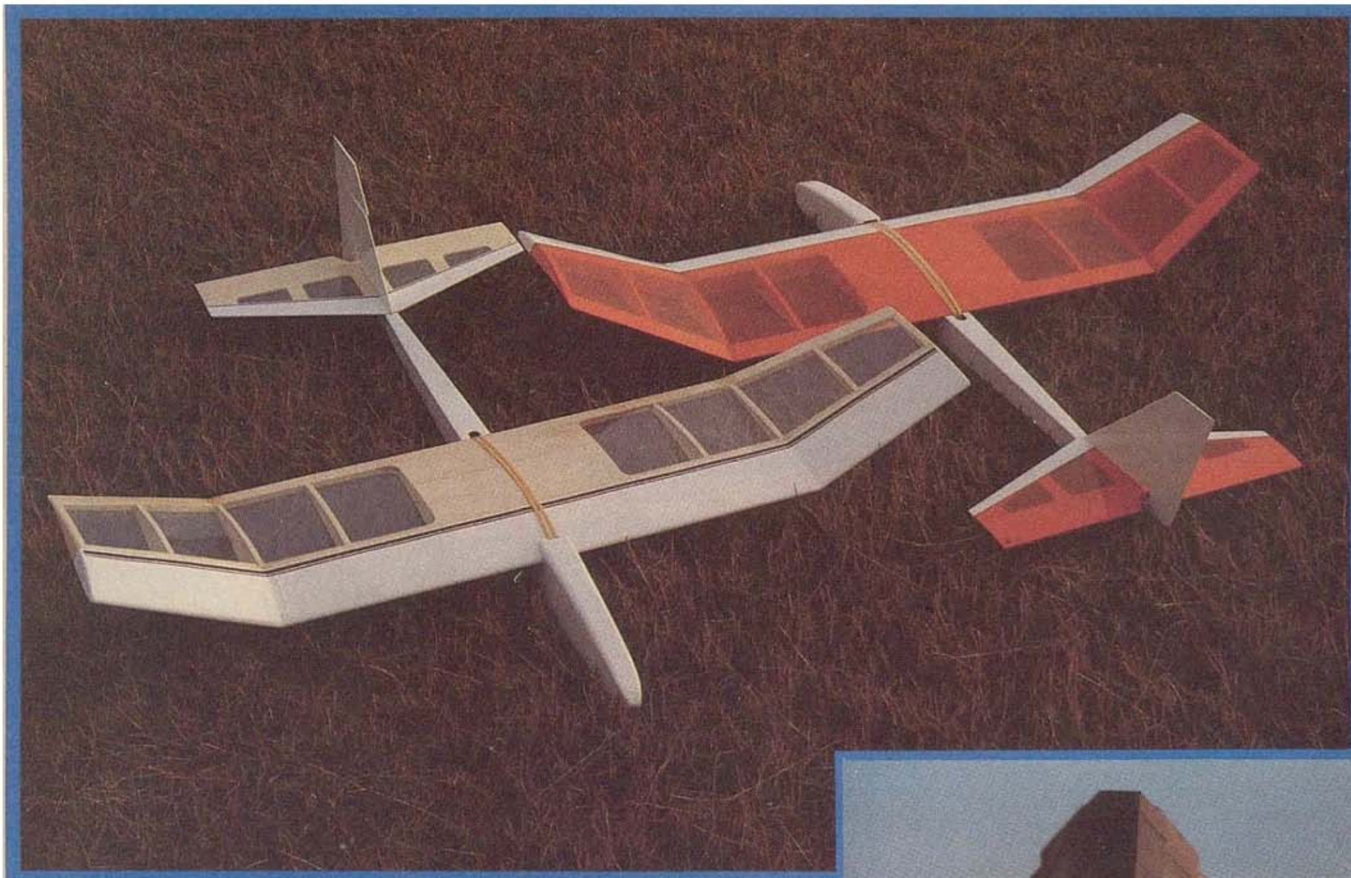
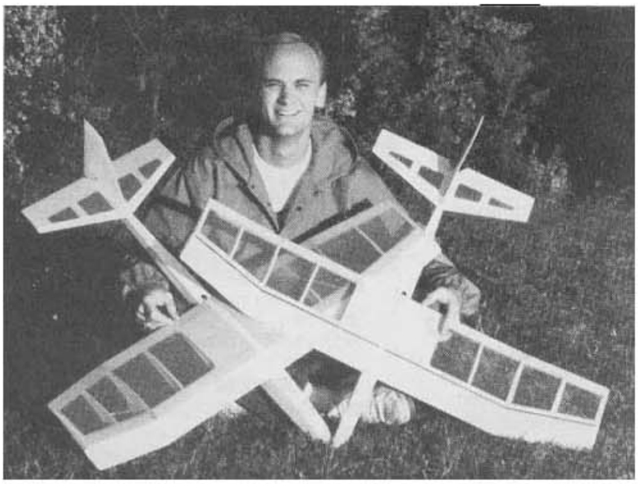


