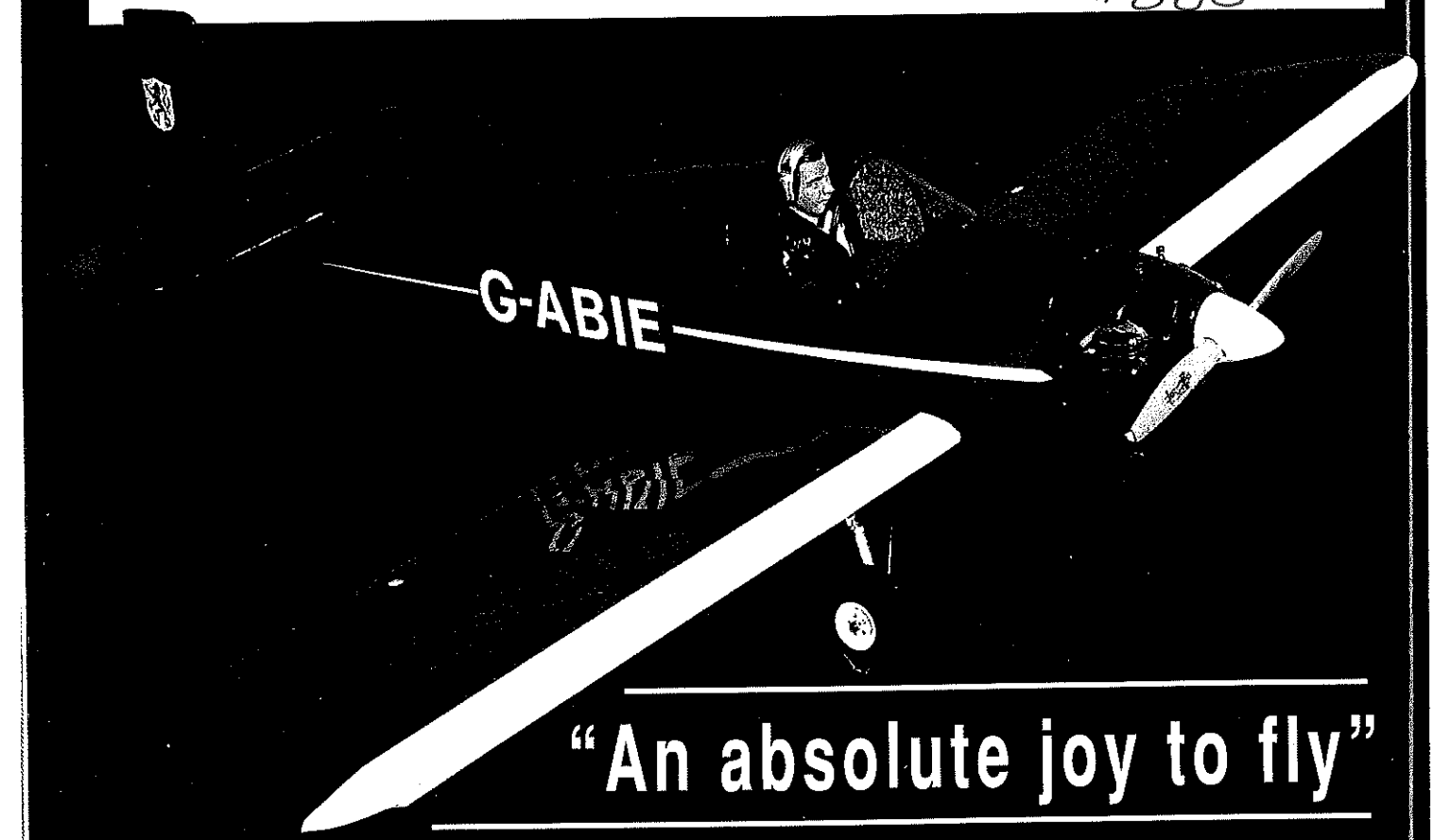
DRUINE TURBULENT

#880



"An absolute joy to fly"

On final approach. Design has been a favorite of modelers and full-scale aircraft builders for many years.

Melanie Lorrance holds the Turbulent in place. "Its undeniable resemblance to a model aircraft only adds to its appeal."

Photos by the author Graphic Design by Carla Kunz

EVER WONDER WHY some full-scale aircraft are repeatedly chosen as subjects for modeling, but others are rarely developed? I'm sure a wide and diverse group of motivational forces are at work, from a desire to recreate longtime personal favorites to the comfort found in having seen certain Scale models fly well.

The French-designed Druine Turbulent is short of the macho appeal of a warbird or the spectacular colors and aerobatics of the contemporary aerobatic prototypes, but it is undeniably long on simplicity and diminutive size. And its undeniable resemblance to a model aircraft only adds to its appeal.

The popularity of the Turbulent as a modeling subject likely ties directly to its long-running popularity with full-scale home-builders worldwide—particularly in England and France. It has relatively simple all-wood construction, a minimum of welded tubing or sheet metal, and excellent aerodynamics.

