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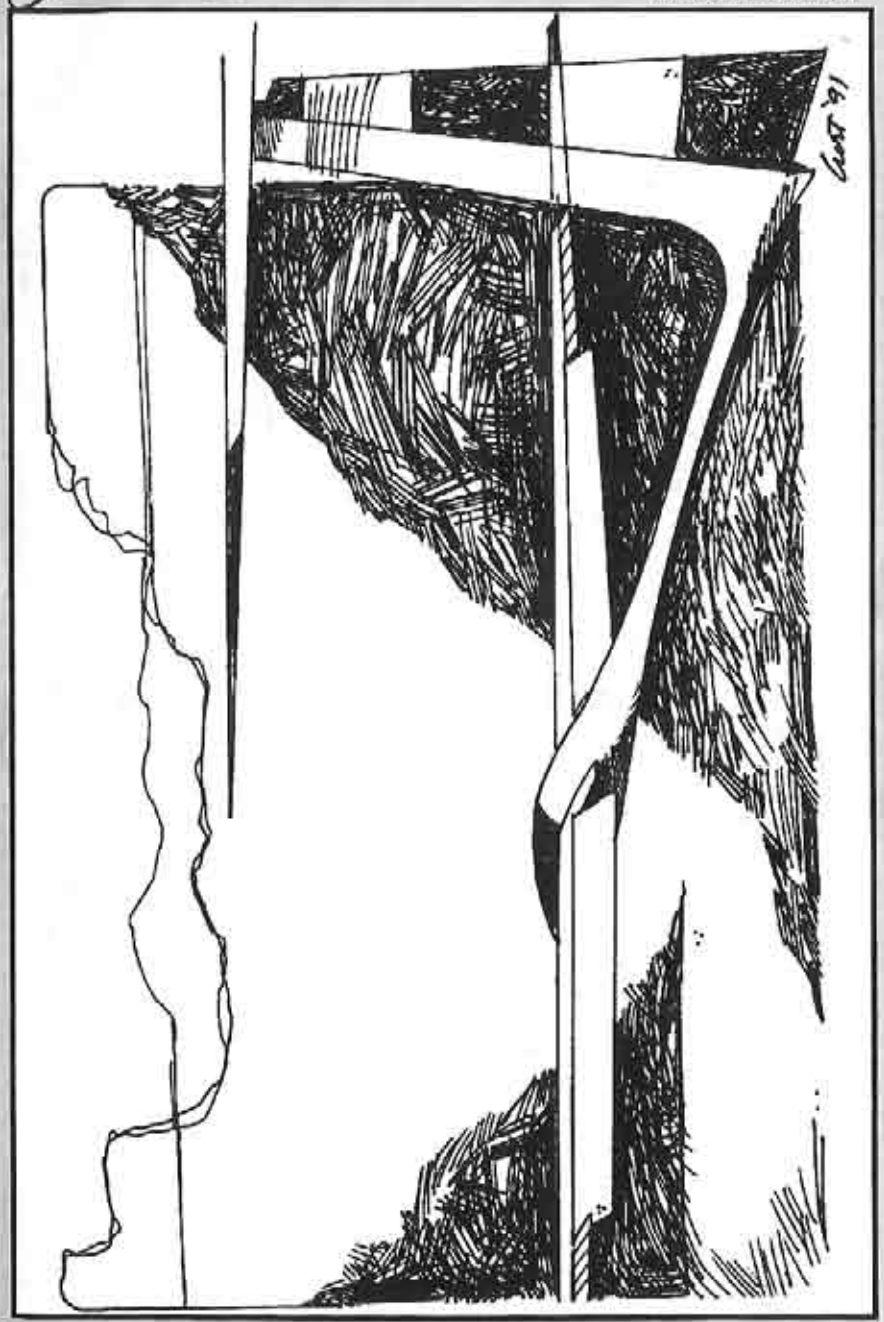

R/C Soaring Digest

A publication for the R/C sailplane enthusiast!

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R/C Soaring Digest (RCSD) is a reader-written monthly publication for the R/C sailplane enthusiast and has been published since January, 1984. It is dedicated to sharing technical and educational information. All material submitted must be exclusive and original and not infringe upon the copyrights of others. It is the policy of *RCSD* to provide accurate information. Please let us know of any error that significantly affects the meaning of a story. Because we encourage new ideas, the content of all articles, model designs, press & news releases, etc. are the opinion of the author and may not necessarily reflect those of *RCSD*. We encourage anyone who wishes to obtain additional information to contact the author. *RCSD* was founded by Jim Gray, lecturer and technical consultant. He can be reached at: 210 East Chateau Circle, Payson, AZ 85541; (602) 474-5015.

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The Soaring Site

This month, the cover was done by artist, Curt Nehring. Last month, on page 2, we included a photo of this Southern California flier with his 3M Gnome. Curt has written to say, "I have gotten lots of inquiries about my photo in *RCSD*...everybody wants a 3M Gnome and there aren't any. I talked to Bob Sliff (Midway Models/ Hobby Horn - '92 F3E Mgr.). He sez only the plans are available in limited numbers. (They have to be redrawn, and probably not until well into the New Year.) Could you possibly mention that in *RCSD*? Thanks! It will save these folks a long distance call."

Doc's Boomer Thermal

Over the Christmas holidays, we hope none of you experienced what happened to Doc in Greg Vasgerdsian's rendering in the December issue (page 15). To give you some background, Greg has been putting his artistic talents to work depicting humorous situations designed specifically for you readers. When he's not out flying or doing his regular job in the graphic arts field, this Northern California flier is sketching out and finalizing ideas for *RCSD*. Thanks, Greg!

How many subscribers, now???

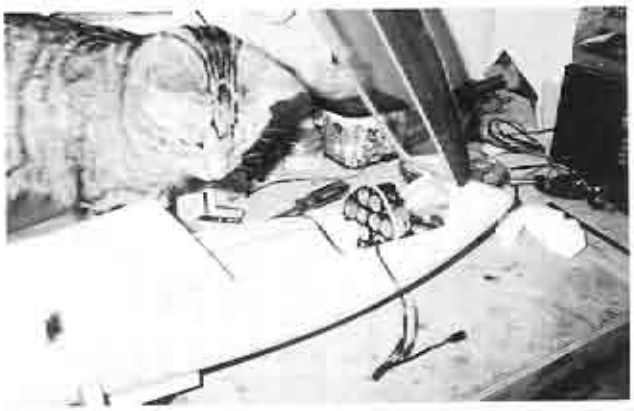
This question has been asked of us numerous times within the last month, so we have included the updated map in this issue. As of the December mailing, there are 1523 subscribers in 17 countries and the total monthly distribution exceeds 1700 copies.

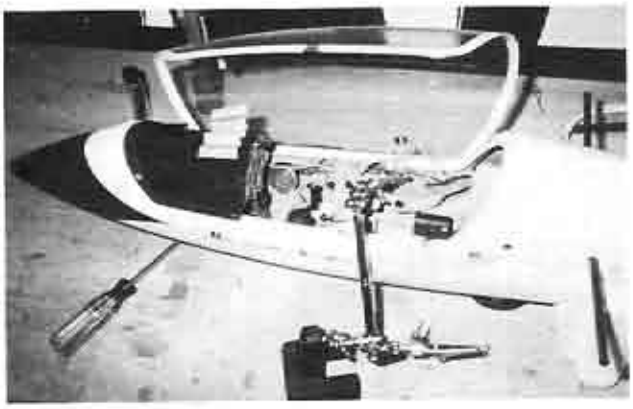
Happy New Year,
Jerry & Judy

I Need Lots of Room When I Put Together My Babies!

...by Hugo Sandroni
Gardena, California

This is what my shop (custom furniture) looks like on week-ends...gliders all over the place.Ema helps a lot in small places where I can't reach with my hands. Here, she is checking the landing gear going up and down. The sailplane is a multiplex ASW-22 and will be flying soon. Complete (scale) cockpit details and 8 servos, rudder, stab, gear, ailerons, flaps, and spoilers.



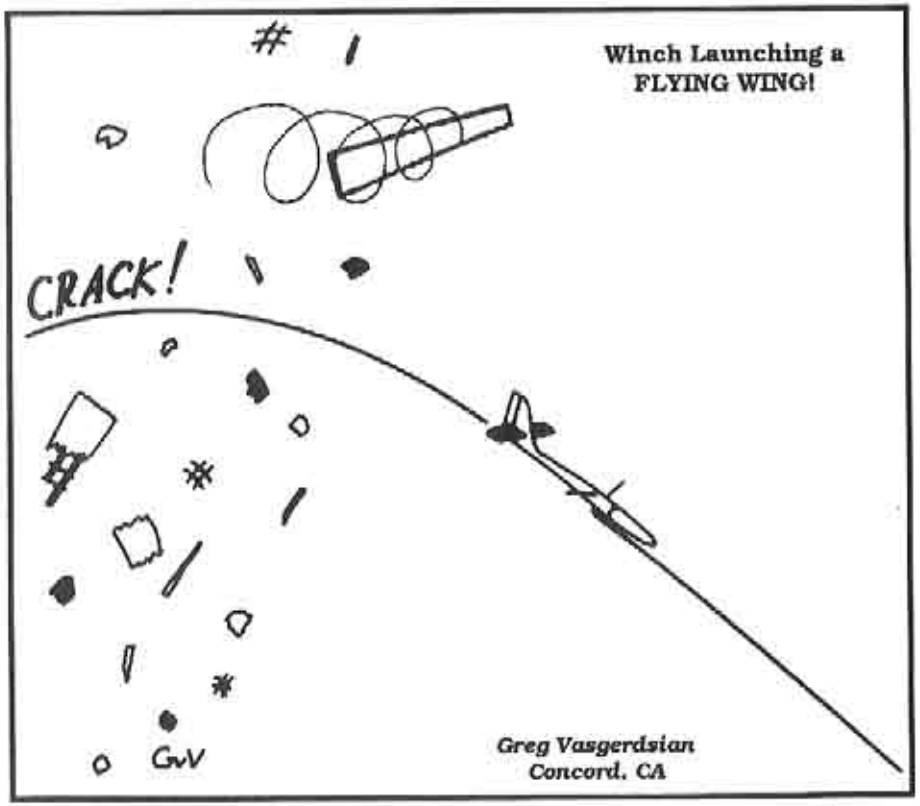


I have a stall warning system in my Mini-Nimbus, and it works fine!

Two done and six to go. Lots of hours getting the Synergy ready. I have about 20 flights with it. I love it! Super poxy finish. The Falcon was repaired after a crash on the winch. I had 5 piece wings and a 3 piece fuselage. It is ready now, and flies better than before. Note the flat wings and horten wing tips. Model features Ziegelmeyer's arrow shaft hinges, servo mounts, skid and tow hook with a Hobby Poxy finish.

The Desert Union of Sailplane Enthusiasts (DUST) field is the best place to fly in Southern California. We flew here in one SC² contest where there were more than 70 flyers in attendance. We really enjoy the place and the people of DUST.

The Baby is taking shape. It will be covered with silk and nitrate dope. 200 hours so far and 100 to go...my heart is in it! I got this Grunau Baby IIA thanks to Soaring Digest's *services. The kit called for a IIB, but it is a IIA. The spoilers are on top only, landing skid and other details make the difference.*



On the Wing

B²

P.O. Box 975
Olalla, Washington
98359-0975

We've been corresponding with Marc Vepraskas for a couple of years now. During this time he's been attempting to design, build, and fly a thermal duration swept 'wing design utilizing the Eppler 222 - 230 series airfoils and foam and balsa construction. He recently sent us the following report on his progress, together with a videotape of the first test flights.

The Nanosaur Flying Wing

...by Marc B. Vepraskas, AMA 90549

The ancestry of the Nanosaur project can be traced to Bill and Bunny Kuhlman's article's "On the Wing..." in *RC Soaring Digest*. I have always been fascinated by wings. In 1975 I built the *RCM* Standard plank and in 1979 the *RCM* Windfreak, both plank designs. In 1989 I built the Klingberg 2M wing. Normally I fly a straight wing Sagitta 2M. I wanted to build my own wing design with the features B² (Bill and Bunny) discussed. The Design of the Nanosaur Project utilizes all that I have learned up to June 1990. I had to freeze the design at some point and start building!

The inspiration to design was started by reading "Winged Wonders", a book on the Northrop N9N project. The N9N was a 60 foot span 1/3 scale flying model of the XB-35 bomber project of the 1940's. The author, Mr. Wooldridge, covered the complete story of flying wings. Another book which helped me was "Faszination Nurflugel", a German book on the development of flying wing models up to 1988. Together, and after reading and looking at all the pictures, I was hooked and Nanosaur was born.

Design started in February, 1990 with a letter to B² asking for advice. I needed a source to plot the new Eppler 222 - 230 series of airfoils, specifically designed for flying wings. These airfoils exhibit a very small center of pressure movements as angle of attack is changed. The use of the Eppler airfoils is important to limit the pitch sensitivity on a flying wing. I found the airfoils in Chuck Anderson's airfoil program and ordered the IBM version software. B² advised I use the E222 at the root and the E230 at the tip with 3 degrees of negative twist (T.E. raised) for thermal flying. I decided to use the E222 at the root transitioning to the E226 at mid span and transitioning to the E230 at the tip.

In researching articles on wings I came across a British *White Sheet* magazine of the Spring of 1986 (# 36). One of the articles was by Reinhard Werner who stated, "Flying wing designers should think big! The greater our wing chord and area, the greater are our chances to escape Reynolds numbers trouble and effect a wing loading adequate to conditions of minimum sinking speed." I chose 13.5" for my chord and 122" as my span as I would otherwise have trouble transporting the wing in my van!

Nanosaur was designed to be a open class thermal flying sailplane. The wing span is 122.5" with a constant chord wing of 13.5". The constant chord was used to help stability and reduce the twist required. The negative side of the constant chord is (that) the wing's roll rate is degraded slightly as more weight is on the tips. The wings are swept back 20 degrees and winglets are used at the tips. The winglets block the aft 75% of the wing tip. The winglets are designed to help reduce tip stalls and aid in visibility.

In order to design the rest of the wing I needed to determine the approximate

C.G. position to help layout the components. To calculate the C.G. the neutral point of the wing first must be found. After the N.P. is found the C.G. is 5% of the root chord ahead of the N.P. The N.P. is the aerodynamic center of the wing. The N.P. is calculated as the mathematical addition of the chord at 1/2 of the semi-span to 25% of the wing chord. Where the two points add up is the N.P. On Nanosaur this calculates as

tan 20 x 30" + (0.25 x 13.5") =
0.3639 x 30" + (13.5 / 4) = 14.3"

back from the L.E. at the root. The cg is located 5% ahead of the N.P. or 13.5" back. My flying experience so far has the C.G. 12" back! My 3 degrees of twist possibly makes the wing overly stable, dictating a more forward C.G.

The wings specifications are as follows:

1- Wing span of 122.5"
2- Wing area of 1620 sq in (11.74 sq ft)
3- Wt is 84 oz with C.G. at 12" back from L.E.
4- Wing loading is 7.6 oz/sq ft

The wing is shaped with foam cores and covered with 1/16" balsa. The balsa works well but is costly and requires hours of sanding. The cores were divided into two 30" panels 2" thick by 16" wide. A total of 4 panels were cut with the 20 degree sweep angle. Templets were made of the airfoils E222, E226 and E230 and cores cut out with a hot wire. The cores were cut to match the centerline of the three airfoils to allow the gluing of

Nanosaur...Designed, built & flown by Marc Vepraskas.

Marc Vepraskas holding Nanosaur.

two panels into one wing half. I used the top and bottom of the foam blanks to "vacuum bag" the wing to "bed" the shape. I bonded the 1/16" balsa skin to the cores with epoxy glue. The important point to remember is that with the 20 degrees of sweep the cores have to be cut with the airfoils placed in the direction of flight, not perpendicular to the leading edge!

The only control surfaces are elevons controlled by their own servo in the wing, located 7 inches ahead of the elevon. The elevons are 20% of the wing chord or 2.75" wide and 26" long. I used heavy 1/4 scale type pin hinges, five per elevon. The elevon ends 3" from the tip to allow the wing structure to hold the winglet. The servo is a standard Airtronics type with a 36" long lead running out of the wing at the root 1.5" back from the leading edge.