STYLUS

The Stylus surpassed all of Carl Dowdy's expectations on flying and was a joy to build.



ABOUT THE AUTHOR

Carl Dowdy, 25 years old, graduated in 1985 from N.C. State University with a B.S. in Aerospace Engineering. He works at Manned Flight Simulator, Naval Air Test Center at Patuxent River, Maryland. He has been lead Project Engineer on the F-8 Oblique Wing Research Aircraft and the A-6F Simulations. Carl has been an active modeler since Jr. High School, building his own design R/C models.

By Carl Dowdy

Hi-start launch gets underway.

While I was at North Carolina University, I used to pore over the model airplane magazines that could be found downstairs in the library's magazine room. Rumors had it that I spent more time there than I did studying! Regardless, I learned a great deal. It was during my reading that I came across articles by Herk Stokely and Dick Sarpolus that dealt with Low Aspect Ratio Sailplanes. By coincidence, I had just purchased a miniature radio control system and was eager to build something for it. It seemed that a One Meter hand launched glider would be the ideal way to apply my new knowledge and radio. So, after a little number crunching and a few sketches, the Stylus was created. Some aerodynamics may be in order now.

As an aerospace engineer, I was taught that the Reynold's Number was the ratio of inertial to viscous forces. That was a little hard for me to visualize, so I found it convenient (if not accurate) to think of the Reynold's Number as the relative coarseness of the air an airplane "sees" while it is flying. Using this idea, a 747 airliner flying at 400 mph will see a very smooth fluid, while an ultralight flying at 50 mph will see far fewer air molecules flowing over its surfaces; thus the air will seem more like 120 grit than 400 grit sandpaper. Therefore, the ultralight does not react as efficiently. This Reynold's Number gets to be a problem for smaller models. However, you can fool the Reynold's Number into thinking the plane is larger by increasing the chord of the wing. It is the chord that is the parameter of interest, so you see that hand launched R/C gliders with higher aspect ratios (therefore smaller chords for the same span) see degraded performance. To sum up the articles by Stokely and Sarpolus: At lower Reynold's Numbers, the gain in performance you get by increasing the chord is greater than the loss in performance due to a decrease in aspect ratio. Also, a low aspect ratio sailplane has better handling and, for the One Meter span, packs in more area to lower the wing loading. However, low aspect ratio sailplanes are not the greatest thing since peanut butter! They do have drawbacks which will be discussed in the Flight Testing section.

There were several additional ideas that were incorporated into the design in an attempt to create a good hand launched glider. The dihedral that I used was chosen because it initiates a correcting roll from a poor launch very quickly. Also, it allows the glider to be slipped more easily, which makes for very flat thermaling turns. It also saves weight by eliminating one dihedral joint and makes building the wing a little easier. The Eppler 214 airfoil was chosen because of its higher lift at slower speeds, relatively wide speed range, and usefulness at lower Reynold's Numbers. The stall does take a little altitude, so be forewarned. The remaining effort was to make a strong but very lightweight structure. You should know that construction sections always bored me. I'll try to keep this one short, but stick with me because there are a few hints that will save you some time and headaches.

