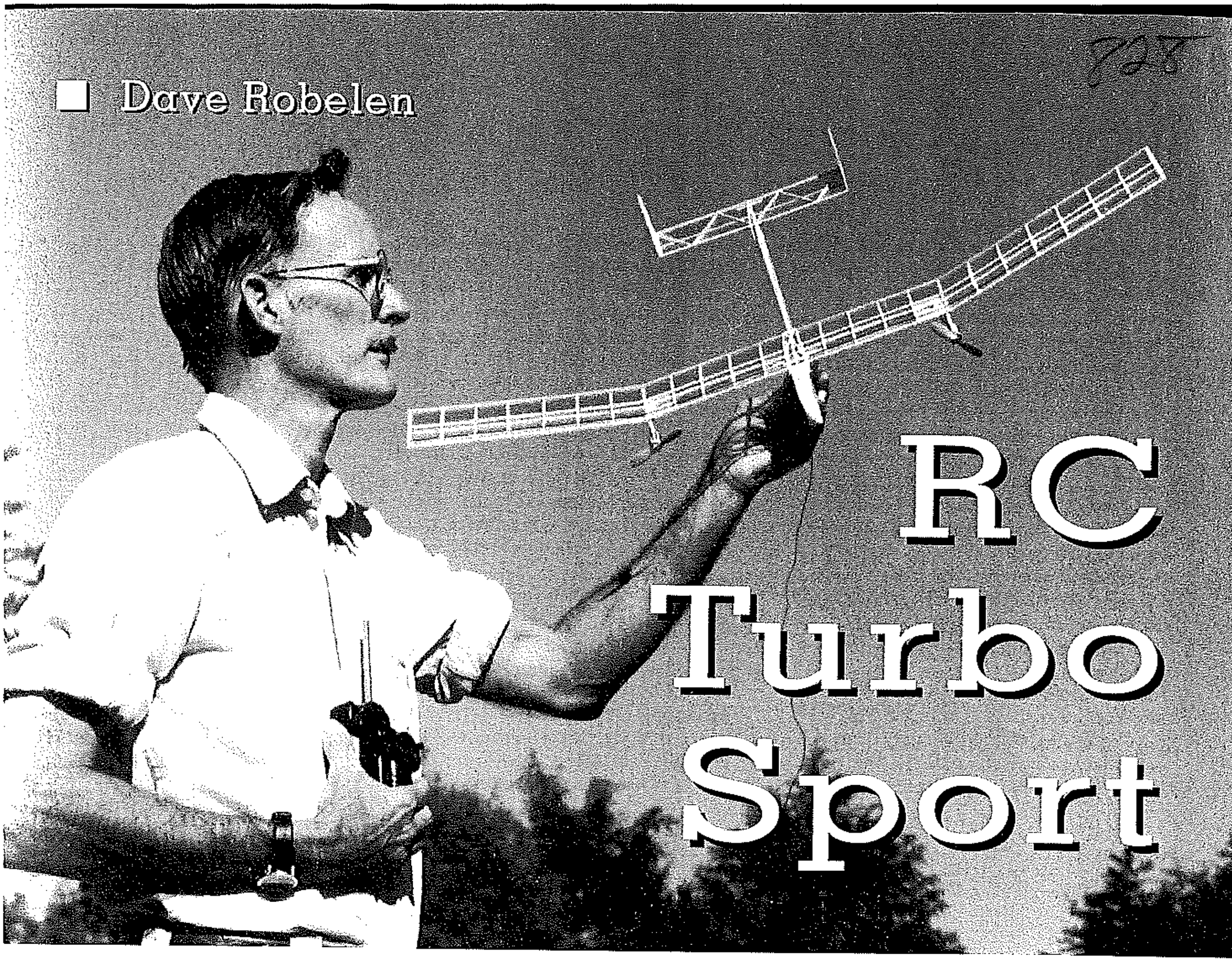
Dave Robelen

RC Turbo Sport



Developing Turbo Sport was a challenge, but the author feels that he's now "onto something really neat" with this lightweight Electric sport model for small-field flying.