The antenna tube is a 1/8" plastic tube running at mid-chord out into the right wing 32". No radio problems or range problems have been seen. My radio is the excellent Airtronics Module SP7 on FM channel 38.

The wing joiner system is one of the keys to the wing's simplicity. Since the wing is over 1.5" thick I wanted to use two large diameter joiners. I used a joiner set perpendicular to the centerline at 37% and 75% of wing chord. The forward joiner is 12" long and the rear joiner is 24" long. Both joiners are 3/8" thickwall, stainless aluminum tubing. The wing rods are the next size of aluminum and 12" and 24" long. To help seat the two aluminum tubes in the white foam, which is weak in compression, I replaced 2" of white foam with blue foam at the two locations, 12" and 24" long. Blue foam is better for compression loading but weighs more.

The end result is the wing is rock steady on launch with no flutter problems. Each finished wing half weighs 28 oz. ready to fly. Total building time was 96 hours!

The winglets are made removable with two hardwood dowels 1/4" and 1/8" inserted into brass tubing in the wing and winglet. The winglets are toed in 2 degrees as an experiment to see if they improve performance.

On the first test flights I used two tow hooks located one inch below the wing on the side of the fuselage 1.5" forward of the C.G. After several flights I realized one hook on the bottom was all I needed and the Y - yoke bridle was not needed. This allowed other "normal sailplane flyers" to fly on my winch or hi-start.

The first launches were on Sunday, March 18, 1991 with a hi-start into a 25 knot wind! The 5 pound plus wing flew straight up! Both 12 volt winch and hi-start launches have been used. The wing goes up like my Sagitta 2M! At this time, only 12 flights have been flown as C.G. and control throws are still being sorted out.

I am now trying different tips and winglets and tow hook positions. The main goal has been reached as (with apologies to Jack Northrop) "The Wing Will Fly!" I will keep you posted on the flight performance of the Nanosaur.

I will make foam core sets and plans available to anyone interested. Price has not been determined at this time. My address is 3262 Chaparral Way, Lithonia, GA 30038. ■

David L. Jones
1932-1991

I first met Dave in 1947. We were in high school and members of the Coos Modelers of Coos Bay, Oregon. We flew control line, hand launch glider, towline glider, Jetex, rubber, and 1/2A gas. Dave built a model of the Horton IV and began a life long love affair with flying wings.

After a tour of duty in the Air Force, Dave earned a degree from the Northrop Aeronautical Institute and began a career in aerospace in the Los Angles area. He loved to design airplanes and founded Western Plan service, which specialized in RC flying wing designs based on his CJ series of airfoils. Dave was an excellent engineer, and his innovative designs, which include The Little Plank, Raven, and Blackbird, are flown all over the world.

Dave was a past president of the Soaring Union of Los Angles (SULA). He was an active flyer at SULA's Dominguez Hills flying field, usually flying one of his own tailless designs. He was contest director for the flying wing glider event when the Nats were held in Los Angles a few years ago.

Dave Jones recently lost a year long battle with cancer, which he fought with great courage and dignity. Wherever you are flying now, old friend, may the thermals be strong and the wind straight into the slope.

Charles (Skip) Clemans
Bellevue, Washington

Looking at the Chart in the Centerfold?

These are the instructions for initial use from B^2:

(1) Pick your favorite model. Measure its span. Compute its average chord. (For a tapered wing, add the root and tip chord, then divide by 2.) Weigh the sailplane equipped as it will be flown.

(2) Draw a vertical line from the appropriate location on the SPAN axis, then a horizontal line from the point where the drawn vertical line crosses the (AVERAGE) CHORD line. Read the AREA from the axis.

(3) Continue the horizontal line across the right page. Draw a vertical line from the correct location on the WEIGHT axis. The vertical line will cross the drawn horizontal line at the WING LOADING.

Other uses:

- Determine weight required to obtain a desired wing loading.
- Recognize effects of increased span on wing loading.
- Use in conjunction with graphs previously published in *RCSD* to assist in the design process.

Enlarged prints of the Chord vs Speed vs Reynolds Number graph (*RCSD* 5/91), C_L vs Wing Loading vs Velocity graph (*RCSD* 6/91), and this month's compound chart may be obtained from Bill & Bunny Kuhlman, P.O. Box 975, Olalla, WA 98359. Cost is just $1.00, postage paid. ■

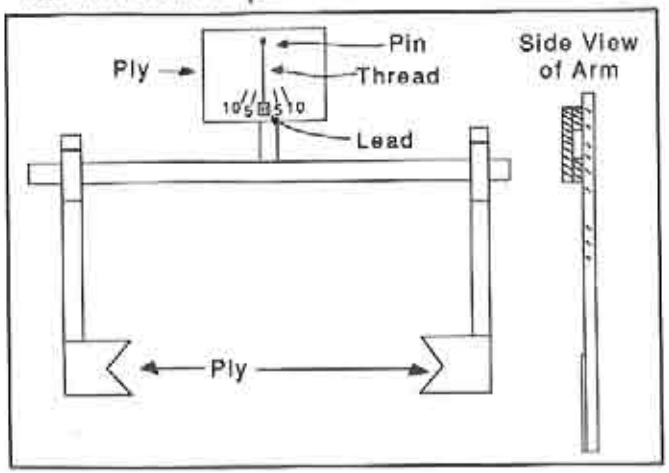
A Low Cost Incidence Meter

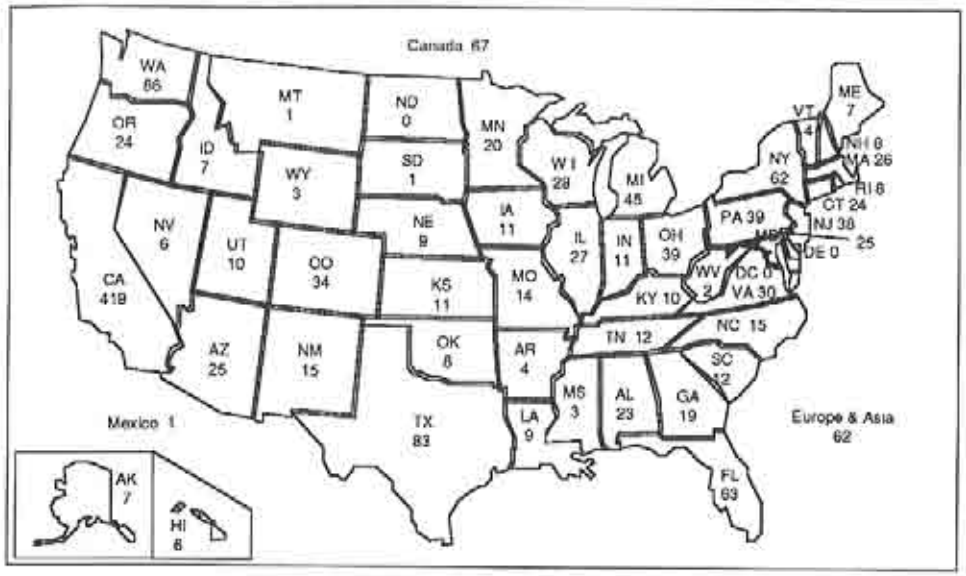
...by Pancho Morris
2715 Eastbrook, Mesquite, Texas 75150

In keeping with my budget theme. Here is an extremely handy tool that is simple to make.

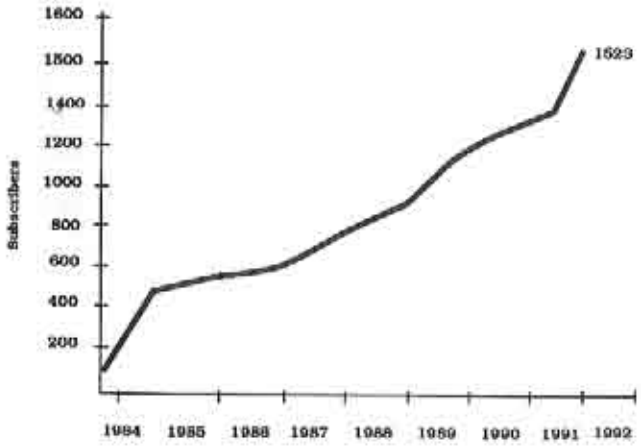
Several years ago, I was building a Craft Air SD 100 Windrifter (one beautiful thermaling machine!). The instructions said to drill holes in the fuselage sides, which were smooth, for the wing alignment and incidence pins. These holes should be drilled so that the wing would have an incidence of 3° with the stabs. How am I going to do that, I wondered? I thought of those nice incidence meters I had seen that were just what I needed, but being short the $25 they cost and it being 11 P.M. at night, I figured I would have to come up with an alternate plan. After some head scratching I thought, "Shoot. I can build one that will work!"

Into the scrap box I went. The drawing should be pretty self-explanatory. Mine is built out of 3/16 X 3/8 basswood and 3 mm lite ply. The vertical arms slide on the horizontal arm by means of the box construction shown. The angle meter consists of a pin stuck into the plywood from which a small piece of lead is hung on a thread. Using a protractor, I marked off 0, 5 and 10 degrees. You could go to 15 degrees if you like.





R/C Soaring Digest Subscribers
(December 1, 1991)



Australia	15
Austria	1
Denmark	2
England	18
Finland	1
Germany	3
Italy	3
Japan	6
New Zealand	3
Pakistan	1
Singapore	1
South Africa	5
Spain	2
Switzerland	1
Total	62
Canada	67
Mexico	1
U.S.A.	1393
Total	1523

Low Cost continued...

Some of my skeptical friends, who buy every tool known to man, have asked me, "Where is the level?" There is no need to know what is level in most cases because you are looking for the relative difference between two surfaces and it does not matter if they are level or not. If not having a level really bothers you, you could attach an inexpensive pocket level to the tool.

Even though this is not a Swiss jeweled movement tool with digital readout to the 100th of a degree, it is very easy to see the difference of a degree of incidence. It has served very well in setting up my sailplanes since it has been built. ■

Flying in Wind and Weather

...By Martin Simons

13 Loch Street, Stepney,
South Australia 5069

Wind variations

The records of any weather station, where the wind meter is usually placed on a mast at some height above ground in a cleared area, show that 'mast height' wind is rarely steady. A typical chart of wind speed measured at mast height looks like the sketch in Figure 2. Increases of wind speed appear as upward pointing spikes on the chart and lulls show as downward spikes. The wind speed varies on either side of an average.

There are about as many lulls as gusts. A very marked lull might bring the wind speed down briefly to zero. To describe the weather as 'gusty' then, does not mean that there is a constantly strengthening wind, but that the flow is irregular, blowing both fast and slow. If each gust were followed by another increase in wind speed, and then another and another, with no intervening lulls, the velocity would reach hurricane force very quickly, which would spoil everyone's day. Of course if a gale or typhoon is coming the mean wind speed may rise quite rapidly, but even then there are lulls and gusts superimposed on the general change, and the same in reverse as the wind abates.

Weather forecasters normally state the mean wind and predict gusts up to some higher velocity. Minimum expected wind speeds are not often mentioned in predictions because damage on the ground or at sea is not done by the calmer spells. For our purposes, however, it can be more dangerous for a flying model to experience a sudden wind drop than to run into a sharp gust. Lulls should be anticipated. If the top gust speed expected is, say, 5 knots faster than the mean, the lulls will probably be about 5 knots below the mean. Such a 10 knot variation, from slowest to highest, is a very severe change in proportion to the flight speed of an ordinary model aeroplane or glider. A 10 knot variation of the wind from peak to trough, negligible to a Boeing 747, would give a noticeable bump to a Piper Cherokee, would be quite serious for a light two metre span sailplane and serious trouble for a small free-flight model.

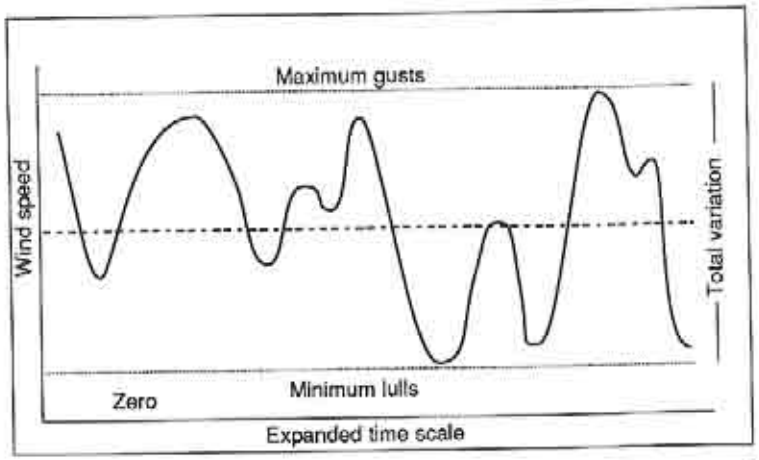


Figure 3 Wind strength with expanded time scale

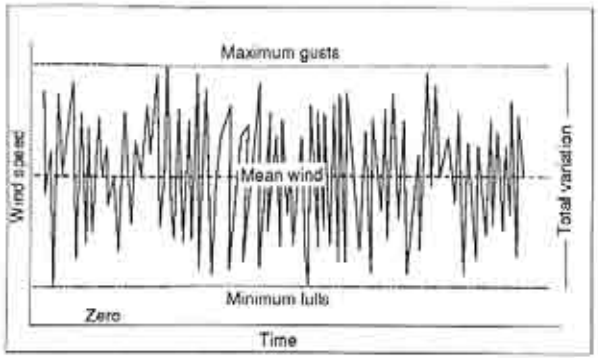


Figure 2 Variation of wind strength

Fortunately, gusts and lulls are never 'sharp edged', although in severe storms they can come dangerously close to it. By 'sharp edged' is meant a change which comes instantaneously, with no warning at all. In a gust, wind speed increases over a certain period, perhaps a few seconds, to a maximum, then dies away in the same fashion, rather than suddenly ceasing. Very probably a lull follows at once. There is some softening of the 'edge'. This is suggested in Fig. 3, which represents a section of the chart of Fig. 2 with the time scale stretched to show more detail. The curving line on the diagram represents wind speed and, as shown, the variations tend to swing up and down around the average, rather than leaping instantly from extreme to extreme.

Wind direction

The same kind of thing happens with wind direction. If the wind is from the west, it may be expected to vary on either side, sometimes swinging towards the north, sometimes towards the south. Over a short time about as many changes will come from one side as the other, the average being westerly. Any approaching general change appears as a shift of the mean but still with swings on either side. Quite often a marked change, caused perhaps by the passage of a 'front', is preceded by a period of calm. The wind gradually dies, then after an interval picks up again from the new direction, very possibly with squalls and storms.