CONSTRUCTION

Wing:

I encourage you to flex and twist the wing during its construction. Doing so helps you understand how each part contributes to the structure. Begin building the wing by cutting out all the ribs from 1/16" sheet balsa and sanding all the common ribs together. If you happen to have a jig, by all means use it. If not, the following method worked fine for me. Note that the outer panels (tips) are built as one piece to simplify construction and are later cut apart. The spars are made from hard 1/8" x 1/4" balsa, while the leading edge is made from 3/16" sq. balsa. Press and glue both spars in place and use rubber bands to hold the leading edge in place. Take care not to glue in a warp that runs the entire

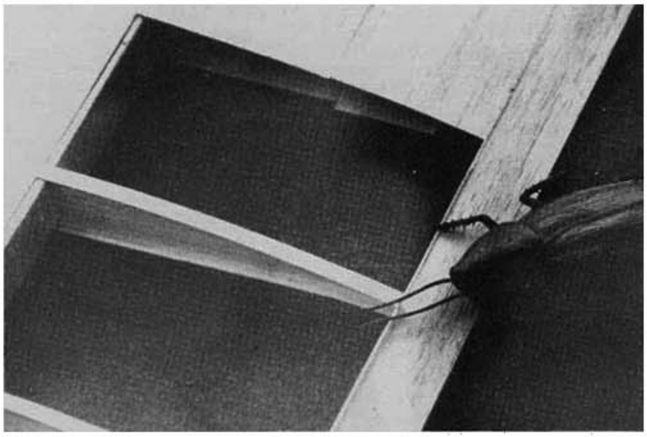
Carl about to let go in a perfect hand launch.

STYLUS

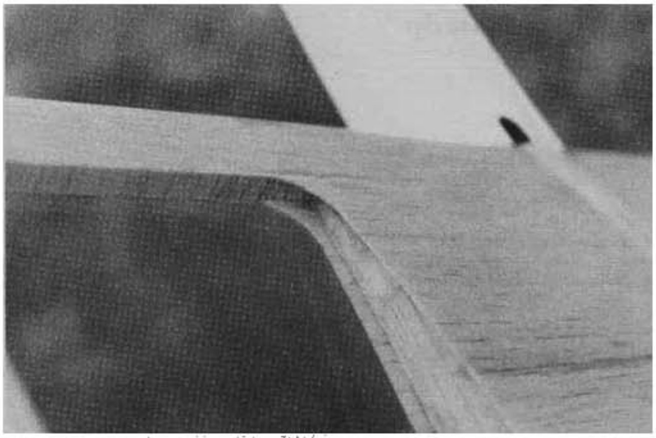
Designed By: Carl Dowdy
TYPE AIRCRAFT: One-Meter Glider
WINGSPAN: 40 Inches
WING CHORD: Root 9"; Tip 7"
TOTAL WING AREA: 344 Sq. In.
WING LOCATION: High Wing
AIRFOIL: Eppler 214
WING PLANFORM: Constant Chord Center Tapered Tips
DIHEDRAL EACH TIP: 3½ Inches
O.A. FUSELAGE LENGTH: 32¼"
RADIO COMPARTMENT SIZE: (L) 9½" x (W) 1¼" x (H) 1½"
STABILIZER SPAN: 16 Inches
STABILIZER CHORD (incl. elev.): 4½ Inches (Avg.)
STABILIZER AREA: 71¾ Sq. In.
STAB AIRFOIL SECTION: Flat
STABILIZER LOCATION: Top of Fuselage
VERTICAL FIN HEIGHT: 6½ Inches
VERTICAL FIN WIDTH (incl. rud.): 5½ Inches (Avg.)
REC. ENGINE SIZE: NA
FUEL TANK SIZE: NA
LANDING GEAR: NA
REC. NO. OF CHANNELS: 2
CONTROL FUNCTIONS: Rud., Elevator

BASIC MATERIALS USED IN CONSTRUCTION

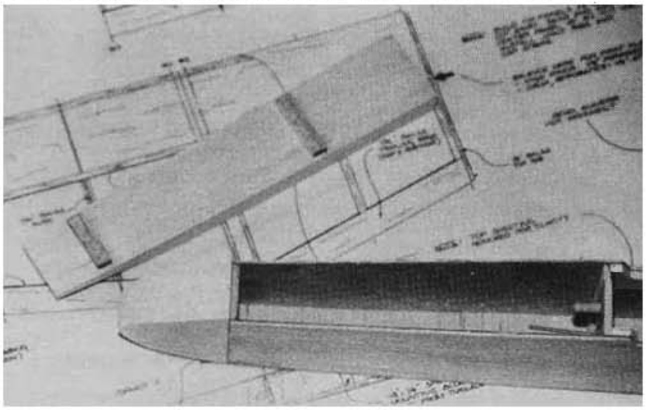
Fuselage	Balsa and Ply
Wing	Balsa
Empennage	Balsa
Wt. Ready To Fly	**11 Oz.**
Wing Loading	**4.6 Oz./Sq. Ft.**