Designed in 1950 around the easily available War surplus air-cooled Volkswagen engines of only 36 hp., Turbulents are very diminutive at only 21.5 ft. in span, and 17.3 ft. in length. Yet they cruise at 87 mph and will climb at 450 fpm. with a gross weight of 620 pounds.

As a Scale subject, the Turbulent's long fuselage moments, wide-stance gear placement, and constant-chord wing are nearly ideal. Much to my delight, the model presented here is just as stable and lands just as nicely as similar sport designs. It is mildly aerobatic, yet is very easy to fly and land. By holding down the all-up weight, using the scale dihedral, and keeping power moderate, it is an absolute joy to fly.

CONSTRUCTION

The Turbulent was designed for the modeler with some previous experience in building from plans. Although it flies gently enough for a newcomer, construction is a bit advanced for that experience level. As a result, the instructions will only cover those aspects that are peculiar to this project.

Materials: All materials and hardware are stock and can be obtained from a local hobby shop or by mail from the manufacturers.

The prebent landing gear is available from Sig and requires only two slight modifications; no complex wire bending is required. The shock absorbers are stock RC car units, and while they certainly are not critical to the model's handling, they do add a touch of realism.

The prepainted pilot shown is from MGA Pilots (Fresno CA 93755) or your local dealer. Other types might be adaptable.

The instrument panel is a preassembled unit from Midwest Products (#1099). It was adapted by trimming the corners to fit.

The prototype has flown wonderfully with the Saito four-stroke twin, but a single-cylinder 60-80 four-stroke should be just as satisfactory. I would not recommend a two-stroke single larger than a .60 (or a 90 four-stroke); the Turbi is intended to fly much more slowly than a sport Pattern design of the same size.

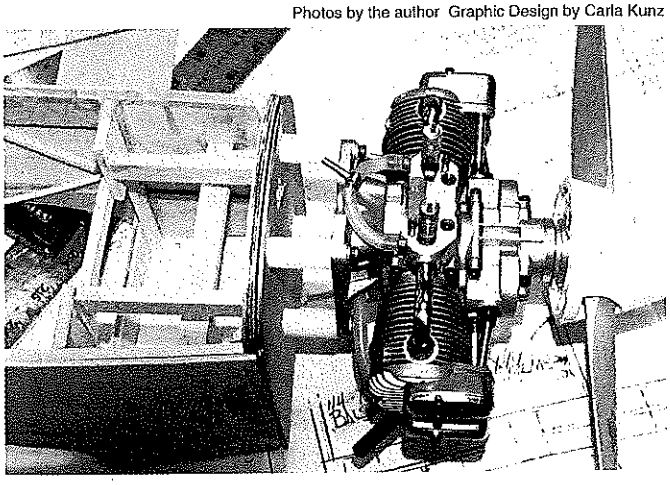
Should the builder not currently own the previous model Saito 90 twin, we have shown a modified firewall, etc. that will accommodate the new version without the need for the nylon grommet extenders we used (the new version is considerably longer fore and aft and the needle valves are horizontal).

If a single-cylinder power plant is to be used, one could construct a semiscale Volkswagen engine on one side of the cowl, using pill bottles, scraps of wood, and tubing, then mount the model's engine on the right, sidewinder style, or inverted.

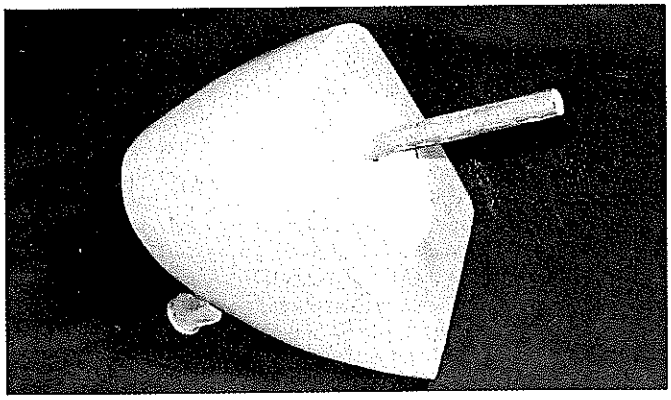
The Turbulent presented here is close to scale in outline and contour, but I chose to omit the prototype's wing slots, primarily since I wanted to be able to spin and snap-roll the model, which it does very nicely. Nonscale strip ailerons add further to simplifying construction of the wing.

Primary adhesive is medium cyanoacrylate (CyA) glue, with epoxy used in the high-stress areas such as landing gear and engine attachment.