Turbo Sport was conceived in response to the design contest sponsored by SGI Inc., the distributors of the Turbo Twin RC :em. I chose to enter the division that wed the removal of the equipment from plastic housing, but no modifications to circuits themselves. The resulting model been so well received by my fellow lelers that I felt compelled to share the with as many others as possible.

first became aware of the Turbo RC em when I saw it advertised in *Model ition* as a package, for a very low price— :cially considering the features. I placed order promptly and when the package /ed I was further impressed by the ious quality of this equipment and the of removing the motors and electronics ı the airborne unit.

settled on a twin-engine configuration the motors spaced well away from the center line to provide some steering effect from differential thrust. Much of my modeling activity in recent years has been in Free Flight events with low-powered models, so I began to draw on this background to help choose the preliminary design details.

The small Mabuchi motors used in the Turbo system are very well made, but their power is obviously limited. To an extent the power or thrust can be increased by adding more cells to the flight battery, but there are tradeoffs in terms of increased weight and reduced run time because of the increased current. Based on the tables provided with the Turbo system, I chose a three-cell 50 mAh battery.

The limited power available made it clear that a low wing loading would be very desirable for efficient flight; a fairly high-aspect-ratio wing was selected to keep the required power to a minimum by reducing the induced drag of the wing.

The airfoil would have profound effects on the wing efficiency, and my Free Flight experience pointed toward a thin, undercambered section for best performance. The first wing was laid out using an airfoil from a successful rubber-powered model with a span of 30 inches and a chord of 3.5 inches. The dihedral layout was "borrowed" from the same Free Flight model.

The motors were placed well outboard to maximize the turning effect of running briefly on one motor at a time. This dimension was a pure estimate, because of a lack of experience with single-engine flight (a situation usually avoided with twins when possible). The motors were mounted on pylons beneath the wing to keep the propeller flow off of the wing as much as possible, and were set forward to place the Center of Gravity (CG) in the desired range.

Selecting the best propeller turned into a bit of a project in itself! A test stand was assembled to measure static thrust, rpm, current, and voltage. Since the furnished props were designed for pushing a small blimp around, both forward and backward, they did not have any twist to help maximize the thrust in one direction. They also seemed to be smaller than the props that other Free Flight modelers were successfully using on projects with similar Mabuchi motors.

The first test runs were made using one of these small props. The results were a thrust of 4.7 grams at 11,000 rpm and a current of 410 mA.

The next prop tested was the one furnished with the Cox Tee Dee .010 engine. This prop was clearly too much for the transistors in the receiver motor control—there was a large voltage drop across the transistors and the rpm was only 5,000. A series of runs was made, cutting a little off the Cox blade each time, with very encouraging results. Since the resulting prop had very blunt, inefficient blades, a new prop was designed and cut from basswood; this became the flight design. Thrust produced was 7.5 grams at 11,500 rpm and a current of 360 mA (for each prop). This prop is 2.411 inches in diameter and has 1.3 inches of pitch.

Since this model used principles very similar to some of the earliest RC models (power on/off to rise/descend), the force arrangement follows what was successful at that time. The CG is set well forward (25%); a small stabilizer is used on a long moment arm; and the stab airfoil is inverted to help generate adequate nose-up force with an increase in speed.

The twin-fin arrangement is used to simplify a strap-on stabilizer mounting, and the final size of the fins was determined by flight testing. The pod and boom fuselage was the lightest, most aerodynamically clean choice available—there are no controls to run to the tail (or anywhere else).