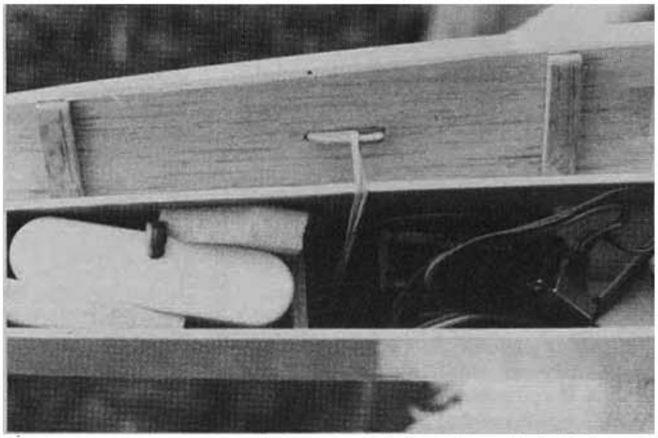
The Balsa Beetle at work on the edges of the wing sheeting. When complete, everything will be even and nicely radiused.



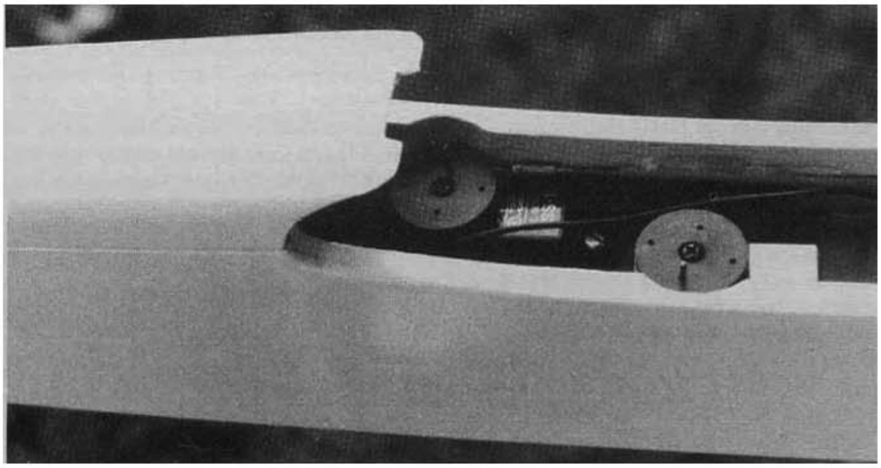
Finished job by the Balsa Beetle.



Nose section of fuselage showing radio compartment. Bottom side of hatch shown. Fuselage is ready for final shaping and sanding.



Receiver and battery pack in nose section. Note ply hold-down catch.



Servos mounted under wing. Small mini servos are used.

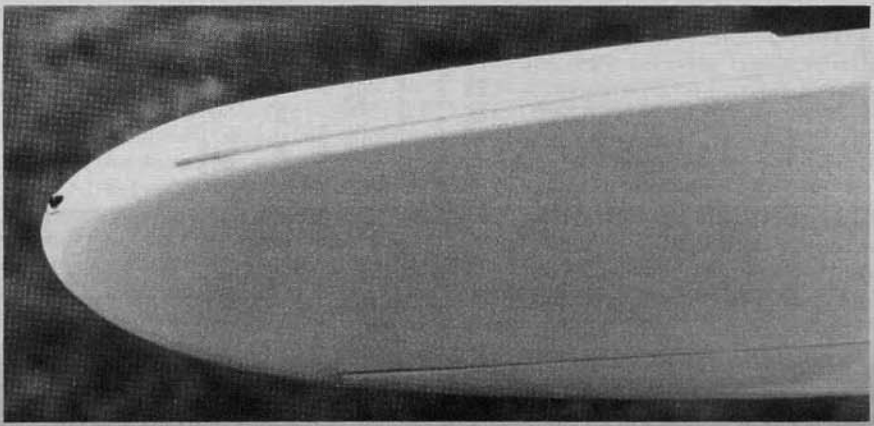
length of the wing. You may need to notch the center of the tip spars and leading edge in order for them to bend from one tip to the other. Glue on the 1/32" leading and trailing edge sheeting (top and bottom). Follow by sanding the sections to the proper dihedral angle, inserting the joint ribs, and gluing on the outer wing panels. Next, glue the 1/32" shear webbing in place. Be sure all warps are out because once the shear webbing is in place any attempts to heat shrink a warp away will be useless. Finish with the 1/32" x 1/4" capstrips, 1/32" center section sheeting, and 1/8" balsa tip ribs. Don't forget to add a little fiberglass and epoxy to the dihedral joints for strength.