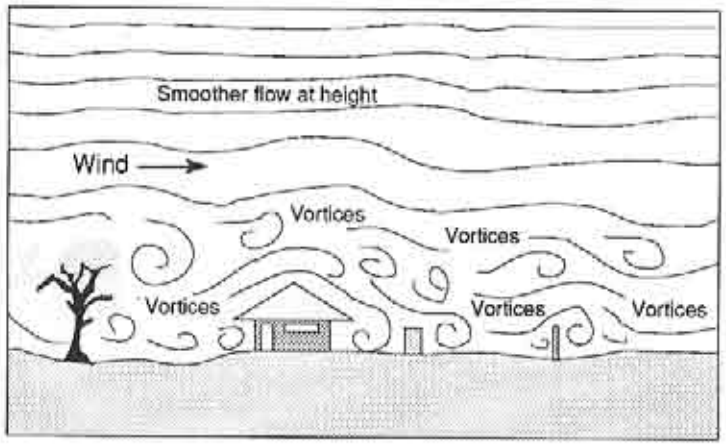


Figure 4 Turbulence caused by obstructions

Vortices

It probably hardly needs saying that when there is any wind, to fly a model in the neighborhood of trees, tall hedges and buildings, is hazardous and not

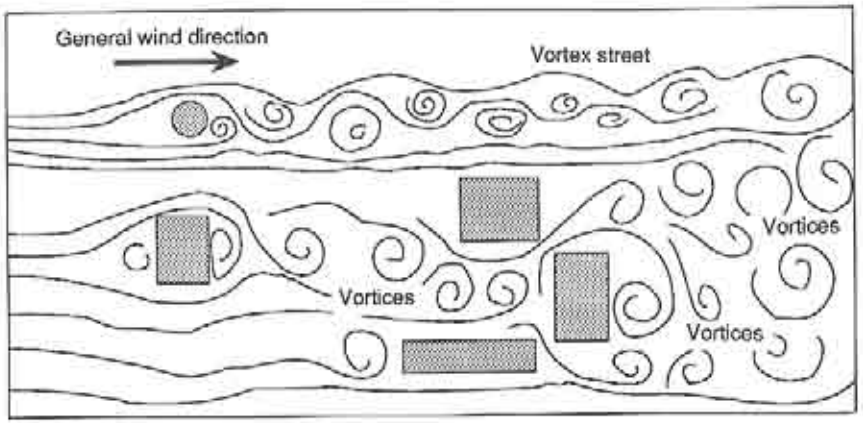


Figure 5 Rough air caused by obstructions: plan view

merely because the model may hit the obstruction. The tree, or whatever it is, will create air turbulence, in the form of vortices or aerial 'whirlpools', which may be severe enough to throw a model out of control (Figure 4). All this arises because we are at the bottom of the river of air. At some height above, the flow is more constant in both speed and direction.

Once an aerial vortex has started it does not die out at once, but moves along with a persistent life of its own, just like the water whirl. It is very common indeed to see such vortices in cities at the corners of buildings, where dust and litter are picked up and spun round. Even when there is no such visible sign, the vortices are there whenever and wherever the wind blows. Downwind of a tall, circular or square tower, there is commonly an entire 'vortex street'. The diagram (Figure 5) is a poor illustration of this, for the vortices are highly mobile and the 'street' can writhe, snakelike, from side to side, up and down.

Thus a single vortex moves along, not following a straight path but tending to swing this way or that as it goes. As it passes any given point, the local current is briefly deflected to and fro, accelerated and decelerated as well. Whether the change comes from one direction or the other, as a gust followed by a lull, or a lull before a gust, depends on where one is at the time it whirls by. On one side of the vortex, it will be felt first as a gust and a lull, associated with a swing in direction, first this way, then that. On the other side of the same whirl, a lull first, then a gust, and changes of direction, that way, then this. If the vortex approaches from directly ahead, the wind will swing rapidly to one side and increase in strength, then die away, then come in from the other side, increase, and die away as the vortex moves on.

Each vortex follows the same rules as the circulation around an atmospheric low pressure area or the more devastating major storm or hurricane. As a hurricane passes directly over a place, the wind rises from one direction, reaches a maximum, then declines as the 'eye', or centre, arrives. Then the wind comes in from the other side, increases, and dies away again. It takes many hours or days for such a system to pass. The same sort of sequence on a small scale may last only a few seconds or minutes as a minor vortex moves through the air where we are flying model sailplanes.

On the large scale, the direction of the atmospheric circulations is determined by the Coriolis force, which arises because of the rotation of the earth. Hurricanes and lows in the northern hemisphere rotate anti-clockwise (viewed from above) and in the southern hemisphere, clockwise. The small vortices set off by a tree, or a chimney, as the diagrams show, may rotate in either direction, so they are much less predictable.

Gusts and wind direction changes, as measured by the standard instruments on a mast, are horizontal. On most days fit for flying models at all there are up and downcurrents and, on average, as many gusts come down as go up. This does not necessarily imply they move at the same speeds. Fortunately, as with the other variations, there is always some softening of the edges. ■

Falcon 880 with own design "Victoria" model at Victoria Park. My winch in background. Photo by Martin Simons, Australia.

Martin with Falcon 880 in Victoria Park September 1st 1991.

Pilgrimage to Wasserkuppe

...by Chuck Lohre
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Finally, I was going to Europe. I had business this past June in Germany and England, but would have a few days for sight seeing.

Upon arrival in Frankfurt, my wife, Janet, and I went to Berlin for two days and then back to our base in Frankfurt. I had planned to visit the Wasserkuppe, one of the world's earliest gliding sites. German sailplane development and construction has always been a part of the area since. The name — Wasserkuppe — comes from the translation, "Water Hill". Sure enough, there were springs at the top, but how the waters flow upwards hundreds of feet is a mystery to me.

Upon requesting information on soaring sites in Germany, Byron Blakeslee, *Model Aviation* Soaring Editor, kindly sent me a copy of his article from 6/88 *MA*, and we easily located it on the map from the description. It was about 60 miles, northeast of Frankfurt in the Rohn area of Germany, sort of like the Appalachian Mountain area around Tennessee.

Originally, we were going to rent a car for the day but that proved expensive because of the three-day minimum rental. After inquiring at the information booth at the Frankfurt Main train station, we were given a schedule for a train ride that would take us to within a 20 minute walk of "The Hill". First, we would take a train to Fulda and then another to Gersfeld. No problem; we had purchased a 5-day rail pass, allowing us unlimited travel.

From Frankfurt to Fulda we rode the new, two-week-old, ICE (Inter City Express) bullet train with seats almost better than a jet plane with closed-circuit TV monitors in first-class cars, definitely designed for a long journey. By comparison, the train from Fulda to Gersfeld was a local, the sort of short route where the train authority "retires" its age-old cars. We traveled from Gersfeld to Fulda Que on a two-car train that felt more like a bus on rails — bench seats and an all-wood paneled interior.

We were traveling on Sunday morning and couldn't help but notice how many young German families from the countryside boarded the train. The dads were strapped with large backpacks because families, as we found out, were Volksmarching. Volsmarching is a German tradition of walking in the country after Sunday church services.

Anyway, Gersfeld was the end of the line. After getting off the train we inquired at a local pub for directions to Wasserkuppe. "Over there behind the church steeple," pointed out a friendly bearded German gentleman,. "About 6 k." I knew we were on the right road when I saw model gliders in and on top of cars. They have some serious cartop carriers over there - sort of like a triple-wide, full-scale glider trailer, great for

their Opals.

We started walking the footpaths along the road, which were pretty well marked. We knew our heading was right as we approached the first sign at a small stream, about 1/3 rd mile from town. It read: "Wasserkuppe", and pointed to the left. The next fork in the road was not so well marked; one read, "Fulda Que", the other to another town I don't remember. We flagged down a passing car who gave us (in German), the right direction — walk toward Fulda Que. They didn't speak any English. So we just pointed to the map. That's when the walk started to get a bit tiring. After all it is up on top of a pretty big hill. I'm still not sure if there actually was a town named Wasserkuppe.

I finally spotted some specks far off in the distance — glider models! We still had about 3 k to go. Janet and I finally made it to the small village of Fulda Que, about 20 houses. In front of one, a parked truck was painted with the words, "Fly the Wasserkuppe", in German; I went up to the office hoping to get a ride, but no one was home. We kept walking up the path until it finally met the road. We were pretty close now about a mile away. We saw a ski lift, but of course it wasn't working in the middle of summer. What looked like a Pawnee-type sailplane towing aircraft was taking off regularly from the center of the hill, which was a huge grassy expanse that must have been at least 3/4 of a mile long. It looked like the plane was giving rides landing and taking off every 20 minutes. Up, up we went to the top of the hill; I could see the different hills the slopers were working the ridge lift. Looked like on either side of the airstrip.

We just walked straight up the hill following the footpaths passing more Germans out for a hike; yes, one older German was wearing lederhosen (leather shorts with suspenders), and looking very official. The road took a much longer route. When we finally got to the top, I was relieved to see that we were at the center of activity with the tie-down area and runway on our right and the hangers, museum and airport buildings on the left. We just wanted to relax a little, it had taken us two hours to walk from Gersfeld.

The Wasserkuppe museum is incredibly historic — all the classics are there — from Otto's hang glider to the Phonix, the first fiberglass plane, built in 1951 under the direction of R. Eppler and N. Nagele by the Stuttgart Academic

Flying Group. One great plane attracting attention was the airframe of a KA 3 (an early V-tailed single seater). I couldn't believe I was in the same room with so much history, planes I've read about over and over and studied three-views and photos for hours.

After we toured the museum we had to consider how to get back to the train stain. The gentleman at the information desk told us there were no buses to Gersfeld, but there was one back to Fulda. If I ever go back to the Wasserkuppe, that's the way I'd go, unless of course you want the scenic walk. The trip to Gersfeld and the walk was a precious experience because we really got to see a little of the rural part of Germany.

After we came out of the museum the whole hill had clouded over; you couldn't see 500'. No matter, next was the gift shops and here's where Janet perked up. I picked up some nice aviation souvenirs, and Janet found a hat for her Dad, at a better price and quality than we were to find anywhere else.

After shopping, we decided to take a rest and figure our how to make the last train of the day to Fulda. After ordering a beer and some hot wine, I heard someone say something in English. "Speak English?" I turned and asked the voice. "Perfect English," the young man replied. He was with two other guys in the Army. They were from: St. Louis, MO, Columbus, OH, and a town in Vermont. Much to Janet's delight I asked after a bit, if they would give us a ride down the hill. We left shortly afterwards, driving though the countryside back to Fulda, their home base, and discussing what the German people were like. Seems they take forever to construct buildings, they had observed. One thing I enjoyed was the German pride in their trains, especially the new ICE bullet train.

After window shopping in Fulda some (nothing is open in Germany on Sunday), we got back on the train to Frankfurt. If you are ever in the area, I'd highly recommend a stop at "The Hill". I could almost see those soaring pioneers gliding down the hill after getting slung shot off. They used horses and curious farmboys to drag the gliders back up. I didn't get to the Wasserkuppe Memorial — a Falcon perched atop a cairn of rocks —, which was quite a distance from the top, I was told, or get a chance to talk with some fellow modelers but you have to save something for the next time. It looked like they were flying standard glass type slope/thermal machines, one with a T-Tail. The ones I saw in a car in Gersfeld were of built-up construction, probably too lightly built for the winds earlier that day. I can't wait to go back and bring a model or go full scale flying.

On our way back home through England, we had some time in Manchester. While Janet shopped, I cruised over to the downtown hobby shop. We got to talking a lot about soaring and my new Magic's (a 138" unlimited composite material sailplane by Frank Weston) construction techniques. The owner mentioned that he's looking for hobby shops in the U.S. to work with on an exchange basis, trading hard to find items, etc. His name is, A.J. Ridyard, Partner, Model Shop Manchester, 209 Deansgate, Manchester M3 3NW, Telephone: 061-834 3972, Fax: 061-831 7459. A.J.'s shop is a full line hobby shop containing every type of model including radio control planes, cars and boats. He also had a Train Department, as well. ■

Composites & Model Gliders (Chemistry & History Matters)

...by Graham Woods
"Merchistoun", Moat Lane, Priestwood, Bucks HP76 9BT, England

Fiber Glass

Surprisingly, the first glass fibers were known to the ancient Egyptians; closer to home though, the first glass fabric was made in 1893 shown at an exhibition in the form of a dress of all things. The industry as we know it started in the late thirties, molten glass being drawn through a spinnarette at high speed. Before winding onto bobbins it is treated with a sizing agent to protect the surface of the glass fiber which also acts as a lubricant when weaving it and also aids the adhesion of the glass to the resin system.

What we commonly know as glass fiber or E-glass was one of the first types of glass fibers to be developed, it gets its name from its original use in Electrical insulation. It is a borosilcate glass (like pyrex) with a low alkali content. Other glasses have been developed since for their electrical, chemical and physical properties; A-glass is an even cheaper type having a high alkali content used for filling (chopped strands and mat, etc.) but less resistant to chemical attack. S-glass is an even stronger glass than E-glass with poorer electrical qualities but better physical qualities. I daresay that there are lots of other types but we generally only meet the E type, and sometimes the S type in hybrid conjunction with other fibers. Glass fiber production didn't really take off though, until the advent of polyester resin in 1942 when it became apparent that light strong moldable plastic shapes could be easily formed.

Today, with the advent of all these new materials, don't get the idea that glass has gone completely out of fashion, it still plays a very important part in the field of composites.

Boron

Boron started life as the first advanced composite material back in 1963 when Avco and United Technologies Corp. in America started production of boron filaments. Since boron does not freely occur in nature it is synthesised from borax or one of its ores.

A fine tungsten wire, resistance heated, is drawn through a reaction tube filled with Boron Trichloride and the tungsten is transformed into tungsten diboride and continues to collect amorphous boron on its surface.

The fiber has three times the tensile strength and five times the compressive strength of steel, but is less dense than aluminium. It is generally used in the form of pre-impregnated UD tape (since its brittleness prevents it from being woven into fabric) and composites made of it have the highest compressive strength of any material available. It is, however, very expensive ($400/pound) compared with graphite.

Since the early seventies it has been used on numerous aircraft: F-14, F-15, Mirage 2000, F-111, UH-60, SH-60, B-1. Either as boron-epoxy tailskins bonded to aluminium honeycomb, or in stringers, helicopter blades and reinforcement parts. It is also used for golf clubs, tennis rackets, etc. (5-10% boron in boron-graphite hybrids).

Graphite Fiber

The earliest use of graphite fiber was a piece of carbonised cotton thread, by Edison, used for the first electric light bulbs but things have come a long way since then except that the principle of manufacture has stayed much the same. Those early graphite fibers weren't much use to anybody and were quickly replaced with wire in light bulbs and interest in such fibers quickly faded until scientists Johnson, Watt and Phillips at the Royal Aircraft Establishment at Farnborough, England in the sixties pro-

duced the first continuous graphite fiber. Early development used specially prepared acrylic precursors of poly (cyanoethane) (not cotton thread), but it wasn't really until the early seventies after they lodged their patent in 1968 that graphite fiber became economically practical with the introduction of commercially available Polyacrylonitrile (PAN) fibers.

Polyacyrlonitrile fiber wound on drums is one of the starting points for the manufacture of continuous graphite fiber; the fiber is drawn through two hot air oxidation ovens with precisely controlled temperatures and then into two more low and high temperature furnaces (up to 1500°C) where the hydrogen and nitrogen atoms are expelled from the fiber and it is pyrolysed to graphite fiber. From here, in this ontinuous process, the graphite fiber is surface treated, sized with epoxy resin (1%) to make it compatible with resin matrices, dried and wound onto spools as tows ready for weaving.

Graphite fiber produced in this way contains 95% amorphous graphite but by heating to higher temperatures (up to 2700°C) the graphite is turned into a crystalline fiber containing 99% graphite. PAN fibers not carbonised, just oxidised, are used in place of asbestos, and are woven and knitted to produce fire-proof garments for motor racing and so on.

Individual fibers at 7um. are much thinner than Aramid at 12um. diameter and tows come in sizes from 1K (1000) to 32k (32000). Different PAN fibers or pitch materials produce different grades of fiber; nowadays designer fibers are available to give high modulus or high strength.

Kevlar

Monsanto and DuPont were the people who started a lot of the research on Polyamides in the ten years between 1955 and 1965, DuPont's Stephanie Kwolek 'discovered' Kevlar in 1965 and DuPont was the first company to set up a production line. As time went by (the mid-seventies) other companies started producing aromatic polyamides under various names: Monsanto called theirs X-500, the Soviet Union called theirs Vnilon and Azco's Twaron.

The precursors for polyamides are partially alkaline, the amide part, and partly acidic, the carboxyl part. I shan't go into the chemistry of it but the polyamides can be either aliphatic in nature (straight chain carbon atoms) or aromatic (carbon atoms in rings of six with the amide and carboxyl groups in either the meta- or para- positions). (For the chemists among you, typical precursors are para-phenylaminediamine and Terephthaloyl-Dichloride.)

The two components are brought together in a solvent for polymerisation, then extracted and dried, dissolved in sulfuric acid, spun, washed and dried. Different precursors produce different properties in the fiber, Kevlar comes in three forms: RI (tire reinforcement), 29 (body armor) and 49 (aerospace).