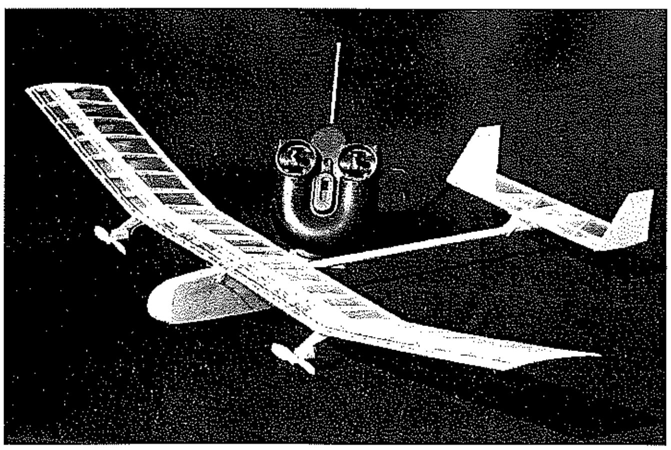
With all of these design decisions made, construction was begun on the first version. The wing was built with 1/16 square balsa spars, 1/16 balsa ribs, and Japanese tissue covering. It was reinforced at the motor pylons with 1/16 sheet and was given two coats of Sig Lite Coat dope thinned 50 %. This wing weighed eight grams, complete with the motor pylons.

The stabilizer was built in a similar fashion, with 1/16 square leading and trailing edges, a 1/16 square spar, and 1/32 sheet ribs. It too was covered with Japanese tissue and doped with thin Lite Coat.

The tailboom was made from a rolled balsa tube to ensure minimum weight. I made the pod from balsa sheet; 1/32 for the sides, top, and bottom, with 1/16 for the bulkheads. Very light foam was used for the nose block.

The wing was mounted with four degrees incidence; the stabilizer was mounted with 0° incidence on a low pylon cut from foam sheet.

The receiver and battery were positioned in the pod to achieve the desired CG; the



Power is limited, but care in construction will yield a fun model that has more-than-adequate performance.

RC Turbo Sport

Type: RC Sport

Wingspan: 29.5 inches (projected)

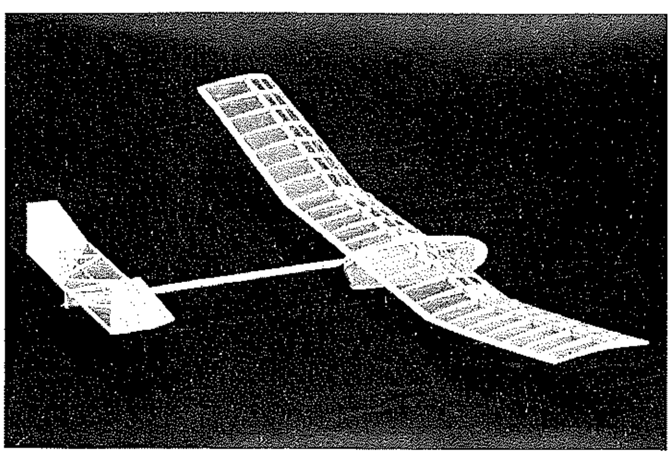
Motors: Mabuchi

Batteries: Three 50 mAh Sanyo

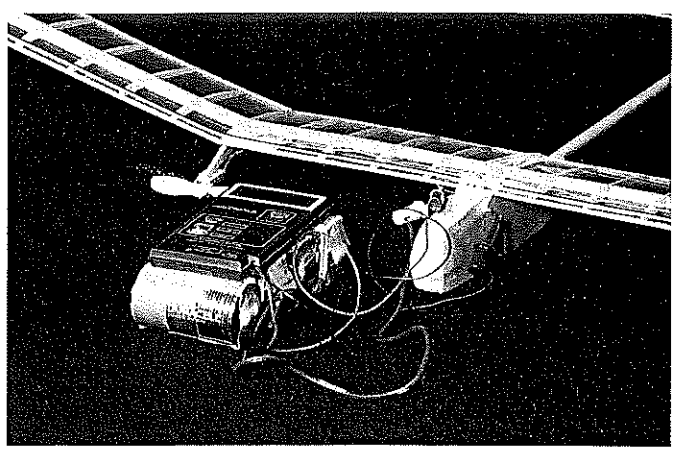
Flying weight: 46 grams

Construction: Built-up

Covering: 1/4-mil Mylar



Turbo Sport will stay aloft for nearly four minutes in late-evening air. Tailboom is made from drink straws.