Fuselage:

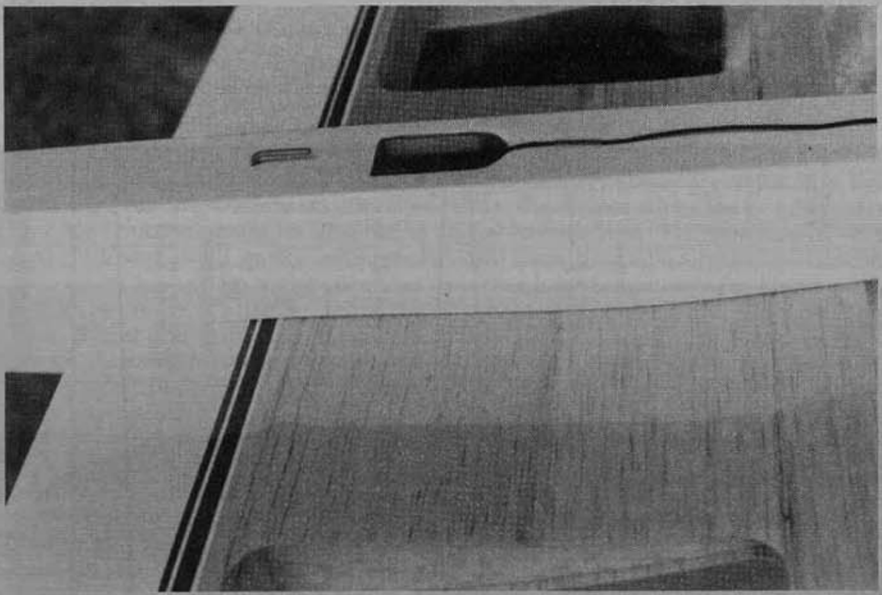
The fuselage construction is relatively easy. Start by cutting out all the parts in kit fashion. The airfoil shape for the wing saddles can be cut from the sides with a rib template. Be sure to **leave** wood on the fuselage sides for the undercambered section of the wing. You might consider cutting notches into the 1/8" balsa formers for the pushrods or cables before gluing them in place. Also, glue the dowels and their 1/64" ply doublers in place for the rubber bands that hold down the wing. I recommend rubber bands on this plane. Two #64 rubber bands are sufficient and, if placed flat, have very little drag. Use a very thin layer of epoxy to glue the 1/64" ply doublers to the 1/16" sheet balsa sides. Be sure not to make two right sides (it happens!). Since a large part of the fuselage bottom is flat, lay it on the bench while gluing the formers in place. Glue the 1/16" balsa cross graining on the top and bottom. Securing the hatch is somewhat left up to the builder. One of my favorite ways is to glue 1/8" x 1/4" hard balsa "keys" on to the bottom of the hatch. Hooks are attached to the bottom of the hatch and to the fuselage bottom, then a small rubber band is used to hold the hatch in place. This allows you to lift and pivot the hatch to gain access to the radio area. Whatever means you use, be sure that the hatch is secured well, since hand launches can be abusive. The finger hole gives you room for personalization. Mine was made from scrap 1/4" sheet balsa. I have even heard of using a small spring loaded door that closes after launch to reduce drag! The main thing is to see that your finger cannot tear through the front of the hole and that the formers reach to the fuselage sides, distributing the stress of a gorilla hand launch.