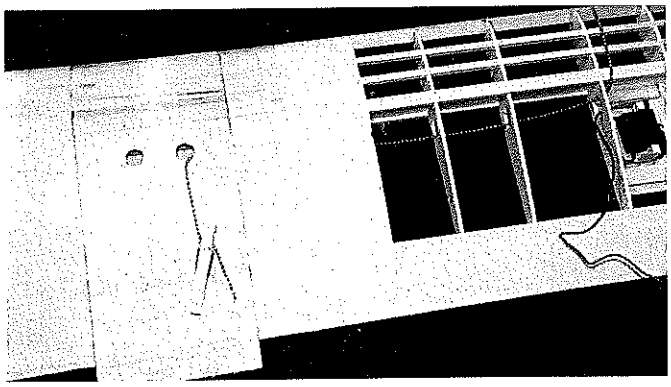
Balsa should be chosen to match its intended use: Light C-grain for the formers,



Old-style Saito 90 twin requires hardware-store standoffs; not required with newer version (as shown on plan).

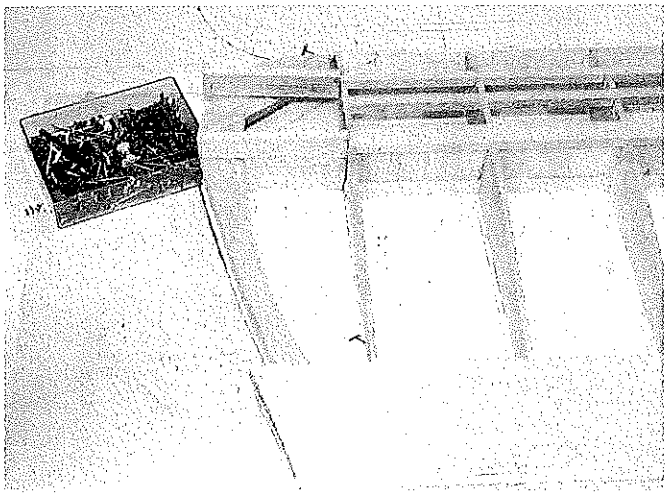


Cowl plug is foam, with layers of glass and epoxy over it. Dowel handle for convenience during fabrication.

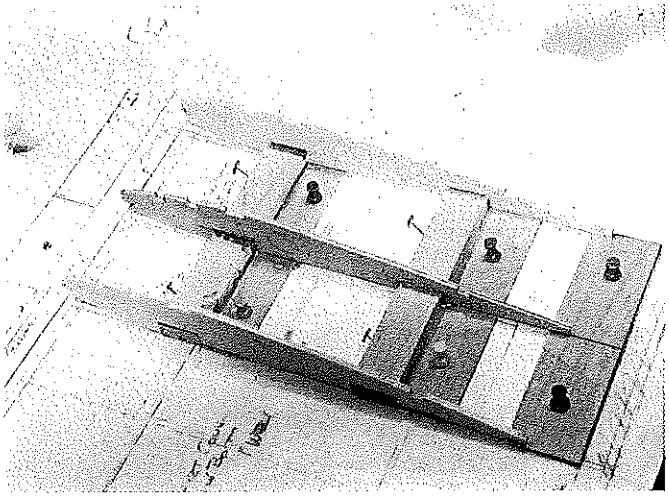


Aileron servo is mounted to a removable plywood plate, which is then screwed to basswood crosspieces in the wing.

Empennage is built using "sandwich" method: Sheet balsa core with strips added for ribs and edges. Block-sand to final shape. Light, strong, simple.



Preassembled wingtip is blocked up for proper shape. Scrap balsa fill around front spars; sand all to contour.



Center section of wing has plywood center rib and balsa outer ribs. Landing gear blocks are backed with plywood.

wing ribs, trailing edges, and the tail group; medium C-grain for the fuselage sides; and light A-grain for the planked areas.

Plywood should be birch aircraft-grade, and hardwood wing spars should be long-grain Sitka spruce, if obtainable; if not, basswood can be substituted. Landing gear blocks are stock Sig items. Tail wheel bracket and hardware is a Goldberg/Klett GD-231 with the tiller cut in half and mounted with 2-56 bolts and nuts.

All empennage hinges should be of the molded-and-pinned type, such as Du-Bro 117 or Sig SH-217. Laminated "hot" hinges are fine for the ailerons.

While several steps in the construction are a bit out of the ordinary, they have been "borrowed" from designers who have used them successfully for many years. In each instance these techniques are simplistic alternatives.

Tail Feathers: These are constructed using a "sandwich" technique I first saw on Free Flight Scale designs by England's Eric Coates 30 or more years ago. The advantage is considerable strength with light weight. The surfaces are from the appropriate flat sheet stock, then built up top and bottom with sections of strip and sheet.

These sandwiches are block-sanded to desired airfoil shapes and the tapers required (#100 paper to rough out the shape, then finer grades of paper to finish). This approach is infinitely simpler and more accurate than shimming up a framework of ribs, leading and trailing edges, and so forth, then covering it with sheet on either side.