Four alkaline D cells were wired in series for the charger. Micro clips connect to leads exiting Turbo Sport.

otors were fastened to the pylons with 1/16 ›uble-stick foam adhesive tape. The fins ɜre cut from thin foam sheet and glued to e stabilizer tips. I then strapped the wing .d tail in place with thin rubber bands, uted the antenna alongside the tailboom) reduce drag), and headed for a small sture to begin flight testing.

The first flying session started with some nd glides to double-check the incidence d CG settings. The result was a thin shim ded under the stabilizer trailing edge and ɜ confidence to begin powered flying.

The first powered flight was rather brief d ended with a cracked wing spar, but still ɜlded plenty of information. Perhaps most ɪportant was the fact that there was plenty thrust, and the Turbo Sport was very ıble. On the other hand, the airplane did t want to turn as expected, and the two-ck transmitter was very challenging to use this fashion without confusion!

Repairs were made, and after some nsideration I cut down the tops of the fins and headed back out. This time the Turbo Sport started out looking good and I had a chance to start a turn to the right when the motors shut down and the model landed against a fence. More broken wing spars! Repairs completed, I took the Turbo Sport outside and hung it from a low tree limb to run some range tests. The result was to double the ground range by allowing the antenna to hang straight down.

I headed out to a neighborhood ballfield for the next flying session. This time there was real progress! The first flight yielded a full lap around the field with a climb to about 30 feet (although control was sluggish) and I still was easily confused about converting up and down on the two sticks to left and right turns.

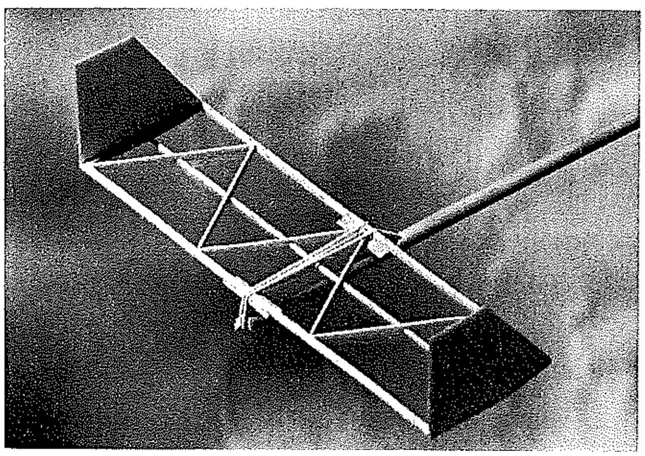
After a fresh charge on the little battery I chopped another piece off each fin and launched again. Turbo Sport climbed up to 50 feet and started cruising with turns on command, finally landing nearby after several minutes of smooth flight.

Now was the time to begin a program of refinement to get the most out of this new flying machine.

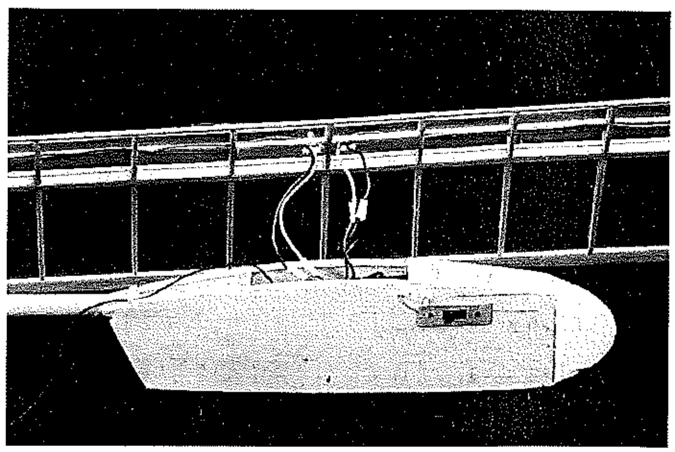
The main part of the airframe that had been giving me trouble was the wing. My first spar design was clearly too fragile, and the tissue covering warped the wing with changes in humidity.