Most of the fibers we know are of the 'Kevlar 49' type and are aromatic polyamides with a high modulus; the contraction of these words gives us the word 'Aramid'. Aliphatic polyamides such as Rayon, Nylon and Polyester are more 'stretchy' because of the nature of the final structure of the compound, but the aromatic polyamides, based on carbon rings, form a rigid structure (polymer chains coupled with hydrogen bonds) to give an almost 100% crystalline structure, and hence a strong, resilient fiber.

Nomex

Sandwich construction, ie. a low density core bonded to strong thin skins, dates back to the 1940's and nowadays Nomex in a sandwich is making a real impression in the airline market.

If ever you wondered where all the quality Balsa went to since 1974, not finding it in the shops, I can tell you that a lot of it ended up in the floor panels of Boeing 747's! It was an ideal material, light, strong end grain balsa bonded to aluminium sheets, however pressure on costs meant that airlines were looking for weight/fuel/money savings and the use of Nomex in floor panels in place of balsa meant a saving of up to 400kg (800+lb.) per 747 or a couple of extra passengers.

We're not exactly in the airline business but we too can make weight savings if we use it in the sandwich construction technique in the moulding of wings and fuselages.

Nomex paper is made by DuPont but the actual honeycomb is made by Ciba-Geigy at Duxford, England. The paper is made of tiny fibers called floc and fibrids of meta-aramid, similar though not exactly the same as Kevlar, and is flame resistant. Layers of Nomex paper are 'lined' with resin and stacked on top of one another and then cured. The paper is then expanded to produce the honeycomb and then this honeycomb is dipped in more resin and heat cured to make the finished product. In aircraft floor panels, cross-plies of UD glass are bonded to either side.

For us modellers it is a replacement for Rohacell polyimide foam sandwiched between glass skins for wings and is relatively new on the scene, for those balsa users it must be good news as more quality balsa appears on the shelves!

Spectra and Dyneema

In 1979 a Dutch company, DSM, invented and patented a gel spinning process, its first product was high performance polyethylene fiber (HP-PE). Subsequent development led to a new polythene fiber, Dyneema SK60. Allied-Signal in Petersburg, VA took out a license and started to produce its own fiber which they called Spectra which was first released in 1985, both have similar properties.

As with graphite and Kevlar the aim is to produce a fiber with a high degree of orientation of the molecules, referred to as crystallinity, and these fibers have a crystallinity of up to 85%.

In the process, as I understand it, ultra-high molecular weight polyethylene is dissolved in a solvent, then spun through a spinnerette to make thin gel like filaments in a quenching bath. The fiber is then drawn from the bath and as this process goes on, the molecules align themselves in parallel (up to 95%) orientation. In this last stage lies the secret of the process and this lining up of the molecules gives the fiber its properties.

The fibers have many properties which are suited to individual needs, lightness is its main attraction to us, with a specific gravity of $0.97 g.cm^{-3}$ it is the lightest fiber available.

This lightness in conjunction with its strength makes it the strongest fiber on a weight/strength (Tex) basis; 35% stronger than aramid and 100% stronger than graphite. Being polythene it has the simplest structure and the raw materials are cheap. Polythene is also extremely resistant to chemical attack (more so than aramid) and is suitable for use in many chemical environments: hoses, etc. It is a very flexible fiber and can be woven and knitted easily, I doubt that its impact has been fully realised as yet.

From our point of view, its use in composites had one large problem in that resin matrices don't adhere to its surface (ever tried gluing polythene?) but this drawback has largely been overcome by plasma treating the fiber.

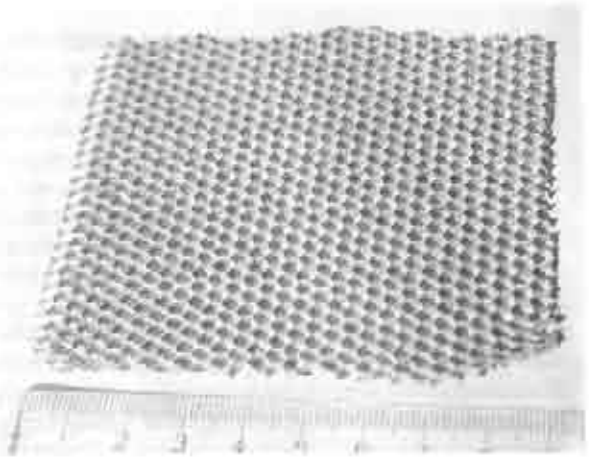
The fiber/fabric is pulled between electrodes in a reaction chamber filled with low pressure gas excited by RF radiation. The electrons, ions and free radicals produced in the chamber modify the surface of the fibers both physically and chemically and make for better adhesion to resin matrices; there is also an increase in tensile strength of the fibers. It is currently used by some modellers, Jerry and me, and sometimes in skis,

fishing rods, body armor, crash helmets and kite strings!

Quartz Fibers

Quartz fibers have been around for more than 25 years now but have largely been devoted to sophisticated military uses owing to their high temperature capability and negligible thermal expansion.

The fibers (7-14um. thick) are made directly from naturally occuring quartz crystals from Brazil and the USA and unlike some silica fibers are 99.99% pure silicon dioxide with maximum crystallinity. The yarn is as strong as high strength graphite but can be used within high temperature environments, in conjunction with special phenolic and epoxy resins, where aramid, graphite and glass cannot be used effectively. It can be found as rovings, woven cloth, chopped strands, etc. as with other fibers, but its temperature stability means that it has found use as an ablative material (surface layers can be stripped off by decomposition and sublimation) for rocket motors, launch tubes, nose cones for high mach missiles, etc. In the domestic market it has some uses in tennis rackets and fishing rods but its use is not very well known.



Nomex Honeycomb

Alumina fibers have similar uses but these two are not for us unless you have a glider that does Mach 3, that is. ■

New Electric Products? Maybe?

...by Ed Slegers
Route 15, Wharton, New Jersey 07885

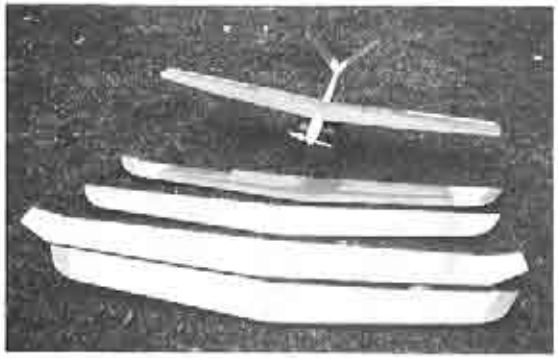
Why, maybe? Without you the reader and consumer letting the manufacturer or designer know what you want, it is doubtful that they would get past the prototype stages.

Mark Allen of Flite Lite Composites sent me two prototypes of an electric powered sailplane he is developing. If you like what you read and see in the pictures, let Mark know. With enough positive response I'm sure he will go into full production and some really fine airplanes will not wind up on a shelf as another unfinished prototype.

As most of you know, Flite Lite makes the well proven line of Falcons and Eagles. The electric planes have the same fine quality. They are not conversions, but planes designed from the ground up just for electric power. I can definitely tell you that a lot of time, energy and money was spent getting everything to work properly, as you can see by the five different airfoils in the picture.

Mark and I have been talking about an electric airplane for a long time but, because of his backlog trying to fill all the orders for Falcons, he could never quite find the time to get the electric done. I finally talked Mark into sending me the prototype to finish. As it turned out, most of the work was done. As usual, the workmanship was excellent. Most of my time was spent making the other four wings and trying them to see what airfoil was the best.

The first electric plane is a seven cell thermal duration plane. Because of it being a prototype and, for marketing reasons, I can not give you all the specs. What I can tell you is that the plane has an 80 inch wingspan, flying weight of about 38 ozs., and obechi covered white foam wings that are clear lacquered the same as the stabs. There are two servos in the wing and one in the tail to operate the elevator. This leaves lots of room in the fuselage for the batteries. The batteries can be installed and removed without having to remove the wing. The fuselage is fiberglass reinforced with kevlar. The best part is that it flies great. Really, great!



The second prototype is a 60 inch electric sport plane. Weight on mine was 28 ozs. with an .05 on six cells. This one also has an obechi covered wing and V tail that is clear lacquered. The fuselage is also fiberglass. In both prototypes the fuselage is smaller then the production models. The seven cell may have the option of a polyhedral and the sport plane may have the option of different airfoils.

I can definitely tell you that both planes are excellent flyers and the workmanship is excellent. These are planes designed solely for electric power by a designer with a record that speaks for itself. If this is the type of electric plane you have been waiting for call Flight Lite at 1-707-792-9174 and talk to Mark about getting one on order.

WACO 10-550

Another new product comes from Weston Aerodesign. Weston has a new plane called the 10-550 in his line of planes. This is a 10 cell 550 Sq inch plane for an FAI .O15. This is a very fast plane that was designed for the 10 cell F3E class. I've had lots of fun using this plane as a sport model using a FAI .O5 on 7 cell. The 10-550 is a little smaller then the 7-570 so it does not thermal quite as well but does fly much faster. What I like very much is the fuselage. The fuselage is larger then the 7 cell so that battery removal is much easier.

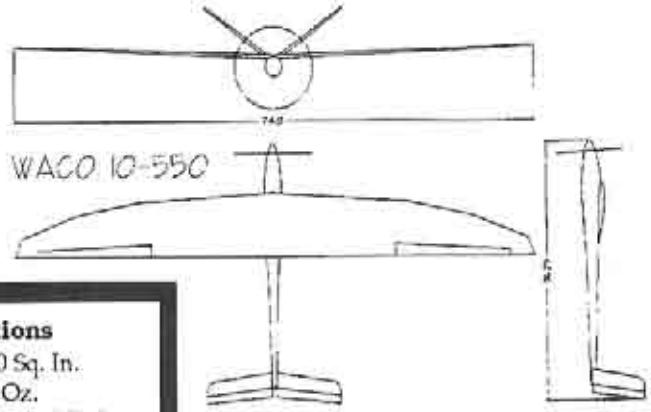
For the flyer that does not want to burn holes in the sky, Frank is thinking about making a polyhedral wing that would fit both the 10-550 and the 7-570. I think this would be a great way to go. Again, if this is what you want, call Frank Weston at 1-301-974-0968.

Model Construction Videos "Launching Equipment and Techniques"

"Launching Equipment and Techniques" is a new video tape brought to you by D.O. Darnell. This tape covers everything from hand launching to an F3B zoom launch. Tow hooks, winches, retrievers, hi-starts, hand launch and more is shown. Although most experienced

glider pilots have had to try at least one of these techniques it is still fun to see other flyers trying different forms of launching. This would also make a great addition to a club video library for the beginners to see what is needed to launch a sailplane. It would also be nice for a hobby shop to show to customers who are getting started in sailplanes. Just to watch NATS winner Brian Agnew hand launch his Vertigo or to see a Muller Comet do a zoom launch off an F3B winch is worth getting the tape. M.C.V. 4227 E 83rd St., Tulsa, Ok. 74137; (918) 481-5855

Good Flying!



Specifications

Wing Area	550 Sq. In.
RTF Weight	42 Oz.
Motor	Astro 15 FAI
Battery	10 900 SCR

Designed for 10 cell F3E competition.

The Sport Flier

...by Greg Vasgerdsian
Concord, California

(Once upon a time, in R/C Soaring Land...there was a purely fictional character who loved to fly for fun. His name was Doc and he was always asking himself questions... ED.)

As the rain tapped on the window, Doc was busy in his workshop. He was putting together a new hand launch glider and had decided to try out the E214 airfoil on it. His cat, Scooter, slept curled up by the heater, while the dust covered, 12" television played a Star Trek marathon which had started first thing in the morning and promised to continue throughout the day.

Winter was here and Doc welcomed the change. A little more time to build, and no lawn to mow after work. It's too dark! Being in the West, he still had plenty of flying days, but he was glad to see the flying season slow down.

Doc did a lot of thinking when he built his models. Of course, he had to pay attention to the task at hand, but most of the time his thoughts were elsewhere. "Good therapy" he thought, knowing it was just a way to escape from the outside world.

Buzz had stopped by earlier to show him his latest creation, a 50" fluorescent yellow and hot pink slope model that, as Buzz stated exuberantly, "Smokes." He always welcomed talking with Buzz; the guy seemed to have a different outlook on things. Buzz was a pretty hot contest pilot, too. He lived for thermal contests, which was something Doc had grown weary of.

A sport flier, Doc flew anything that soared (slope, thermal, electric, etc.). He loved building as much as flying. As he stacked up a set of rib blanks to shape, he smiled thinking of last June when he hooked a thermal from 10 feet. That one flight was magical, really bringing home the enjoyment he got from soaring. Then, he laughed out loud remembering how he over-rolled the rotor and squared off with a boulder. Of course, it wasn't funny at the time.

The rib stack was bolted together, now, and Doc proceeded to rough carve the ribs to shape, taking a pause to put down a few Oreo cookies. He gazed across the room at his half-finished scale Slingsby Skylark. "Got to have it ready by February," he thought, and get some good flying in with it before heading up to Soaring Land's annual Fun Fly. Doc thought about how he was willing to travel through numerous states just to go to a big Fun Fly, but he never showed up at the many thermal contests around his area.

More often than once, he'd get the question from someone from the flying field, "Heh, Doc, why don't you show up at the next contest? They're a lot of fun." At one time he really took to contests, but it quickly fell away. He did love the socializing and seeing what people were flying, but flying a 3 minute flight and landing on a dime wasn't really his cup of tea.

Doc picked up his sanding block, put some fresh 80 grit on it and began final sanding of the ribs. Was he just burnt out, he wondered. He didn't think so. After all, he was burning a cloud of balsa dust up at the very moment. No, Doc just felt out of it.

He stopped to watch T.V.'s Captain Kirk make his usual moves on another unwary Space Princess. Contests were great for those with the competitive spirit, but Doc knew so many fliers that either didn't like to compete, or did so knowing that their flying skills just weren't going to place them above the top 20. Doc wondered why there weren't more fun fly soaring events...slope, thermal, or whatever. Why was the emphasis in organized soaring mostly on competition? Doc laughed remembering last spring's thermal contest where the top four finishers flew 15 year old designs.

Doc eyed his new set of ribs. "This should be a fine flier," he thought. The phone rang. "Heh, Doc, this is Buzz."

"Yeah, Buzz?"

"Next weekend we're getting together a handful of fliers to go up to the meadow and do some flying, if the weather shapes up. What do ya say? You in?"

"Sounds good! I'll give you a call on Friday, Buzz!"

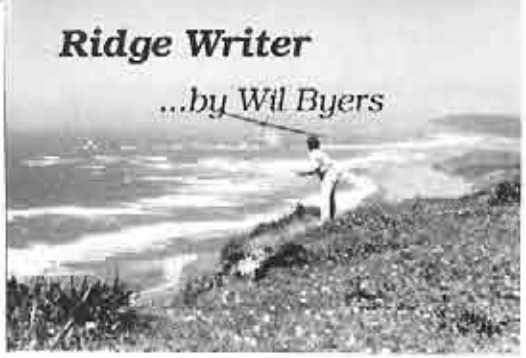
"Okay, bye!"

A nice walk, some good flying with friends. This was Doc's type of fun. Now, which plane would he plan on flying....? ■

Martin Vels with Garry Jordan's "Kestrel". Photo by Bruce Abell. Taken at Armidale Sailplane Expo., Australia, 1991.

Ridge Writer

...by Wil Byers



RT. 4 Box 9544, W. Richland, Washington 99352; (509) 627-5224 (7:00 PM - 10:00 PM weekdays, after 9:00 AM weekends)

HAPPY NEW YEAR!!

I hope 1992 is as good to you as 1991 has been to me, my family, and my model aviation.

Hey, is it cold where you live? If it is, you can probably understand the kind of weather that we have to deal with here in the Northwest from time to time. Sometimes it gets so cold here that the radio frequency coming out of our transmitters freezes. Then the model we are flying is stuck in mid-air until the temperature rises sufficiently to thaw out the radio waves. RRReeeaaalllllyyyyyy!!!!! After all, would an old Scout tell you a falsehood?