Cut the hinge slots and install the elevator joiner before cutting out the rudder slot, rounding the exterior edges or beveling the

Continued on page 39

DRUINE TURBULENT

Type: RC Sport Scale

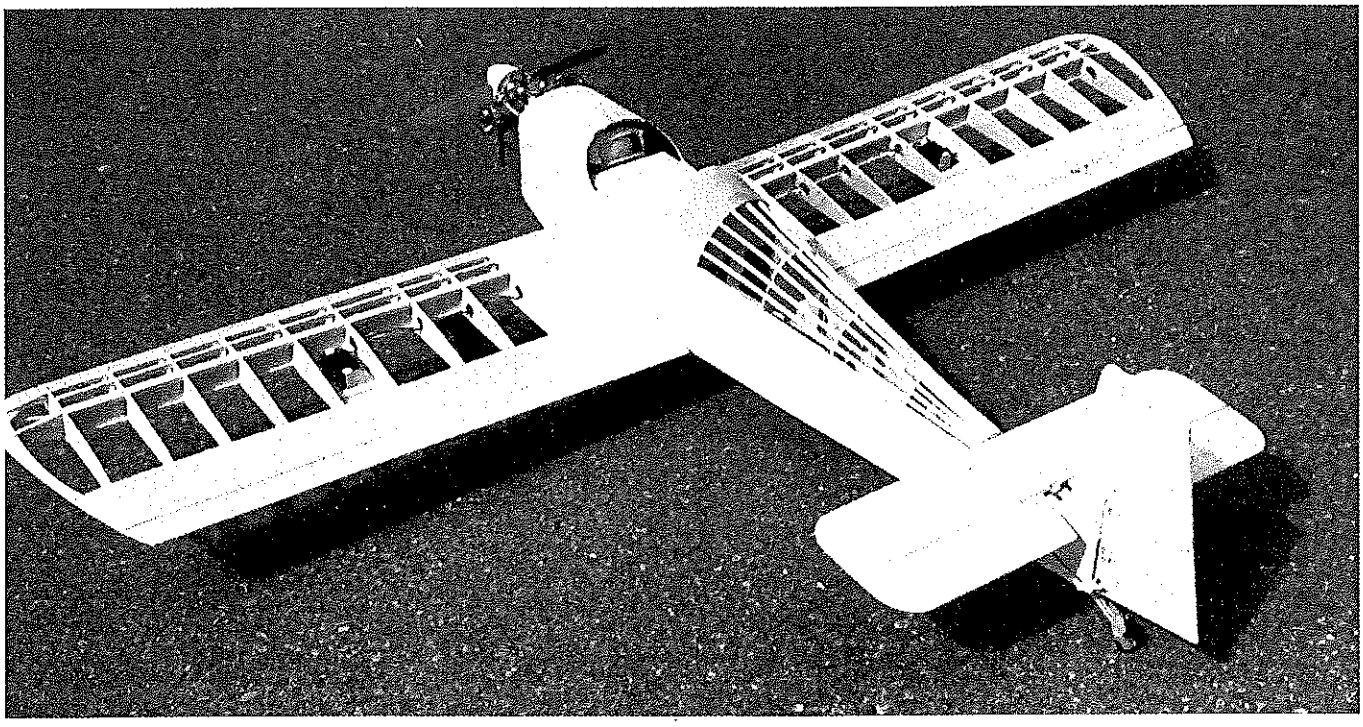
Wingspan: 72 inches

Engine: Up to 90 four-stroke or .60 two-stroke

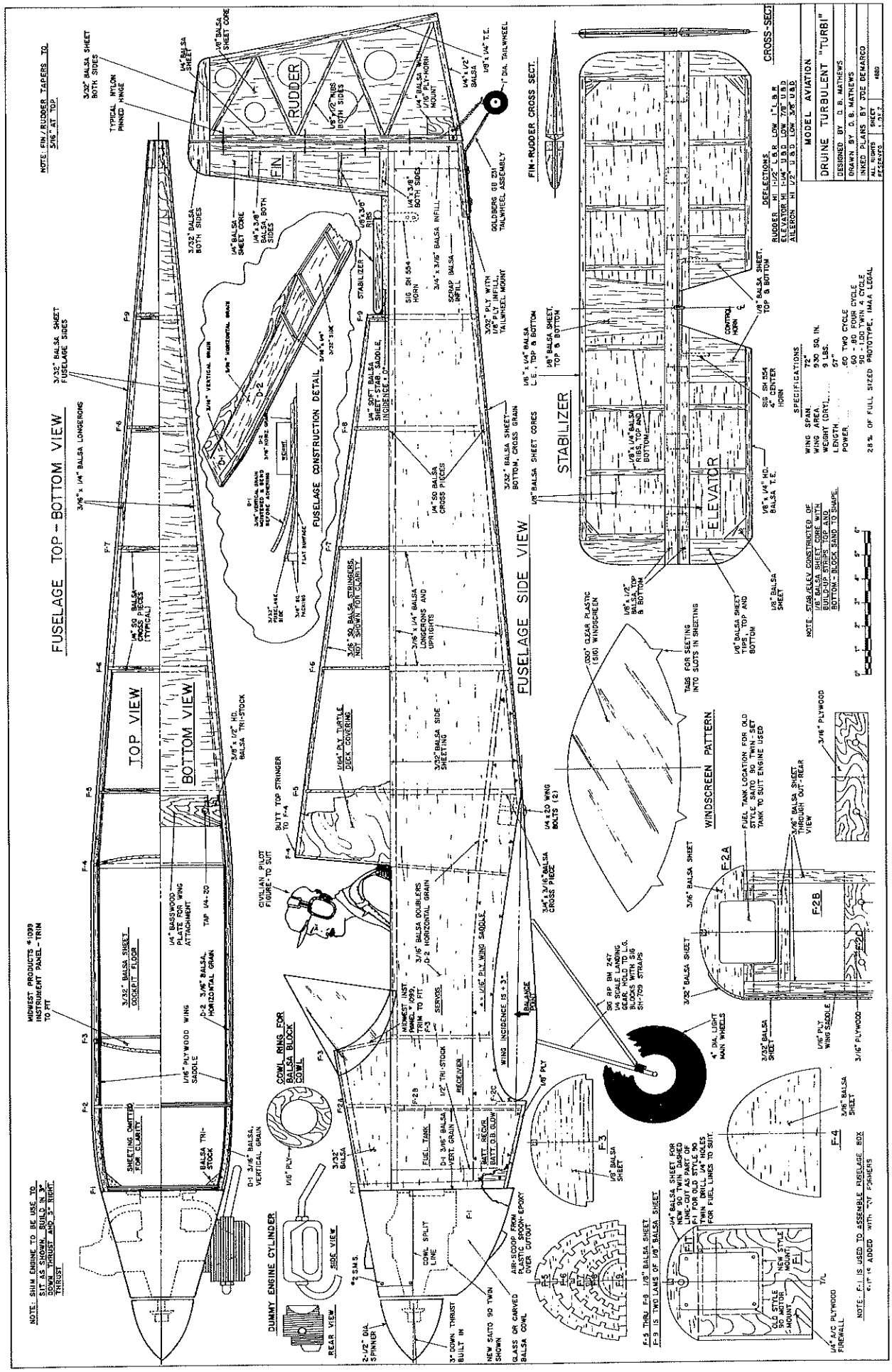
Flying weight: Nine pounds

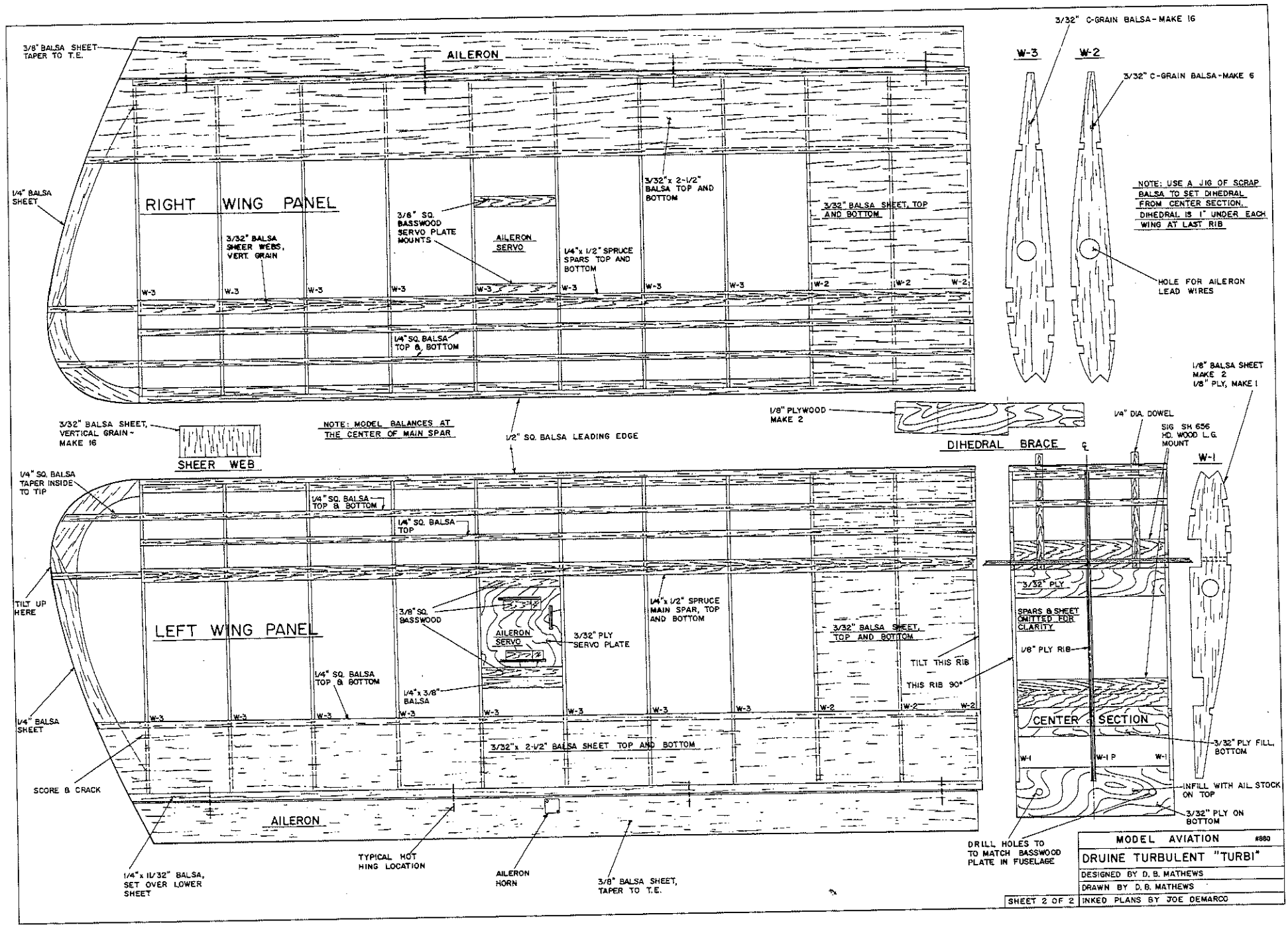
Construction: Built-up

Covering/finish: Film



The author describes Turbulent's structure as "light, yet sufficiently strong." Strip ailerons simplify construction.


FUSELAGE TOP -- BOTTOM VIEW
TOP VIEW
BOTTOM VIEW
FUSELAGE SIDE VIEW
FUSELAGE CONSTRUCTION DETAIL
FIN-RUDDER CROSS SECT.
CROSS-SECT
STABILIZER
ELEVATOR
FIN
RUDDER
WINDSCREEN PATTERN
DUMMY ENGINE CYLINDER
REAR VIEW
SIDE VIEW
NOTE: SHIM ENGINE TO BE USE TO SIT AS SHOWN, BUILD IN 3° DOWN THRUST AND 3° RIGHT THRUST
NOTE: FIN/RUDDER TAPERS TO 5/16" AT TOP
MODEL AVIATION
DRUINE TURBULENT "TURBI"
DESIGNED BY D. B. MATHEWS
DRAWN BY C. B. MATHEWS
BUILT PLANS BY JOE DEMARCO