I found another airfoil that looked promising: the Benedek B-6356. I decided to try cutting a wing from very light foam using the new airfoil. This was a real disaster! The foam wing was too flexible until I put a bunch of surface bracing on it; then the weight was excessive. Armed with this dismal experience I went back and laid out a new balsa wing frame using the Benedek airfoil. This wing was covered with 1/4-mil Mylar.

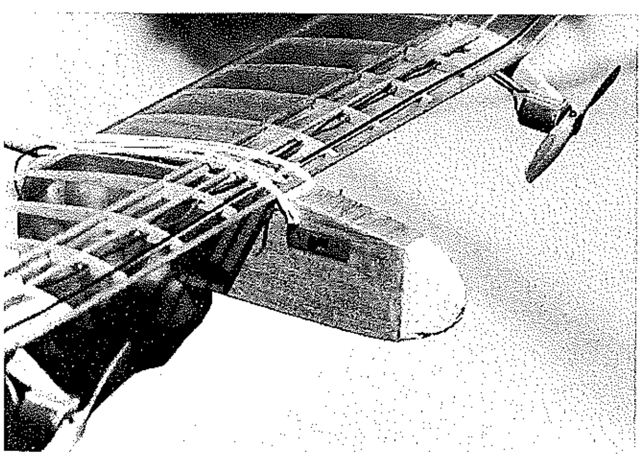
Flight testing resumed with hand glides. The new wing was very promising, except for a problem with yaw stability when trimmed near the stall. This cleared up very nicely when I installed a narrow tape



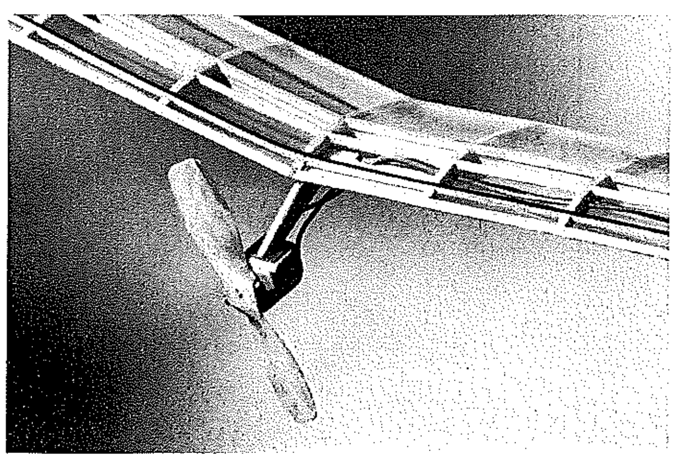
ɜingle rubber band holds the stabilizer in position. Fins are cut m foam plates, attached with glue gun.



The motor leads are routed through the wing prior to covering. Adjust equipment location for proper CG position per plan.