Well, anyway if you live in an area where the temperature sometimes dips a bit lower than you would like, you just might be interested in an idea passed my way by another **cold** modeler. The idea is one that will assist you in doing a quality job of vacuum bagging wing cores, elevator cores, or even molding parts.

This concept comes via a fairly new modeler who could see a simple need and had an idea to address that deficiency. His name is Ted Stroben, a Tri-City Soarers club member. Ted was watching some vacuum bagging, one happy modelling day, and realized that in order to do a good job one must heat their work space properly. He also saw that, if your work space is large and hard to heat, it can mean you will have an unnecessarily high cost associated with exciting the air molecules in that space sufficiently to obtain that nice warm working environment. Thus, he knew any means of heating the area inexpensively is welcomed by those who have difficulty parting with their hard earned money.

So, if you have bagged wings in the past, you will know how important this concept is. If you haven't built wings in this fashion, you should know that temperature plays a big part in getting good results. It plays an important part because the viscosity of epoxy decreases with an increasing temperature. In other words it has an inverse relationship with temperature. Therefore, if the working area temperature is suitable it will allow the epoxy to flow better and work easier. I.E., when the epoxy is being worked into the cloth with a squeegee it will penetrate the fabric better. And, when it is curing it will be sucked out of spaces where it need not be. Temperature, therefore, plays a very important part in obtaining well bonded vacuum bagged wings.

Well, Ted said, "What a modeler needs is simply an old electric blanket." Wow, this was fantastic! All one needs to do is locate your local St. Vincent DePaul, Good Will, or second hand store and then a composite modeler could make some old electric blanket happy by taking it home. The blanket can usually be bought for around $5.00. Five dollars that can easily be saved by reducing the number of kilowatt hours that turn the electric meter.

Now, all that is required of the main heating system is to warm the work-space while the glass is being impregnated with epoxy and laminated to the Mylar transfer sheets. Then the glass and transfer sheets are applied to the foam core and all of it is placed in the bag. The vacuum is then applied to the bag and any leaks found and plugged. After that process is complete the electric blanket is placed over the work area and wing. The temperature is set to your desire (approximately 80 degrees) and then it is left to cure for 12 to 20 hours. Thus, the main heating source can be reduced and only the area that needs to be warm is heated.

The system works great and it is certainly inexpensive to operate. You may even wish to wrap the blanket entirely around the work bench if possible. Or it might be that your application requires more than one blanket. At any rate, if you can improve on the idea or have a better one I believe a number of composite builders would have an interest in your design.

National Soaring Museum (NSM)

If you are involved in scale models or in full size soaring, you may have an interest in the National Soaring Museum (NSM). You may be interested because the NSM is a facility about "historical soaring activities, renovation of old sailplanes, soaring pioneers, unusual uses of sailplanes" and all aspects of soaring since the first flights of Otto Lillienthal. It most assuredly is an outstanding source of materials for any scale project one might want to undertake.

Also, in a conversation on the phone with Paul Schweizer recently he expressed a desire to have some model enthusiasts participate in supplying scale models to the NSM. The museum wants models for the Evolution of Gliders and Sailplanes Exhibit that they are assembling. These models are to be 1:24 scale for U.S. designed aircraft, while the European replicas are in 1:25 scale because most European ships are built using the metric system of measurement. The idea behind the exhibit, of course, is to show how gliding and soaring has evolved over the past hundred years or so. When the exhibit is completed it will contain 80 of what the museum considers the "most significant" and popular American built gliders and sailplanes. Additionally, the exhibit will have 40 European designs on display. (You don't suppose any of the designs were ever built for slope soaring, do you?)

The fun part for those of you who decide to involve yourself in this project is that you will live on into eternity. That's right, as you will be recognized by the museum and they will have a plaque not only describing the design, but it will also name the builder of the model. Hey, this is a pretty neat idea and certainly an excellent way to demonstrate how committed the modelling community is to aviation in general. And, especially how dedicated we are to soaring in particular. If you are interested, please write or call the National Soaring Museum, RD#3 Harris Hill, Elmira, N.Y. 14903. Their telephone number is 1-607-734-3128.

Slope Scene

The Gentle Lady being flown by Skip Johnson is just a good shot of how it feels to be out on the slope looking up at your model floating by. The evening this shot was taken the lift was very gently rising off the valley floor and it was quite smooth. This is what ***RELAXATION*** flying is all about!

The picture of the Multiplex DG-600 shows how realistic a scale model can appear as it cruises past the front of the hill. One of the things about slope soaring, that can't usually be performed by a thermal pilot, is flying the model below the pilot. This may not seem like much,

Multiplex DG-300 all glass ship waits to be flown.

Lynsel Miller's very nicely done TG-3.

The next three pictures come from of Greg Neveu of Yakima, WA. Greg took these pictures at the 1990 International Scale Fun Fly.

The first photo is of a DG-300 all glass model. It is a kit available from Bob Boomer of Beemer R/C West. This model uses a Wortman FX-60-126 airfoil and is a very nice flying ship. It has a wide speed range and is capable of flying in 35 MPH plus winds. It is also quite able to thermal soar when the ridge lift lightens up or the winch is the only alternative.

Rick Szabo's Glassflugel ASW-22 during the 1990 International Scale Fun Fly.

but it does lend an extra touch of realistic enjoyment to flying a scale ship, because it tends to give the illusion that you are flying in another aircraft looking down on the glider or sailplane below. By the way the DG-600 is an excellent kit. It is also a superb flying 1/5 scale model. It uses a Ritz airfoil and therefore thermals well. The Ritz section also lets the model do nice aerobatics. One feature of this ship that is quite nice is the plug on wing tips, which allows the sailplane to vary its wing loading, span, and change the wings aspect ratio. Thus, the ship has a great deal more versatility in varying wind conditions. The DG-600 is available from Beemer R/C West.

Another entertaining photo is of Pat Chewning's Swift 800. This is a Flite Lite kit by Mark Allen. The model as you can see employs V-tail, flaps, and ailerons for control. It is a good slope soarer because it has quite good penetration, a good roll rate, and the flaps can be used to slow it down. If you notice in this picture Pat is using some Crow to provide glide path control. There is a point I would like to make about this model and how it was finished. Pat had painted the model's wing tips with a fluorescent orange paint. This added color to the wing tips, made the model extremely easy to see and to identify which way the model was turning. If you need some extra visibility on your model you might want to try painting you wings with a fluorescent paint.

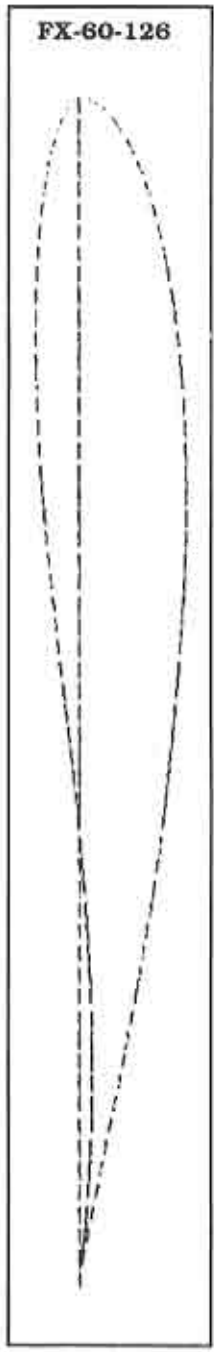
Next is a picture that demonstrates what aspect ratio is all about. This is a picture of Rick Szabo's ASW-22 from Windspiel models. The model is built by Fiberglass Flugel of Germany. The airfoil utilized on this skinny winged beauty is a Quabeck 3.0-13 section. Mr. Michael Selig noted when he saw the model fly, that it had a most realistic flight performance and that the wings flexed very scale like.

The final photo is of Lynsel Miller's TG-3. I can't tell you much about the model other than it appears to be of built-up construction. I can tell you that it was detailed very nicely and that he can apparently winch launch the model as well as fly it from the slope.

Pat Chewning's Swift on landing approach at a private site in the Columbia Gorge. Note the crow setting with flaps down and ailerons up!

A second shot of the DG-600. This time the tip extensions are installed.

A late evening shot of Skip Johnson's Gentle Lady cruising in very light lift.



Airfoil of the Month

This airfoil may not be well known by many flyers, but it certainly deserves to. It is a very good all around choice for a model that is either scale or non scale. It has an extremely good speed range and it probably could accommodate flaps and thereby provide for slow landing speeds. The FX-60-126 has proved itself capable to perform on large scale ships such as the DG-300 giving them the ability to climb out on the weakest of lift and yet penetrate into the wind when needed. Give it a try or consider it when looking at a new model that employs it.

Have a great 1992! Please send information and pictures if you have something you want to share. Your ideas or thoughts may help someone else accelerate their learning curve in the hobby. ■

Crescent Wings: Planform of the 90's?

by Norman Anderson, Albuquerque, New Mexico

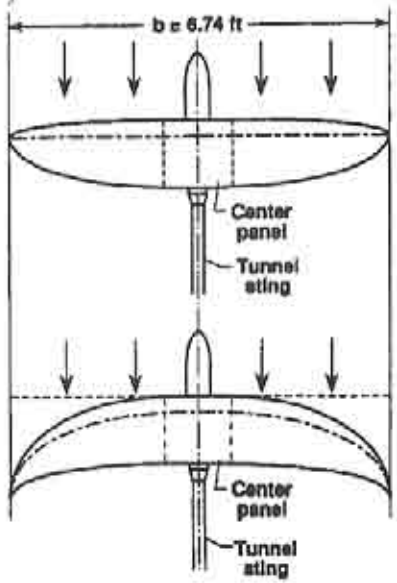
In 1989 NASA published the results of a study on the aerodynamic performance of crescent planform wings (NASA report #89-2240-CP). The study was actually two reports, one investigating the effects of the crescent planform on drag, the second further exploring aerodynamic characteristics at high angles of attack. The first report identified very small improvements on overall efficiency, but then admits that the improvements were within the measurement error of the experiment. The second report explored the lift, drag, pitching moment and yaw stability of the crescent planform at high angles of attack. The findings were quite interesting.

All measurements were made with both the crescent planform and an elliptical planform. The wings were 6.74 feet in span, 6.47 ft^2 in area, aspect ratio of 7, used a NACA 0012 airfoil and were operated at a Reynolds number of 1.8 million. No twist (washout or washin) or dihedral was built into the wings. Referring to the figure marked "Figure 5b", the crescent wing showed slightly lower lift than the elliptical wing, but continued to lift until 1.5 degrees after the elliptic wing stalled. Further, the report states that "The post-stall behavior of the crescent wing was steady and benign; however, the elliptic wing displayed a much more abrupt and unsteady stall behavior." For the R.C. sailplane pilot, this means a greater margin before stall and much gentler recovery after the stall, a small price to pay for the minuscule reduction in lift coefficient.

Pitching moment was found to be linear and stable (see Figure 6). For the R.C. pilot, this means that a larger tail will be necessary to attain the high angles of attack at which that this planform works best. The report also states that the crescent planform "... displayed increased lateral stability as compared to the elliptic..."

As for yaw, the report notes that both planforms became positively stable at high angles of attack, and states, "The crescent wing configuration, especially, displayed a very stable behavior for small deviations in sideslip angle at this condition." Once again, this bodes well for the R.C. pilot, since these conditions mean that the wing should tend to drop straight from a stall, and not tend to fall off on a wing.

All in all, the crescent planform seems to have a lot going for it in the area of handling and high angle of attack performance. It does have one drawback, however: producability. I have a proposal that, as most things in life, strikes a compromise. If you were to draw a line that makes the trailing edge of the crescent wing straight, you have a planform highly reminiscent of the Scheumann planform. Many modern R.C. sailplanes already use an approximated Scheumann planform, so all that is needed is to modify those to produce a modified crescent. I propose that many of the benefits of the crescent planform can be realized by simply sweeping the trailing edge of the outer panels of the modified Scheumann wing. Who will be the first to try? ■



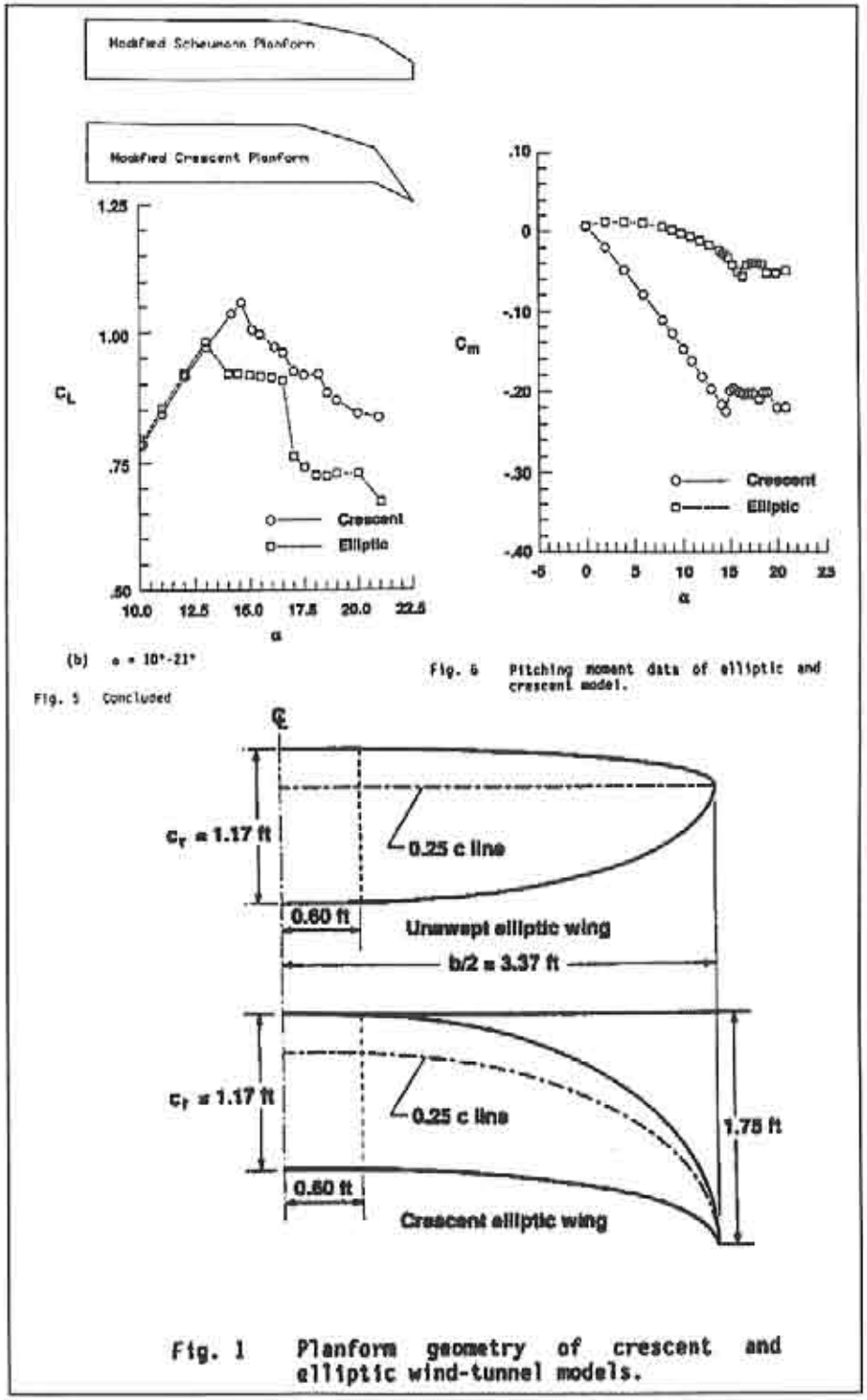
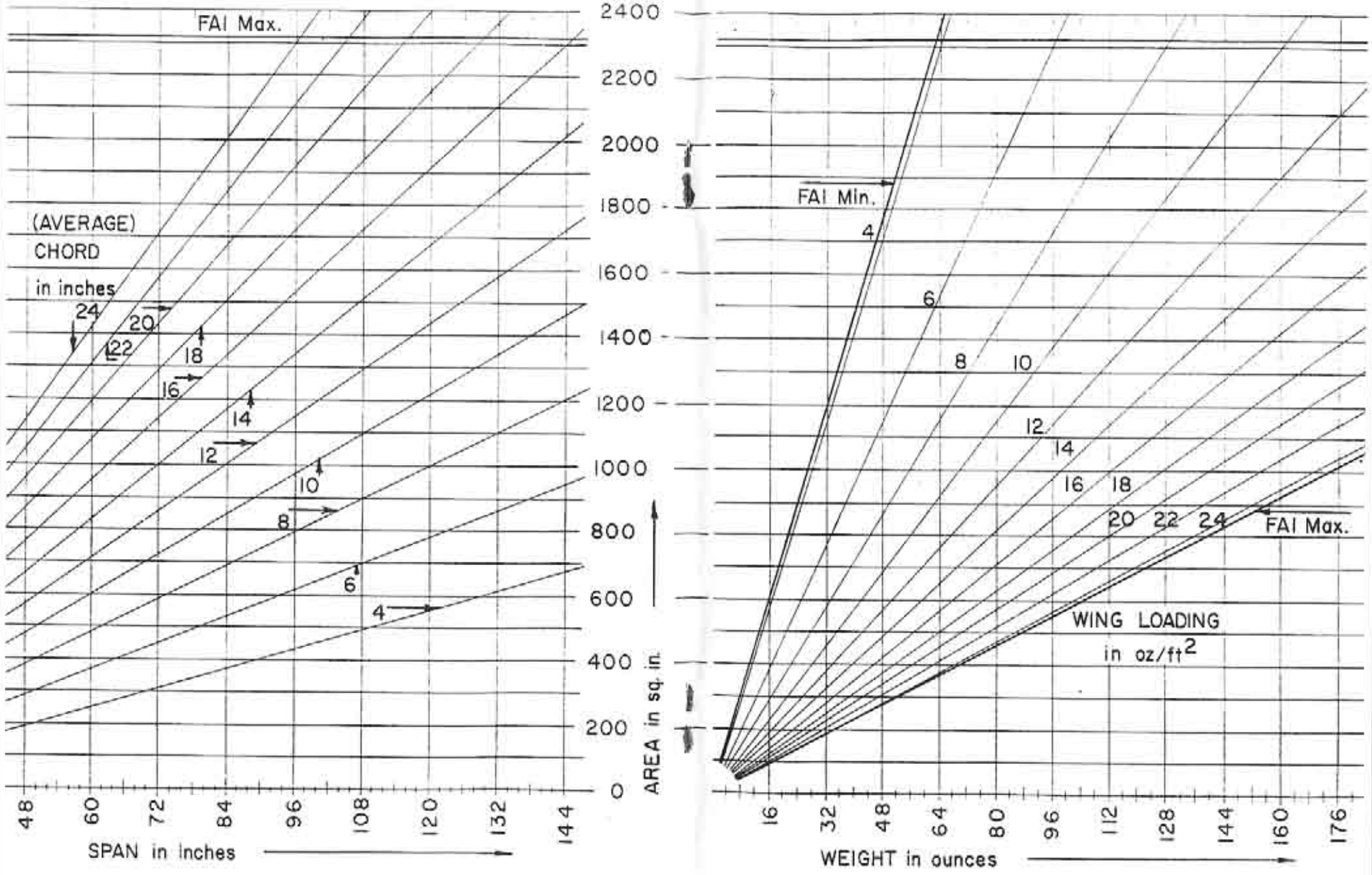
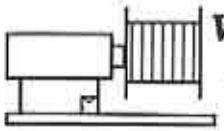