SPECIFICATIONS
WING SPAN 72"
WING AREA 930 SQ. IN.
WEIGHT (DRY) 9 LBS.
LENGTH 57"
POWER .60 TWO CYCLE
.90 - .80 FOUR CYCLE
28% OF FULL SIZED PROTOTYPE, IMAA LEGAL
DEFLECTIONS
RUDDER HI 1/2" L&R LOW 1" L&R
ELEVATOR HI 1/4" U&D LOW 3/8" U&D
AILERON HI 1/2" U&D LOW 3/8" U&D
SHEET 1 OF 2 SHEETS
PLANS SERVICE 4880


AILERON
3/8" BALSA SHEET TAPER TO T.E.
RIGHT WING PANEL
1/4" BALSA SHEET
3/32" BALSA SHEER WEBS, VERT. GRAIN
3/8" SQ. BASSWOOD SERVO PLATE MOUNTS
AILERON SERVO
1/4"x 1/2" SPRUCE SPARS TOP AND BOTTOM
3/32"x 2-1/2" BALSA TOP AND BOTTOM
3/32" BALSA SHEET, TOP AND BOTTOM
1/4" SQ. BALSA TOP & BOTTOM
W-3
W-2
3/32" C-GRAIN BALSA-MAKE 16
3/32" C-GRAIN BALSA-MAKE 6
NOTE: USE A JIG OF SCRAP BALSA TO SET DIHEDRAL FROM CENTER SECTION. DIHEDRAL IS 1" UNDER EACH WING AT LAST RIB
HOLE FOR AILERON LEAD WIRES
3/32" BALSA SHEET, VERTICAL GRAIN - MAKE 16
SHEER WEB
NOTE: MODEL BALANCES AT THE CENTER OF MAIN SPAR
1/2" SQ. BALSA LEADING EDGE
1/8" PLYWOOD MAKE 2
DIHEDRAL BRACE
1/8" BALSA SHEET MAKE 2 1/8" PLY, MAKE 1
1/4" DIA. DOWEL