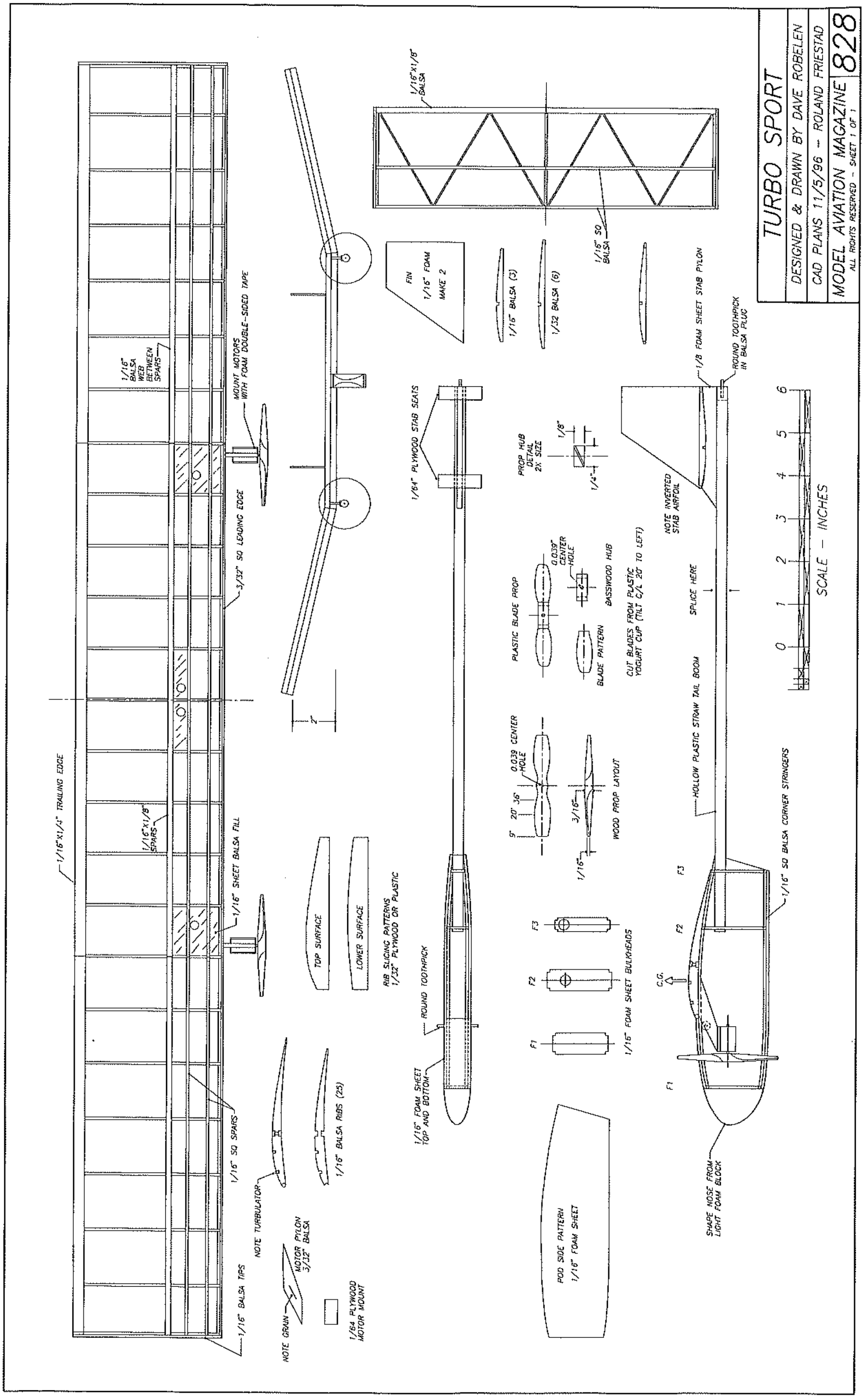


ginal pod was balsa, but can be made from foam plate. Note ıg turbulator, added to improve yaw stability.



Mount motors with foam double-stick tape. Basswood prop was derived from prop sold for Tee Dee .010 glow engine.

Full-Size Plans Available—see page 184



ırbulator near the leading edge.

This time I had an inspiration and set the ıil for a very large circle with steady ower. This circle trim was a real help! łow I could watch the Turbo Sport climb to high altitude hands-off and practice my ırning skills while gilding at a safe height bove ground.