Tail Surfaces:

Cut out the horizontal and vertical stabilizers from light 1/8" sheet balsa. Leave enough wood in the cut-outs to allow you to round the corners. This can be done by wrapping sandpaper around your knife handle and sanding a suitable radius. The rounded corners are necessary since sharp corners cause stress concentrations. Besides that, rounded corners look nice! Cut the slot for the rudder "key" and test fit before covering. Join the elevator halves with a 1/8" x 1/4" piece of spruce or hard balsa. Try sanding a bevel only on the movable surface's hinge line and making hinges out of a strip of MonoKote Trim Sheet. A piece of Scotch Tape, although not as attractive, works equally well. Sealing the surfaces in this manner makes them more effective. The most important thing is to see that the elevator and rudder move freely through a wide range of motion before you install the radio.



View of underside of nose showing landing skid.



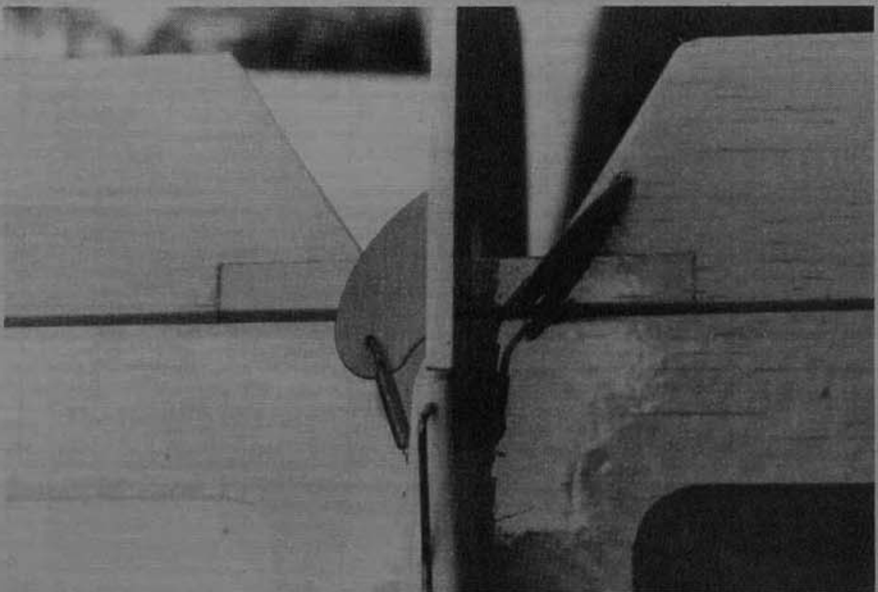
Looking at underside of fuselage at wing location. Shows launching hook and finger hole for hand launching.

Sanding and Covering:

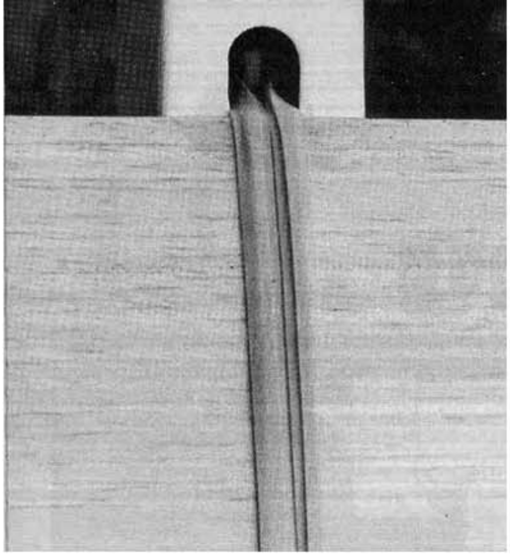
Now, before you start bringing out your covering iron, don't forget to sand everything well. The models that are really impressive have had a nice job of sanding before the application of that beautiful finish. Be sure to get all the balsa dust out of the pores of the wood so that the covering will not bubble up. The Stylus does not depend on MonoKote for strength, so feel free to use other types of covering if you wish. Just be sure to keep the finished weight as low as possible. After covering the tail surfaces, cut away the necessary MonoKote for making wood to wood glue joints for the horizontal stabilizer / rudder and horizontal stabilizer / fuselage connections. Make sure that the tail surfaces are joined at an accurate 90° (not just "close enough")! If your Stylus is now sitting on the bench with the radio installed and the finish on, we can get on to the fun of flying.