SIG SH 656 HD. WOOD L.G. MOUNT
W-1
1/4" SQ. BALSA TAPER INSIDE TO TIP
TILT UP HERE
LEFT WING PANEL
3/8" SQ. BASSWOOD
AILERON SERVO
3/32" PLY SERVO PLATE
1/4"x 1/2" SPRUCE MAIN SPAR, TOP AND BOTTOM
3/32" BALSA SHEET, TOP AND BOTTOM
1/4" SQ. BALSA TOP & BOTTOM
1/4"x 3/8" BALSA
TILT THIS RIB
THIS RIB 90°
3/32" PLY
SPARS & SHEET OMITTED FOR CLARITY
1/8" PLY RIB
CENTER SECTION
3/32" PLY FILL, BOTTOM
INFILL WITH AIL STOCK ON TOP
3/32" PLY ON BOTTOM
1/4" BALSA SHEET
SCORE & CRACK
3/32"x 2-1/2" BALSA SHEET TOP AND BOTTOM
AILERON
TYPICAL HOT HING LOCATION
AILERON HORN
3/8" BALSA SHEET, TAPER TO T.E.
1/4"x 11/32" BALSA, SET OVER LOWER SHEET
DRILL HOLES TO TO MATCH BASSWOOD PLATE IN FUSELAGE
MODEL AVIATION #880
DRUINE TURBULENT "TURBI"
DESIGNED BY D. B. MATHEWS
DRAWN BY D. B. MATHEWS
INKED PLANS BY JOE DEMARCO
SHEET 2 OF 2

Druine/Mathews

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rudder/elevator faces. Since the fin/rudder is considerably wider at the base than at the top, a wide bevel is necessary here for free-swinging rudder movement.