I became convinced that I was onto ɔmething really neat! I could keep the ıodel inside a 120-foot-square field, handle moderate breeze, and keep the Turbo port aloft for almost four minutes in late-vening air.

I became an accomplished night flier by sing the lights of a parking lot to keep the ırplane in view. I also found that the Turbo port could also work small thermals very ffectively, frequently staying up five to six ıinutes.

CONSTRUCTION

I will assume that your building skills e such that you can comfortably build a ghtweight stick-and-tissue model; if not, y building something like a One Nite 28 t from Peck-Polymers to see how you feel ɔout this type of structure. The ɔnstruction used is not hard, but it may be fferent from your past projects.

In general, when I refer to light or edium wood I am describing the type of ood that Sig Mfg. markets as Contest alsa. A 1/16 x 3 x 36 sheet of light wood eighs about 12 grams; a sheet of medium ill weigh 18-20 grams. Thinner wood such 1/32 will weigh proportionately less.

My personal choice of adhesive is a ɾanoacrylate (CyA) glue from Wal-Mart illed Quick-Tite.

abilizer: This is a good place to start, just get warmed up. The trailing edge, leading lge, and spar should be cut from medium ɔod; the ribs should come from light ɔck. Protect your plan sheet with waxed per or something similar and clamp the ading and trailing edges in place with ns. Glue all of the ribs in place, using the ue sparingly. The spar is glued in place ıw, and the whole assembly is lifted from e board and sanded smooth. Set aside for ıw and proceed to the wing.

ing: Make a couple of rib-slicing nplates from thin plywood or plastic ɔck using the patterns shown on the plans. ake sure they are smooth.

Cut several pieces of light 1/16 balsa eet to the length of the wing rib. Use the tterns to slice the top-surface curve on the eet, then use the bottom-surface template make the cut that completes the rib. peat until you have a nice stack of rib ınks.

A small, square needle file will cut the ır notches cleanly and quickly. member to cut clearance holes in the ribs ıere the motor leads will pass through.

Prepare a 1/16 x 1/4 strip of firm balsa for trailing edge and clamp in place on the ın, using thin shims to maintain the airfoil. Sand a firm strip of 3/32 square to shape for the leading edge and clamp in place.

Glue all of the ribs in place, tilting the ones at the dihedral joint slightly inward. When dry, unpin the tip sections and prop them securely to the dihedral angle.
Glue the leading and trailing edges securely and add the top spars, gluing as you go. When dry, lift the wing off of the board and glue in the spar webs and the bottom spars. Add the bottom-surface filler pieces and wingtips, and sand the whole works smooth.

Covering: You may want to substitute tissue for the 1/4-mil Mylar. The weight difference is rather small, but the Mylar is much more stable with changes in humidity.

If you are using Mylar, paint a coat of adhesive on all parts of the frames where you want the material to stick (I recommend Balsarite Plastic Film Formula). My favorite covering tool is a MonoKote trim seal iron. It's smaller than a regular iron and easier to handle. Do not shrink the covering until you have it sealed down tightly.

Fins: They can be cut from 1/32 balsa and attached with CyA, I believe there is a better way.

The bottoms of foam plates are an excellent source of light foam sheet that is resistant to moisture without any coating. Attach with a small hot-glue gun. You must have the parts ready and work quickly, but the foam joints will have superior strength and the weight is quite reasonable if you spread the glue thin.

Fuselage: After I had made a rolled balsa tailboom, I discovered that plastic straws from McDonald's and Burger King plug together neatly and make a superior tailboom! I strongly recommend this option.