Fig. 1 Planform geometry of crescent and elliptic wind-tunnel models.

Instructions for the use of this chart are in "On the Wing..."





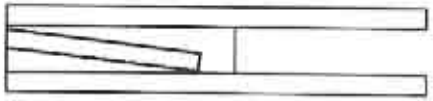
Winch Line
...by Gordon Jones

Gordon Jones, 214 Sunflower Drive, Garland, Texas 75041; (214) 840-8116

Foam Wing Construction - Part 3

At this point it is time to start cutting those nice pretty foam cores. We have to install the spar assembly and, if necessary, lay in servo wires or spoiler cable tubes. Let's start with the spar as this is the most work, and they should be installed first to provide support for the cores.

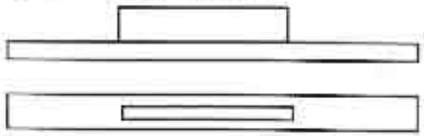
There are several ways to install the spar assemblies in a foam core wing. First, for the spar assembly with the spruce cap (whether it be with balsa or foam filler), measure the depth of the core at the root of the cores. This will determine the height of the wing rod box and spar assembly. Now, draw a mini-plan of the spar assembly to scale; somewhat like the picture below to use while constructing the spar assembly.



Prior to building the spar assembly, measure the length of the spruce cap strips on the wing; i.e., how far out on the wing will the cap strips run? Decide what dihedral angle you will use based on whether the wing is straight or polyhedral. The dihedral angle will determine the length of the carry through tube, and in most cases how long the wing rod box will be. If you are going to use a balsa filler the wing rod box doesn't have to be that long as the balsa filler will extend the wing rod box out into the wing. If you are going to let the foam core be the filler, it is advisable to extend the wing rod box out to provide additional support for launching. Be sure to add some 1/32 inch plywood to the front and rear of the wing rod box running out about 12 inches front and rear for additional support and strength.

Once the spar assemblies are built, measure the width of the spar assembly and mark the length of the wing rod box plus the balsa filler, if you are using that method, on the foam cores. When you mark the cores be sure to move the spar over on top of the first line you mark to get a reference line that is accurate prior to marking the second line. This way you will have a cut that is the same size or a little bit smaller than required. Carefully cut out the core so that the wing rod box fits snugly into the cavity. You can trial fit the spar assembly by turning the whole thing around and fitting it in the cavity backwards. (We haven't made arrangements for the spars themselves, yet.) If any additional cutting or sanding is needed modify the cores as required to obtain a good tight fit.

Next, sand or cut the troughs for the spruce spar caps along the line on the cores. Two easy methods are: one, use a Dremel Moto Tool with a router bit/attachment and a fence. Set the router bit to the depth of the spar and rout out the spar cavity along the line on the cores using a fence to maintain a straight line. Or, you can make a small sanding block from some hardwood to do the job. If you use the sanding block, make sure you allow for the thickness of the sandpaper so you obtain a good tight fit. We want to do as little filling as possible, so take your time. The illustration below depicts the sanding block.



Again trial fit the entire spar assembly into the cores to check for fit. Be sure that the spar is flush with the top of the cores, or even a little below the top of the cores. It is easier to do a little filling on the top rather than having to sand off the excess. Once you are satisfied with the fit of the spar assembly make one final check for alignment of the wing rod by temporarily installing both spar assemblies in the cores and then installing the wing rod between the two cores. The wing rod boxes should line up, and the leading and trailing edges should also line up. If there is a problem, now is the time to correct any mis-alignment rather than after the sheeting is on the cores.

Place a piece of either scotch tape or masking tape over the carry through tube hole so that you don't get any adhesive in the tube prior to gluing in the spar assembly. When you are satisfied with the alignment of the spar assembly and the cores, glue in the spar assembly. This may be accomplished using epoxy, white glue or even 3M 77 contact adhesive. Don't be too concerned about filling the cavity as the excess resin from the sheeting process will fill in any small gaps that may remain. If your fit is not that good try to fill the excess gaps being sure that you don't have any filling agent above the top of the cores.

The next step is to lay out any troughs for spoiler control tubes or servo wires. Lay out the route of the spoiler tubes or servo wires and mark them on the cores. Be sure to align the exits so that they come out at the roots at approximately the same location. This will make working with the fuselage easier when you make the exit holes.

There are several ways to make the spoiler and wire troughs; it depends on what you will use for the tubes. One way to put in the servo wires is to make a cut along the path of the wires with a hacksaw blade. Break an old hacksaw blade off with enough of the blade to make a handle and cover the handle with tape so you don't rip up your hand while making the cuts. Then, with a pulling motion, make a cut along the pre-marked path of the wires approximately 3/8 inch deep. Here you are making a groove that the wire will fit into for a permanent installation of the wires. When you have completed the groove, trial fit the wire so that it fits down in the groove and make any additional cuts as necessary for a good fit. Be sure that you have a small coil of wire at the servo location for soldering and leave about 6 inches or so at the root. Once you have installed the wire to your satisfaction fill any big gaps with spackling compound. Be sure to mark the location of the wire ends on your wing core map so that you will know where the ends are located once the wing is sheeted.

For a non-permanent servo wire installation you can use soda straws, outer Nyrod tubing, or you can make a trough and cover it with balsa flush with the core. The option depends on what you are comfortable with. I have used all of these methods and they work equally as well. For this type of installation, make a cut along the servo wire line with a Dremel Tool set approximately 1/32 deeper than the material that will go in the troughs; or, if you are going to just cover the trough with balsa, make the cuts the depth of the wire plus the thickness of the balsa covers. Again, you can make a sanding block to the dimensions of the material you will use. Try to make your troughs straight by using a fence as you did for the spars. Once the troughs are completed, trial fit the soda straws/Nyrod or whatever you use and make sure that this material is below the core. If you are using a balsa cap, cut out the balsa caps and trial fit them with the wire in place. Be sure that you can get the servo wire through the tubes prior to final installation. Once you are satisfied with the fit, use some light spackling compound to fill the voids between the material and the cores, and to hold the tubes in place..

Another option for installation of servo wires is to wait until you have sheeted

the wing, and use an aluminum arrow shaft as a drill and drill out a hole in the cores for the wires to run through. This is accomplished after the servo cavities have been cut out. I will describe this method in detail after we sheet the cores.

The spoiler tube that you decide upon will determine the type of trough that will be required for the tubes. Several options here are: Nyrod, soda straws, and the plastic tubes that come in some of the kits. One important point here is to make your troughs deep enough so that the tubes are below the surface of the cores. If I am making spoiler troughs I generally use a Dremel Tool with a router attachment and a 1/8 inch drill bit or a router bit of the appropriate size for your tubes to make the troughs. With the drill bit set at the right depth (1/32 in. deeper that the tube material), you can make a nice clean cut along the spoiler tube line by taking your time and cutting slowly. With a little practice on an excess piece of foam, you will get the technique down in nothing flat. This method requires very little filling if you make your cuts straight.

Another method of making the spoiler troughs is to make cuts with an X-acto knife at 45 degree angles along the spoiler tube line. Make your cut with a new blade and angle the blade approximately 45 degrees so that the entry point is about 1/8 inch outside the line you have marked. Do this on both sides of the line and then you can use the tip of the X-acto knife to lift up the cut foam. While this method is fairly simple, there is one drawback; you end up doing a lot of filling once the tubes are in place. Even using light spackle it take more time and adds more weight to the wing. In addition to the excess filling, it also means that you have to sand more.

If you are working on a bolt-on wing, now is also the time to lay in any plywood reinforcement blocks for the wing hold down. Once again, mark out the area where the reinforcement block(s) will go and either sand out the appropriate area or use the Dremel Tool set for the depth of the blocks. If you are using full depth blocks you will want to cut the block area out and fill with the replacement wood block for the hold down supports. Again, this option is up to the builder.

At this point, inspect the wing and do any sanding or filling that may be needed. Recheck the servo wire/spoiler tubes and insure that the wire or control strings will fit through the tubes. Make sure that you have all the locations of the ends of the tubes marked and measured on a core map so you don't lose these locations later.

Now that the cores are ready for sheeting, we will look at preparing the covering material and composites next month.

A Look at MaxSoar

MaxSoar is an analysis program designed to allow the user to test model sailplane designs. The information gained from the computer allows the designer to test individual design ideas against known models with varying airfoils and design parameters. The ability of MaxSoar to compare model designs and compute model performance by observation of tabular or graphics displays provides the modeler the means to design with a great degree of success prior to construction.

MaxSoar, as with PC-Soar, provides two forms of evaluation: the airfoil evaluation, and the whole sailplane evaluation. The tabular and graphics data show the designer the performance range of airfoils and models. With each of the airfoils a Comment section is provided giving the user more information on where the airfoil was derived or general comments on the airfoil.

MaxSoar is divided into two entities: the program and libraries containing the sailplane and airfoil libraries. The program takes care of the administrative functions (screens and such) and the manipulation of data for the use of the library files. The library files (sailplane and airfoil) contain the actual data used or modified by the user for the analysis process. The Airfoil library contains different types of airfoil data used with the models in the sailplane library. These include:

- Theoretical polar data based on the Eppler code
- Princeton wind tunnel data by Selig/Donovan/Fraser
- High Reynolds numbers for large wing chord models
- Althaus wind tunnel data

MaxSoar is designed for use on the Apple Macintosh computer and will run on any Macintosh that can run HyperCard. MaxSoar V2.0 requires HyperCard version 1.2.2, which can be obtained from your local Apple dealer or User Group. (Note: HyperCard version 2.0 has been released and does things somewhat differently than version 1.2.2. The compatibility problems are being worked on and should be rectified shortly.) MaxSoar is based on a HyperCard application and the user should be familiar with HyperCard prior to using the program.

A hard disk is not required but makes working with HyperCard much easier and faster. MaxSoar requires about 2 Mb of disk space, if all designs and polars from the libraries are read in. It will run on a Mac with two floppy drives, but not with all the designs and polars from the libraries in MaxSoar at once. If you plan to use a two floppy system, it is best to copy the designs and polars you are most interested in to a separate disk. This is the reason for the new Library Control function in version 2.0.

The first step after installation on the hard disk or backup of disks for non-hard disk application is to read the help file. This is the first selection on the main menu. Read the help file carefully as it will describe how to operate the program and provide information to the user about moving information to obtain the desired comparisons or information. Helpful tips are also included which introduce the user to the conventions used with examples of buttons, cards, and definitions used in the analysis process. These definitions will assist the user in the preparation of data for entry of a custom design. Be sure to print a copy of the help file for a hard copy reference while you are learning the program.

In addition, the introduction also provides a glossary of terms and includes pictures of the various dimensions to provide a better understanding of what is required. It also makes a good reference for interpreting magazine articles for the newcomer until you become familiar with various terms used.

The Airfoil Polars selection from the Home Card provides the user a look at the airfoil of interest in graphics data and comparison forms. The Data card provides the lift/Reynolds numbers data on the selected airfoil. The next card in the stack is the Polar Comparison card which allows the user the ability to compare airfoils in the Airfoil Polar stack. In addition to the airfoil data provided, comments on each airfoil are given to include: the source of the data, type of test, percent thickness of the airfoil, references, and even the page number in "SoarTech 8", if the airfoil was tested there. These comments make a handy reference and also make the graphic displays easier to understand.

The following are the conventions used for the airfoil designations with suffix letter identifying the source of the data.

A,A2 - D	Althaus Wind Tunnel Data
E	Theoretical, based on Eppler code
P	Princeton Wind Tunnel Data
S	"Soartech" and Volume number
DF	Dropped flap and number of degrees
RF	Reflexed flap and number of

degrees
U Unknown source

The Library Control selection on the main menu is used to manipulate the airplane and airfoil data into the Airfoil Polars or Aircraft Analysis section for use in comparisons and designs. Through this facility you can select the aircraft or airfoil you want to compare or use as part of your design.

The Aircraft Analysis section is where most users will spend their time. With this portion of the program the user can build and compare sailplanes, and look at the parameters and performance characteristics of individual designs. The comparison may be run on known sailplanes already in the database or against those the user builds. It all depends on what you wish to accomplish.

The first card in the Aircraft Analysis stack depicts the basic design information of the sailplane. This includes: wing span, chord/airfoil data, fuselage data and stabilizer data. For measurements that are required for your own design print a copy of a new card and fill in the blanks with the data of your aircraft. If you have trouble with the measurements or what is required in a certain box, refer to the glossary for an explanation of the data or calculation. Or if you wish to use some data from an existing design, copy that design and modify that design according to your changes for a comparison. This is a good way to see if your modification for a particular design will work.