The elevator joiner system uses a Sig SH-554 center-position horn. This is a steel wire with a molded and crimped nylon horn. This unit will be hooked up inside the tail, and the solder link should be wrapped with copper wire and soldered to prevent its working loose.

During final assembly, an access hole for the elevator horn is cut into the stab mount. Reach down into this hole with a pair of hemostats to draw the outer portion of the Nyrod™ up through it. The premeasured Du-Bro DU173 wire pushrod is attached via a solder link to the elevator horn, then threaded into the outer rod as the stab is epoxied to the tail mount. A threaded clevis is used on the servo end of this control.

Note that the fin's rear post runs all the way down to the tail wheel mount! Try not to bevel this portion, and fill around it in the fuselage rear for a tight fit prior to permanently attaching it with epoxy after covering.

Fuselage: This fuselage construction is based on the techniques used by England's Gordon Whitehead for a 48-inch 20 four-stroke Turbulent published in *RCM* in 1977.

Develop a kit of parts by transferring the patterns to wood of the appropriate sizes. I prefer to make photocopies of the parts, cut them out, and glue them to the wood using a glue stick.

Drill all required holes before assembling the parts.

The sheet sides, balsa, and plywood doublers are precut, then installed after the strip framework in the rear areas has been completed. The nose end is blocked up with the rest weighted flat on the building surface; the forward unit can be assembled with epoxy to produce a smooth taper from F-3 to the firewall.

Since the fuselage box top is flat from tail post to firewall, the sides can be assembled over the top view using pairs of identical crossmembers and the formers. Trial-assemble all this with masking tape and clamps, then run medium CyA along all of the joints. Add the tail wheel plywood insert, crossgrained balsa bottom, and the plywood in the tank area.

Remove from the drawing, sand out any roughness, then complete the fuselage by adding the turtledeck formers and stringers. Sheet-covered areas are easily fabricated by adhering the bottom edge of one side to the fuselage box, spraying the sheet with diluted ammonia and water, then gently pulling the sheet down onto the formers and center strip using thick CyA. True the top edge with a metal straightedge and sharp knife, then repeat for the other half.

The cockpit floor sits inside the box; the cockpit coaming can be cut with a pattern made by folding a sheet of paper in half, drawing the desired outline, then cutting it with scissors to provide a mirror-image pattern that can then be drawn onto and cut from the balsa sheet.

Wing: Make copies of the ribs and adhere them to the appropriate sheet stock with a glue stick. Stack-cut the ribs, using the patterns. Be very accurate when cutting spar slots. Don't forget the holes for the aileron extension lines!

The ribs that will have the plywood dihedral brace run through them should be scored by pushing a modeling knife through while leaving enough uncut material to hold them together until the wing panels are joined to the center section.

The wing builds flat on the work surface from the front spar back. Start by pinning the lower trailing edge sheet and aileron hinge spar, then using two ribs, position the lower spars. Install the center rib by tilting it from the bottom up, using the dihedral gauge.

Add the lower sheet aft of the front spar and position and adhere the ribs using the precut shear webs as guides. Note that the bottom rear sheet has the aileron hinge spar on top of it, while the upper butts

against it. Some block-sanding after assembly will create a neat blend at the top of this joint.

The wingtips should be precut from medium C-grain stock and assembled flat. They are then added to the wing ends. Install the upper spars and center-section sheeting; the rear spars are cut at a matching angle, then cracked and pulled down onto the wingtip. The sheet is also pulled down onto the tip. A scrap balsa filler is used at the front spars. All this is sanded to final contour when the leading edge and aileron ends are shaped.

Aileron servos are mounted on a plywood plate that is screwed onto built-in basswood blocks in the wing. The ailerons are cut from ⅜ sheet balsa, then contoured to a taper on the top using a razor plane and sanding blocks.

Repeat all of the above steps to create an opposite wing panel.

Center Section: This is assembled independently from the wing panels. While at first glance it may seem complex, studying the drawings and photo should clarify its fabrication. Cut the balsa and plywood ribs, the plywood sections for the floor, and the landing gear blocks. Assemble the center section in the same sequence as the wing panels, using epoxy. These ribs must be perpendicular to the surface.

The dihedral brace is built integrally, in two pieces that butt against the plywood center rib. It is also the rear brace for the wing dowels, which are drilled and installed after mating the wing to the fuselage.