The pod can be balsa sheet or foam cut from plates. I suggest a reinforcement of 1/64 plywood and a dab of epoxy to hold the piece of round toothpick in place. Start by gluing the tailboom to the rear bulkheads, and then add the edge strips to the side plates. When ready, glue the side plates to the rear bulkheads and add the front bulkhead. Glue the top and bottom sheet in place now and trim out a nose piece from very light foam block. I cut my stabilizer mount from a 1/8 foam meat tray and stuck it on with hot glue. The stabilizer braces are cut from 1/64 plywood; watch the alignment (no stab tilt, please). Glue a small plug of wood in the end of the boom and glue a piece of toothpick in that.

Assembly time! I suggest that you mount the motors with some picture-mounting foam tape that is sticky on both sides. Make the necessary connections to assemble the receiver, switch, and battery as a package—outside the fuselage. I use a short length of wire from each side of the battery through the fuselage sides as charging connections.

Slip all of the gear into the pod now and prepare to hook up the wing. I left about four inches of slack in the wires and directly connected the wing wires to the receiver leads. Be sure your left and right leads are sorted out! Use some thin office rubber bands to strap the wing and stab in place. One band is plenty for the stab, and two work fine for the wing. Check the balance carefully and scoot things around inside the pod until the CG is correct as per the plan.

Props: You can carve your props from basswood, following the information on the plans, or you can choose the plastic blade option. The wooden props are a little more efficient, but the plastic blades get the job done. Whichever you choose, work slowly and carefully to make smooth-running, well-balanced props.

Once you mount the props on the motors you can attach the wire leads. Switch on your radio system and check which way the motors run when you push the stick up. If they pull forward, that's great; if not, reverse the wires until they do. If you have access to a tachometer, check the rpm with a full charge. You should see at least 11,000 rpm; if it is substantially less, your props may have too much pitch. The tip should measure 9 degrees. Check and correct as necessary.

Flying: Start with hand glides over something soft. Use thin shims under the stabilizer until the glide is almost stalling, and adjust the tail until the glide is straight. You should expect the Turbo Sport to glide about 60-75 feet in these tosses, so be sure to allow enough room!

The ideal arrangement is to have a helper for the first powered flights. If not, hold both transmitter sticks forward with a thumb while gripping the transmitter without touching the antenna. Launch the model just like you did for the hand glides, and watch closely. Does it climb smoothly? Stall slightly? Turn? Go straight? Plan on a quick shutdown and review the results. Make any desired adjustments, then try the same again. When you have your Turbo Sport climbing in a smooth circle of 75-100 feet, it is time to work on learning the ntrols.

Under power the airplane turns toward ɜ stick that is pulled back to the center; ring gliding flight the plane turns away ɔm the stick that is pushed forward. Turbo ıort is responsive, and small bumps of ıwer will be plenty to start a turn. Except r extreme measures (dethermalizer?) there no reason to use reverse thrust.

ıarging: I made a field charger by wiring ur alkaline D cells in series. This can be ıne quite simply by tightly wrapping ɔund the cells with strapping tape. ternate the position of the cells so that ımper wires may be added to make up a ɩ-volt pack. Add a two-foot cable of two res from the positive and negative on this ttery pack. The end of these wires have ɔcro clips from Radio Shack to clip onto ɜ charging wires coming out of the model.

I have had the best results using a pocket ɜital meter from Radio Shack to monitor ɜ battery charge. In practice, the charging ck is clipped onto the two charging wires d the voltage is monitored with the meter. hen the voltage stops increasing, the ttery is fully charged. This whole process ɩes less than two minutes for a full charge.

ıave had a great deal of pleasure with this ɔject, as well as the telling about it, and I pe that some of you can share in the fun. ɜase write and share your comments and periences.

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ıurces

ılsa, tissue, Balsarite, music wire, tools: ɡ Mfg. Co., 401-7 S. Front St., ontezuma IA 50171

·mil Mylar: Ed Turner, 3544 Granada Dr., ɪt Worth TX 76118

ɪam plates, CyA glue, Hot-glue gun: Wal-art

icro clips, wire, meters, soldering uipment: Radio Shack ✈