Flight Testing:

If you are like me, this is the second part of the article you have seen. The pictures or plans were probably the first. In the past, my flight testing consisted of those first few flights in which I became "used to" my new plane. However, I encourage you to seriously flight test your Stylus. You can learn a great deal this way. Now, the first couple of flights should be used to feel out the glider. Start with test glides and **carefully** work your way from shallow to steep launches. The last thing you need to do is tear up your glider by being ill-prepared. When you feel confident flying the Stylus, begin by stalling the glider from straight flight at various speeds and pitch attitudes. Note the recovery and altitude loss (makes you really



Bottom view of rudder and stab. Shows elevator cross tie and ply control horns.



Wing is secured with (2) #64 rubber bands.

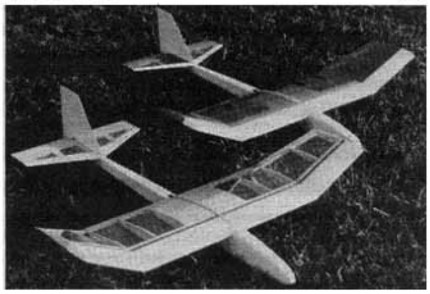
want to watch the speed on landings, huh?)! Also, try stalls from turning flight. This helps you in thermaling by teaching you just how much you can slow a Stylus down before stalling. Do this at various bank angles. If you still feel confident, we'll go for some real fun. Use a hi-start to make sure that you have plenty of altitude. Point the nose of the glider down and pick up speed. Release the stick pressure and watch what happens. If you balanced your Stylus correctly it should have gently pulled itself out of the dive. Now try moving the C.G. just slightly aft (but not much aft) of the suggested C.G. range and use the same procedure. The Stylus will develop a case of the "tuck-unders." This is caused by the location of the center of pressure of the airfoil. There is a place on every airfoil where you could place all the lift, and the plane would not know the difference. Do not confuse this with the aerodynamic center of the airfoil. The aerodynamic center is the point about which the pitching tendency of the airfoil does not change with changes in speed. Now as the airspeed increases, the center of pressure moves toward the trailing edge of the wing. Since the Stylus has such a large chord, the center of pressure can move a long way! This means you will have to balance the Stylus a little further **forward** than other gliders and feed in a little **up** trim. A convenient way of thinking about this is that you are increasing the Stylus' longitudinal "dihedral."

Flying:

You probably have heard a lot of flying stories by now, but this is my opportunity to tell you about flying a Stylus. So feel free to pull up a chair! The Stylus was designed for hand launched thermaling. Launching is a little different, however. Since the Stylus has such a low wing loading, it is harder to get a high launch than with a heavy glider. But once up in the air, the Stylus flies slower and has a lower sink rate. Flight times in still air seem to compare closely with the other hand launch designs I have seen. Thermaling is a joy. The slightest wisp of lift is enough to keep Stylus airborne. Turns are very tight and flat. Usually the first remarks about a Stylus (other than, "Hey, you've got the wrong wing on that thing!") is that it flies so slow and turns so tight. It is also pleasant to find that penetrating upwind with that thick airfoil is not as big of a problem as you might think. The Stylus is definitely a floater. However, its tight turning ability and light wing loading give it an advantage when the thermals are weak and as big around as an Oreo Cookie. You guys out West do not need to worry since your thermals frequently suck up bowling balls, farm machinery, and small children. Anyway, my favorite flight with a Stylus involved slope soaring. Keep in mind that its low aspect ratio makes it very maneuverable.

I wanted to show off my new Stylus to a friend. As it turned out, the day was breezy and we almost called off flying. I had decided just to "test glide" the glider off an embankment for him. Much to my surprise, Stylus rose to about 20 feet above the 15 foot high embankment. I was turning sharply to stay on the 50 foot section of hill when a thermal rolled through! My "test glide" turned out to be a flight lasting several minutes! I tried my hardest to convince my friend that I had planned the flight that way, but I don't believe he bought it.

I honestly believe that if you have even half of the fun I have had with my Stylus, your efforts will not have been in vain. You should also be aware that I have launched my Stylus with everything from a large Two Meter hi-start to the oatmeal box versions (50 ft. of 1/4" flat rubber, 150 ft. of fishing line). So when your arm has had it with hand launching, bring on a hi-start to finish out your battery pack. I wish you the best of luck in building and flying your Stylus. Just remember to build it light and your buddies will be following **you** to the thermals! □



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