The next card in the stack is the calculated design parameters. No data is entered on this card as the information presented is based on the calculated data from the design information card. Based on the data you provide on the design information card this part of the program will even provide you with a center of gravity range to work with. If you are designing your own sailplane I suggest that you compare your design against a similar design to ensure that you are on the right track performance wise.

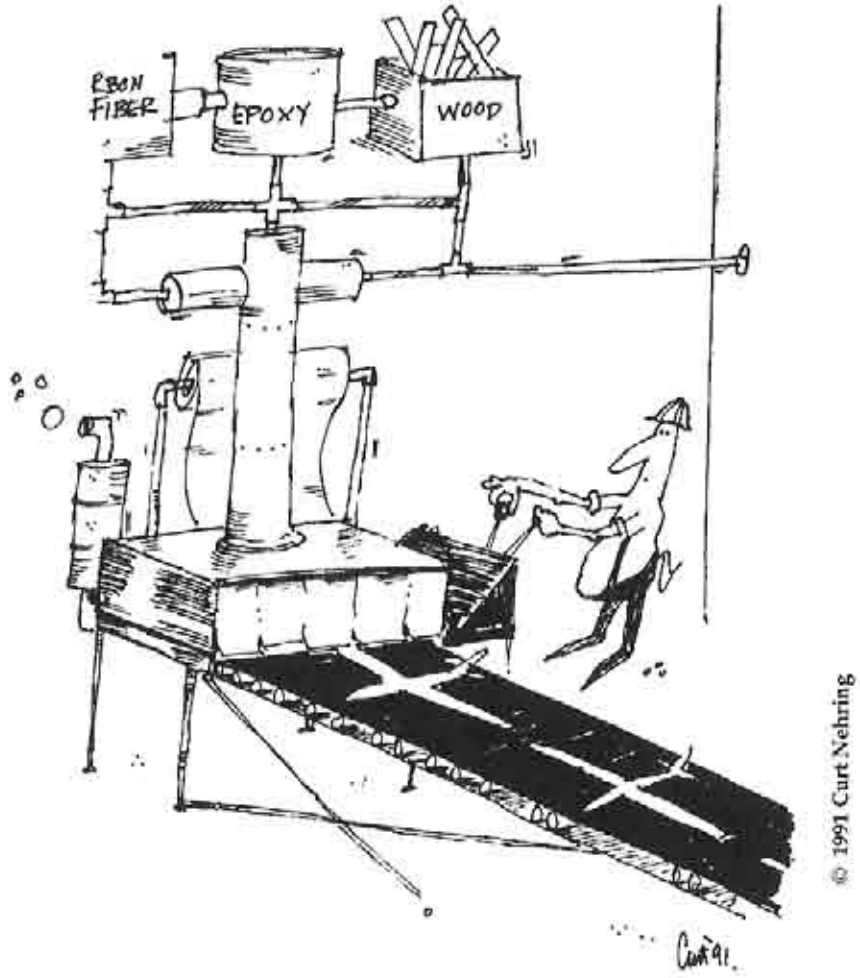
The third card in the stack is the sink rate plot card. This card provides the sink rate of the computed sailplane versus the flight speed. This information is provided in graphical form and provides performance information under various wind conditions.

The last card in this stack is the lift/drag ratio card. This card allows you to view the lift/drag based on the parameters of the selected design. This will provide overall efficiency of the design, and is especially helpful in determining design changes.

The remaining selection on the main menu is the Aircraft Comparison option. This card allows you to enter up to five aircraft designs for comparison. These comparisons are based on sink rate for the first card and lift/drag rates on the following card. To make viewing and printing somewhat easier I suggest that you only compare two designs at one time. While the program will allow you to look at five, it can become a little cluttered if the designs are close in performance.

MaxSoar is a great tool for anyone wanting to design their own sailplane, or for those who are interested in modifying the performance of an existing design. This program allows the user the flexibility to change various pieces of the airplane and satisfy particular requirements to one's individual taste. If you are interested in testing your own design theories this program affords you that opportunity without having to build the plane to see if your theory works.

In conclusion, John and Linda Hohensee have produced a fine design analysis program for the Macintosh. With all the IBM programs that are currently available it is good to see one for the Macintosh. They are currently in the process of making some modifications to the program which will further enhance the usability. If you own a Mac and want a good analysis program this is the one for you. ■



R/C Soaring Resources

Do you hold seminars and workshops? Would you like to be included as a contact to answer questions on soaring sites or contests in your area? If so, please contact *RCSD*. Our address and telephone numbers are on page 1.

Seminars & Workshops

Free instruction for beginners on construction and flight techniques. Friday & week-ends (Excluding contest days) Bob Pairman, 3274 Kathleen St., San Jose, California, 95124; (408) 377-2115

Free instruction for beginners on construction and flight techniques. Sunday - Thursday. Bob Welch, 1247B Manet Drive, Sunnyvale, California 94087; (408) 749-1279

Fall & Winter 1 day seminars on composite construction techniques. Free with purchase of Weston Aerodesign plan set ($35.00) or kit. Frank Weston, 944 Placid Ct., Arnold, Maryland 21012; (301) 757-5199

Reference Material

Madison Area Radio Control Society (M.A.R.C.S.) *National Sailplane Symposium Proceedings*, 2 day conference, on the subject and direction of soaring. 1983 for $9.00, 1984 for $9.00, 1985 for $11.00, 1986 for $10.00, 1987 for $10.00, 1988 for $11.00, 1989 for $12.00. Delivery in U.S.A. is $3.00 per copy. Outside U.S.A. is $6.00 per copy. Set of 8 sent UPS in U.S.A. for $75.00. Walt Seaborg, 1517 Forest Glen Road, Oregon, WI. 53575

BBS

BBS: Slope SOAR, Southern California; (213) 866-0924, 8-N-1

BBS: South Bay Soaring Society, Northern California; (408) 281-4895, 8-N-1

Reference listings of *RCSD* articles & advertisers from January, 1984. Database files from a free 24 hour a day BBS. 8-N-1

Bear's Cave, (414) 727-1605, Neenah, Wisconsin, U.S.A., System Operator: Andrew Meyer

Reference listing is updated by Lee Murray. If unable to access BBS, disks may be obtained from Lee. Disks: $10 in IBM PC/PS-2 (Text or MS-Works Database), MacIntosh (Test File), Apple II (Appleworks 2.0) formats.

Lee Murray, 1300 Bay Ridge Road, Appleton, Wisconsin, 54915 U.S.A.; (414) 731-4848

Contacts & Special Interest Groups

California - California Slope Racers, John Dvorak, 1638 Farringdon Court, San Jose, California 95127 U.S.A., (408) 259-4205.

California - Northern California Soaring League, Mike Clancy (President), 2018 El Dorado Ct., Novato, California 94947 U.S.A., (415) 897-2917

Canada - Southern Ontario Glider Group, "Wings" Program, dedicated instructors, Fred Freeman (416) 627-9090 or David Woodhouse (519) 821-4346

Texas - Texas Soaring Conference (Texas, Oklahoma, New Mexico, Louisiana, Arkansas), Gordon Jones (Contact), 214 Sunflower Drive, Garland, Texas 75041 U.S.A., (214) 840-8116.

Maryland - Baltimore Area Soaring Society, Steve Pasierb (Contact), 21 Redare Court, Baltimore, Maryland 21234 U.S.A., (301) 661-6641

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LSF

The League of Silent Flight (LSF) is an international fraternity of RC Soaring pilots who have earned the right to become members by achieving specific goals in soaring flight. There are no dues. Once you qualify for membership you are in for life.

The LSF program consists of five "Achievement Levels". These levels contain specific soaring tasks to be completed prior to advancement to the next level.

League of Silent Flight
10173 St. Joe Rd
Ft. Wayne, IN 46835

You are invited to join the
NATIONAL SOARING SOCIETY

- OFFICIAL AMA SOARING "SPECIAL INTEREST GROUP"
- YEARLY NSS "SOAR-IN" TOURNAMENTS
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- EXCELLENT BI-MONTHLY NEWSLETTER
- NSS FULLY SUPPORTS THE F3B SOARING TEAM & LSF SOARING PROGRAM
- NSS IS INVOLVED IN THE ORGANIZATION AND OVERSEEING OF THE SOARING PORTION OF AMA NATS (INCLUDING AWARDS BANQUET)
- YEARLY DUES ARE $15 U.S.A. AND $20 OVERSEAS (SPECIAL FAMILY RATES)
- NSS OFFICERS ARE FROM ALL 11 DISTRICTS

For information, Contact:
NSS Secretary/Treasurer
Robert Massmann
282 Jodie Lane
Wilmington, OH 45177
(513) 382-4612

T.W.I.T.T.

(The Wing Is The Thing)

T.W.I.T.T. is an organization of engineers, scientists, pilots, sailplane enthusiasts, model builders and many other persons having an interest in flying wing/tailless aircraft technology. Write to T.W.I.T.T., P.O. Box 20430, El Cajon, CA 92021 to find out how you can participate.

Send SASE for membership application and flyer: "What is T.W.I.T.T." or, send $2.00 for full information package including one back issue of our newsletter, postpaid. Full membership is $15.00 per year and includes twelve issues of the newsletter. Back issues of newsletter are $.75 each, postpaid.

The Vintage Sailplane Association

VSA is a very dedicated group of soaring enthusiasts who are keeping our gliding history and heritage alive by building, restoring and flying military and civilian gliders from the past, some more than fifty years old. Several vintage glider meets are held each year. Members include modellers, pilot veterans, aviation historians and other aviation enthusiasts from all continents of the world. VSA publishes the quarterly magazine BUNGEE CORD. Sample issue $1.-. Membership $10.- per year. For more information write:

Vintage Sailplane Association
Route 1, Box 239
Lovettsville, VA 22080

NEW PRODUCTS

The information in this column has been derived from manufacturers press releases or other material submitted by a manufacturer about their product. The appearance of any product in this column does not constitute an endorsement of the product by the *R/C Soaring Digest*.

High Fiber Density Carbon Strips & Sheets

...from Composite Structures Technology

Composite Structures Technology has instituted improvements in carbon laminate production resulting in a higher fiber density carbon laminate for a higher strength to weight ratio. During the curing process, excess epoxy which adds weight without strength is removed leaving a higher carbon fiber content in the finished sheet. The resulting laminate surface is finely textured instead of smooth. CST offers this high fiber density carbon in 76 sizes to meet every modeling need. Unique are the tapered spar caps that taper in thickness from either 0.030 or 0.060 inch at the root to 0.014 inch at the tip. This concentrates the strength and weight at the root where more strength is needed.

CST offers a wide variety of carbon products for every modeling need all of which are available through your local hobby dealer. Manufacturer's inquiries are also welcome. Direct orders can be placed by calling 1-800-338-1CST or send $3 for a complete composites information package to: CST, Dept. M111, P.O. Box 4615, Lancaster, CA 93539. ■

Fiberglass Fuselage for Alcyone

...from NorthEast Sailplane Products

Northeast Sailplane Products is pleased to announce the availability of the new fiberglass/Kevlar fuselage Alcyone as of December, 1991.

This enhancement to the Alcyone means reduced building time and cleaner lines for the builder, who can still enjoy the simple radio installation and excellent flight characteristics for which the Alcyone is already famous.

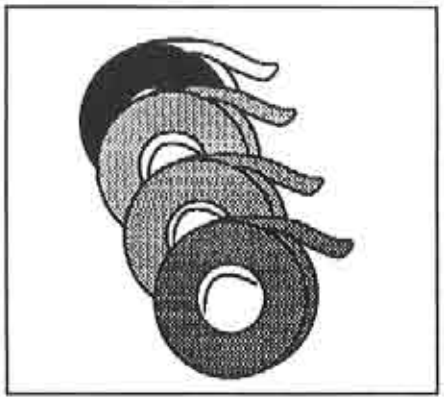
The fuselage comes in two pieces, the main fuselage and the nose cone. The fuselage retains the basic lines of the current wood fuselage and is fully retrofitable. The Kevlar reinforcement in the tail helps prevent breakage in those hard contest landings. When you slip off the fitted nose cone, underneath is a full fuselage minus the piece that would correspond to the canopy on the wood version. The fuselage nosecone allows for hassle-free access to the radio gear as well as an aerodynamically clean seal for the fuselage.

For current owners of the Alcyone, a fiberglass fuselage is available for $59.95. The new kits, available through Northeast Sailplane Products, will sell for $199.95. The wood fuselage version will still be available for $149.95, no change in price. The NSP order line is 802-658-9482. ■

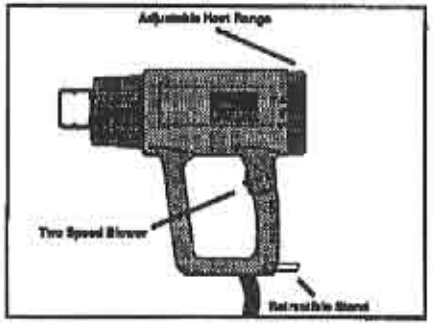
Soaring Accessories

...from Soaring Stuff

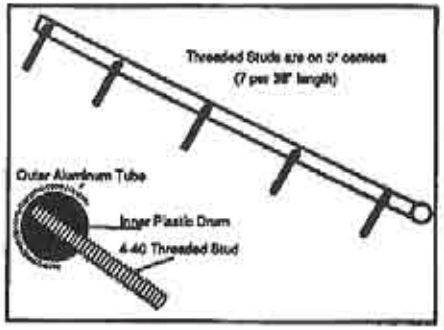
Sailplane Tape. This industrial quality vinyl tape is perfect for model sailplane usage. Flexible enough to go around compound curves, just enough adhesive tack to stay securely but won't tear your covering when you remove it. 1" wide rolls by 108 feet. Available in White, Yellow, Red, Purple, Orange, Blue, Green, and Black. $3.95 per roll



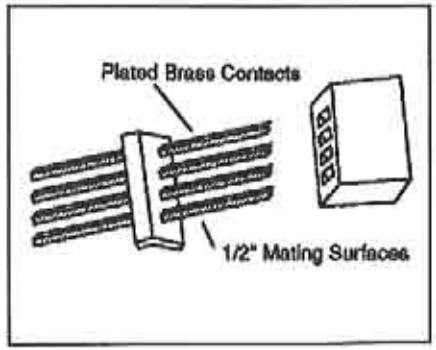
Pro Heat Guns. When you are through putting up with "Mickey Mouse" heat guns that spit sparks, squeek and squawk, and don't heat evenly, this is for you. Dial temperature control, a two speed fan, a built-in stand to hold the gun upright vertically....and much better quality than anything else on the market. $34.95 plus $3.00 shipping.



Gapless Hinges. These F3B style aluminum tube hinges will give you a frictionless, gapless hinge. Designed to provide a maximum deflection of 95 degrees, so they can be used for flaps (with crow model), ailerons, rudders, or elevators. They are supplied in 36" lengths...and can be use in any combination for longer lengths. Rout out control surfaces to clear the 1/4" tubes, drill for the stainless steel mounting studs, and epoxy in place. $9.95 per 36" section postpaid.



Plug-In Wing Servo Connectors. These computer grade plug-in connectors turn all of that chaos into order. These four-pin connectors allow you to slide your wings onto the joiner rod, and make the aileron and flap connections at the same time. The positive and negative power connections each share a pin, leaving one pin for each of the signal wires. $1.95 per pair postpaid (2 pr. required per plane)



Visa, MasterCard, and American Express are all accepted by Soaring Stuff. Dealer inquiries are invited. Soaring Stuff, 9140 Gualalupe Trail N.W., Albuquerque, New Mexico 87114; (505) 898-1129. ■

Airfoil References

...By Chuck Anderson, Tullahoma, TN

Several years ago, I began writing a book on airfoils for model sailplanes, however work on this project had to be stopped for higher priority work such as making a living, building a house, upgrading airfoil plot programs, etc. More recently, I have received a number of requests for data sources for model airfoils. Therefore, I extracted and condensed the section on Data Sources and References to make a reference list available. I hope you find it useful.