Add the top sheeting, then use a scrap of the aileron material to fill above the bottom plywood sheet. This is then sanded to match.

Block up each wing panel one inch at the outermost rib, and using a table edge and sanding block, final-sand the inside rib to be level with the table edge.

Carefully punch out the prescored notches and slide the dihedral brace inside the panel, with the panel blocked up and the center section held firm with weights. When satisfied with the joint, smear epoxy on both rib faces and the dihedral brace, then slide them together. Repeat for the opposite panel.

After the epoxy has cured and all sanding is completed, reinforce the two joints by wrapping one-inch glass tape and epoxy around them.

The wing is now ready to mate with the fuselage. Position and drill the holes for the wing dowels (a 12-inch-long ¼ bit is very handy here). Check the straightness of the wing relative to the tail post before drilling and tapping the blocks for the ¼-20 nylon wing bolts.

Cowl: The cowl was fabricated using a white foam plug created by gluing a measured block to the firewall and to the spinner backplate. It was then cut to shape with a bread knife and coarse sandpaper.

I attached three successive layers of six-ounce glass cloth with HobbyPoxy II. Each layer was rough-sanded with #80 sandpaper before adding the next. The final coat of HobbyPoxy was layered on, then an inflated balloon from a party store was pressed over it while slowly releasing the air until it clung to the rear of the plug. This produces a nice, smooth outer surface requiring only a small amount of filling and sanding.

The cowl was cut vertically with a razor saw behind the spinner and in front of the firewall. It was also cut horizontally in the midline of the cylinders. A "story stick" of scrap balsa was carefully cut and trimmed to create a cutout pattern for the cylinder heads and exhaust stacks. Once it would fit around them, the pattern was pencil-transferred onto the cowl halves and cutout with a carbide stone in a Dremel® tool.

The cowl is screwed onto sections of basswood block epoxied to the firewall.

Sections of plywood are epoxied onto the bottom half of the cutout. The other half is held to them with sheet-metal screws.

The air scoops shown are sections of plastic spoon epoxied over holes in the cowl. The top hole allows additional cooling air to enter, which then escapes from two similar holes in the cowl bottom. I did allow some clearance all around the cylinder cutouts, and have encountered no engine overheating problems.

Landing Gear: This unit is from Sig's ¼-scale Cub. The only required modification is bending the rear leg forward using a vise and large Vise-Grip™ pliers. This is because the gear on the Turbi is swept forward more than a Cub. The crossbrace wires, etc. are not used.

The joints are wrapped with soft copper wire and silver-soldered (using a propane torch) while the gear is temporarily attached to the center section with Sig SH-709 straps.

The RC car shock absorbers are functional, but they are not really anything more than decorations. Ours are attached to the wing by plywood stubs adhered to the bottom spar and held with bolts and elastic stop nuts. They are held behind the wheels by washers soldered fore and aft of their struts.

Covering/finish: Scale Model Research (3114 Yukon Ave., Costa Mesa CA) has several color Foto-Paaks and scale three-views for scale decoration if desired. The colors and markings we chose are pure whimsy.

After the usual sanding and vacuuming, the sections are covered following the manufacturer's recommendation. Do not use low-heat plastics or fabrics on this model.

Painted areas, such as the cowl, are done in matching shades of Cheveron Perfect polyurethane. The interior of the tank area should have been coated with brushed-on epoxy before the tank was installed. The photo model's numbers are die-cut sticky-backed vinyl units from an office-supply store.

Trim colors are UltraCote™, ironed directly over the base color. Not a problem, since this material breathes and allows trapped air to escape when placing one layer over another. Minimal bubbling is a definite plus.

Preflight: With an ElectroDynamics onboard glow lighter and its battery close to the firewall alongside the 1,200 mAh flight pack, our model required no nose weight to balance it. However, do not hesitate to add nose weight to reach a safe balance point. *Do not fly this model in a tailheavy condition!*

Control throws as called on the plans are close to optimum for mild aerobatics. Roll rate, loops (inside and out), spins, and snap rolls are well-controlled and predictable with these settings.

A slow, solidly reliable engine idle is imperative with this Turbi, since at its relatively low wing loading the model is a floater and doesn't want to stop flying.

Flying: This Turbi is a pussycat! It flies like a trainer! Takeoffs are simply a matter of lining up, adding power, and watching it take off and climb. No viciousness here.

With the wide-set main gear, landings are a joy. Line up and keep it level using ½ throttle on the base leg, then chop power to idle on final descent. Three-point requires a bit of *up* elevator that is released just before touchdown. Wheel landings are a sight to behold as Turbi settles gently onto its fat tires.

The Turbi's flight profile is very much that of a sport aerobatic model. The aerodynamics are similar to that type of model: long tail moment, rudder behind the elevator, and semisymmetrical airfoil.

But this model is not one of those wild flip, jump, and dart designs either. This Turbulent is a Scale sport aerobatic model airplane. That was the intent, and all the expectations have been more than met.

This is a fun airplane; build one and enjoy! ✈

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DRUINE TURBULENT

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