Data Sources

The following references were used in compiling the airfoils and data:

"Theory of Wing Sections" (Ref. 1) is somewhat dated but still a good reference for classic incompressible airfoil theory. The Dover paperback edition price has increased considerably since I bought my copy over 30 years ago but it is still a good buy. "Theory of Wing Sections" is available from most aviation book distributors.

"Soartech" (Ref. 2) is the only US publication dedicated exclusively to the technical side of modeling. "Soartech" is published at irregular intervals by Herk Stokely and is highly recommended to anyone who is interested in more than the latest kit review or who won what. Eight issues have been published to date; however, only Volumes 3 to 8 contain airfoil data referenced in this book. "Soartech 8" is the most valuable of this series and consists of a single report titled "Airfoils At Low Speeds" by Michael S. Selig, John F. Donovan, and David B. Fraser. "Soartech 8" contains 400 pages and covers the series of wind tunnel tests on model airfoils in the Princeton wind tunnel between 1986 and 1989. If you can afford only one book, be sure it is "Soartech 8". "Soartech 8" costs $16 ($18 Canada, $23 overseas surface, and $30 overseas airmail). Back issues of other volumes are available. Contact Herk Stokely for current availability and prices.

"Airfoil Sections" (Ref. 3) is an extensive selection of mainly free flight airfoil sections but does include many Eppler sections. Most coordinates are not computer generated and may contain rounding or typo errors. Using coordinates with errors will produce airfoils with bumps or dips when plotted with most airfoil plot programs; however, most plots are usable when defects are smoothed out with a French curve. "Airfoil Sections" is available from The National Free Flight Society.

"Proceedings of the Conference on Low Reynolds Number Airfoil Aerodynamics" (Ref. 4) contains highly technical papers by most of the currently active experts on low Reynolds number aerodynamics. It contains papers by Eppler, Sommers, Selig, Liebeck, Mueller, and many others.

"Low Reynolds Number Airfoil Survey Volume 1" (Ref. 5) is a very complete survey of experimental and theoretical data up to 1981. Very extensive bibliography with hundreds of references.

"Stuttgarter Profilkatalog 1" (Ref. 6) is an engineering reference book containing a collection of low speed airfoil wind tunnel data. The data was obtained in the Laminar Wind Tunnel of the University of Stuttgart. This report contains mostly Wortmann airfoils for full scale sailplanes although results from tests of a few Gotten and NACA airfoils are included. The data were obtained at chord Reynolds numbers of 250,000 to 4,000,000 and are not too useful to modelers. The text is printed in both English and German. The "Stuttgarter Profilkatalog 1" is an interesting book but not worth the price for most modelers.

"Porfilpolaren Fur Den Modellflug" volumes 1 and 2 (Refs. 7 and 8) were the most complete sources of wind tunnel data in the world at Reynolds numbers from 40,000 to 250,000 until the publication of "Soartech 8". Vol. 1 was published in 1980 and Vol. 2 was published in 1985. Both volumes are in German but the books are mostly data and anyone familiar with airfoil data should have little trouble understanding them. Herk Stokely has published an English language translation of Vol. 2 by Bob Fraser and his wife in "Soartech 5". Highly recommended and a must buy for anyone seriously looking at model performance. I bought my copies from the Wilshire Model Center, but I understand they are now out of business.

References

1. Abbott, Ira H., and Doenhoff, Albert E.: "Theory of Wing Sections". Dover Publications, Inc. New York, NY 1959

2. Stokely, Herk: "Soartech", 1504 Horseshoe Circle, Virginia Beach, VA 23451

3. Malkin, John: "Airfoil Sections", Upper Hutt, New Zealand, May 1971

4. "Proceedings of the Conference on Low Reynolds Number Airfoil Aerodynamics". UNDAS-CP-77B123. Edited by Thomas J. Mueller. The University of Notre Dame, Department of Aerospace and Mechanical Engineering, Notre Dame, IN. June 1985

5. Carmichael, B. H.: "Low Reynolds Number Airfoil Survey Volume 1". NASA CR 166803, November 1981

6. Althaus, Dieter, and Wortmann, Franz Xaver: "Stuttgarter Profilkatalog 1", Vieweg & Sohn Verlagsgesellischaft, Brauschweig, West Germany, 1981

7. Althaus, Dieter: "Profilpolaren Fur Den Modellflug", Neckar-Verlag Vs-Villingen, West Germany, 1980

8. Althaus, Dieter: "Profilpolaren Fur Den Modellflug Band 2", Neckar-Verlag Vs-Villingen, West Germany, 1980 ■

Trainer Device

...by George G. Siposs
Costa Mesa, California

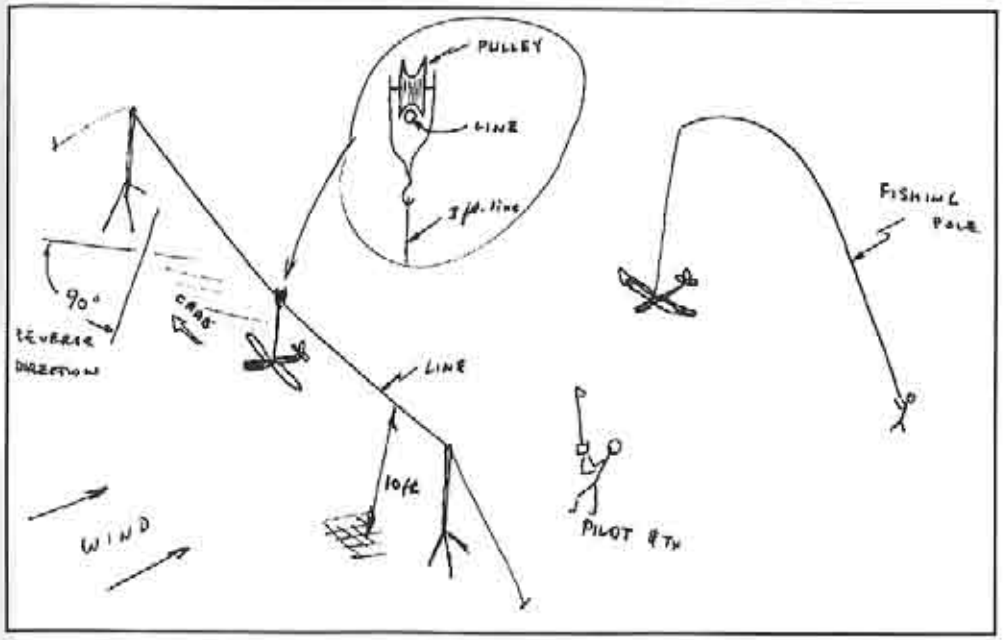
Here is a device that might train beginners who have never had a transmitter in their hands. It could also be a good publicity gimmick at club demonstrations or pilot training.

Stretch a line between two posts that are placed so that the line is directly across the prevailing wind. Alternately, a stiff bar could also be used. The straighter the line or the bar, the better. Place a wheel pulley over the line and at the bottom attach a vertical line to it. Fasten a glider to the bottom end of the line. The point of attachment should be as close as possible to the center of gravity to permit true gimbaling.

Turn on the radio and face the plane into the wind. Move the transmitter lever. This will cause the glider to "crab" along the line; it is like flying against the brow of a slope. At the end of the travel turn the transmitter in the opposite direction so that the plane executes a 90 degree turn. The pilot should walk around the rig so as to become used to crossing the transmitter controls when the plane is facing the pilot.

A simple version of this can be created by suspending the glider under a long pole. Even in this case the action of the rudder and the elevator can be observed.

This device can be valuable for self-teaching especially if the pilot has never had a transmitter in his hands and he is jittery. Could save a plane...■



On July 13 and 14, 1991, the Central Arizona Soaring League and the Albuquerque Soaring Association met in Springerville, Arizona for two days of soaring. Rick Palmer, who coordinated the sites, sent in photographs of the event. It looks to be a beautiful thermal location and, according to the report written by Don Groggin, they are looking forward to holding the event in 1992 and hope some of their friends in Colorado will be able to make the trip.

Re: June '91, Catapulting Sailplanes, Frank Deis

...by Jim Porter, 100 Bonnie Blvd., Hudson, Iowa 50643

Frank's article popped me out of the rut and generated some enthusiasm to try something different. A little pondering, a trip through the nearest discount DIY (do it yourself) store and about fifteen dollars of materials got me started.

It's a real gas and you can do things in very little space. Some variations on Frank's idea that I think make the catapult pole cheaper to assemble and perhaps easier and safer to work with are:

1. Instead of chain, use 1/16" galvanized aircraft cable with crimped ferrules. I found the cable for $.09/foot versus $.29/foot for the cheapest chain. The cable is also stronger and easier to handle. No tangles.
2. Attach the cables to the eyebolts with 3/4" quicklinks, three to one link for the "front" eyebolt and one to one for the "rear" eyebolt. Now, the cables can be detached, rolled up and stored in an accessory bag - much neater, no dangling, banging and tangled lines.
3. Weld, braze or solder a 3/4" I.D. washer to the bottom of the pole. This prevents the pole from sinking into the ground.
4. 1/2" EMT is more than adequate for the pole, and cheaper.
5. Buy one additional spike, grind the head down to fit into the EMT, drive it partway into the ground and use it to locate and support the pole. Now, you can spread the lines and drive the other spikes without having someone else to hold the pole.

Give Frank's idea a try and it might get your mind out of the rut.

By the way, this makes a real nice anchor for any high-start. I've used it with a "garden hose" sized high-start and have had no problems with it staying in place. It really reduces the wear and tear on the front half on the rubber. ■

Some Photos of the 1991 Nats

..by Alan Schwerin, Lake Charles, LA

Julian Tamez and Brian Agnew discussing flight characteristics of Julian's 14 1/2 foot X-C (Cross Country) ship. Brian had just crashed his ship, and Julian offered his back-up to Brian for the contest. This ship went on to win the unofficial X-C event, being the only plane to finish the 28 mile course.

An imported Czech F3B ship, flown by Ed Whyte, past president of the AMA.

Another uncovered HLG, this time a design by Peter George. Note the stiff tubing at the rear for the antenna. Tail feathers are made of solid balsa sheeting. (Many HL pilots wrap this antenna around a 3" plastic straw, and extend only about 18" - 20" of the antenna down the inside of the fuselage. Even when specking out, the radio seems to work adequately with this "shortened" wire.)

Two ships flown in the F3B contest. Seventeen competitors actually participated, and the event was won by Larry Jolly with Jack Hiner coming in second.

Another potent 2M ship! — Mike McGowen's Duck was used extensively at this year's contest, especially after Mike folded his Falcon 800's wings on launch. (It is estimated that around 38 wings folded on launch at this year's Nats.)

Upper Right- Buddy Roos attended the Nats last year as a mechanic, and bought a crashed Pixy at the field. After restoring the wings, he put together his own design, called the "Vixen". Outstanding finish! Buddy flew this plane in 2M.

Mike Stump gets his Duck off, with Jim Thomas working the winch/retriever. Connected to a charger all of the time, some contestants requested we be allowed to interrupt the charger when launching, for fear that too much juice was being put into the batteries working the winches.

Part of the staff that managed the impound area. A thankless task, performed very efficiently and friendly by a band of volunteers from the host club.

Brian Agnew's very competitive Vertigo hand launch ship. There is clearly a trend towards uncovered planes in HLG. Not only can this lead to a reduction in weight, provided the sealant one uses is not too heavy, but bare ships can be up and flying much sooner for those impatient to chase the thermals.

Michael Lachowski designed, built and flew this F3B inspired T-tail. Very fast!

The recently released Alcyone, built and flown by the designer himself, LeRoy Satterlee. It has an ingenious wing joining system.

An especially fine specimen of a Falcon 880, built and flown by Peter George, from St. Louis. Peter painted on the neon tips and black stripe, and used regular Magic tape to secure the flaps and ailerons.

Part of the line-up for the unlimited event. 109 pilots entered this event.

4TH Masters of Soaring
March 21 - 22, 1992

Las Palmas School, Covina, California

Hosted by the Silent Wings Soaring Association, Charter Club #1216

This is an invitational contest open to pilots that have made major soaring accomplishments. This includes winners of a 2 day contest, winners of National and Regional contests, Soaring National Record holders, holders of LSF Level V, and holders of LSF Level IV that have completed the contest requirements for LSF Level V requirements. A request for an invitation must include a copy of the published contest results, LSF voucher, or record certificate.

Last year's participants will automatically receive an invitation. Those that did not compete in last year's contest, but did compete in either of the two previous years, are still eligible...but their addresses were lost when they were switched to a new computer this last fall. If you send in your address again, you will receive an invitation and the address will be entered in the new database.

Proof of 1992 AMA membership will be required. All transmitters must be 1991 GOLD stickered. All receivers are recommended to be 1991 narrow band due to local interference. A MAXIMUM of THREE (3) entries per frequency will be accepted. Frequencies will be assigned as entries are received. By eliminating crowded frequencies, this will allow the heavy flying schedule outlined for this 2 day event. On both Saturday and Sunday, the pilots meeting is at 8:45 A.M. with the first flight at 9 A.M.

Pete Olsen (CD) AMA 1534
15409 Oakgrove Ct.
Chino Hills , CA 91709-2448
Days (818) 915-5441; Eve. (714) 597-2095

Schedule of Special Events

Date	Event	Location	Contact
Feb. 1-2	Southwest Winter Soaring - Unlimited - 444 (D)	Scottsdale, AZ	Iain Glithero (602) 831-1905
Mar. 14	Hand Launch	Irvine, CA	Scott Smith (714) 651-8488
Mar. 21-22	4TH Annual Masters of Soaring	Covina, CA D (818) 915-5441	Pete Olson E (714) 597-2095
May 29-31	Mid Columbia Scale Int. Fun Fly	Richland, WA	Roy (509) 525-7066 Gene (509) 457-9017
June 13/14	S.O.A.R. Great Race	Osewego, IL	Lee Sheets (708) 748-8934
July 25/26	World Inter-Glide 92	Fairlop, London	Les Sparkes 81-505-0191

WORLD INTERGLIDE 92

25 & 26 July 1992

Fairlop, London

Flown to F3J Rules

Contact for more information: Les Sparkes, 607 Chigwell Road, Woodford Green, Essex, England IG8 8AE; Telephone: 81-505-0191.

Classified Advertising Policy

Classified ads are free of charge to subscribers provided the ad is personal in nature and does not refer to a business enterprise. Classified ads that refer to a business enterprise are charged $5.00 per month and are limited to a maximum of 40 words. The deadline for receiving advertising material is the 5th day of the month. (Example: If you wish to place an ad in the March issue, it must be received by February 5th.) *RCSD* has neither the facilities or the staff to investigate advertising claims. However, please notify *RCSD* if any misrepresentation occurs.

For Sale - Business

SAILPLANE DESIGNER'S + DRAG REDUCTION & STRUCTURES HANDBOOKS, $7.95 each. Size/locate stable components, many low ReyNmbr airfoils via breaking Eppler's code, define speed/glide slope, design wing structure, drag reduction techniques. Eric Lister, 2214 Regina Dr., Clarksburg, MD 20871.

3-VIEWS scanned to CAD! Re-design/modify a current or favorite plan into your next contest winner! Catalog of CAD services and products $3 (includes sample diskette). Collins Scientific, Inc., 6957 NW Expwy, Suite 311, Oklahoma City, OK 73132.

ATTENTION DESIGNERS: Would you like CAD plans drawn for your next plane? M&M CAD WORKS is now accepting drawing projects. Will convert hand drawn plans or work from your sketches. Reasonable rates. M&M CAD WORKS (608) 831-1941 CST

Find a good home for your "mature" models, excess radio gear, parts and accessories. List them free with **CLASSIFIEDS**. Sailplanes, Electric, slope ships and anything that helps them fly. Send your list with asking price, name, address, phone #, to: SILENT FLIGHT CLASSIFIEDS, 329 Little Ave., Ridgeway, PA 15853; (814) 772-4851. Subscriptions are $9.00/year or $1.00/issue.

GREETING CARDS, humorous, assortment package in groups of 10 for the sailplane enthusiast. We have a card to fit any occasion. Send $10.95 plus $1.00 postage (CA residents please add 7.75% tax) to Curt Nehring, SOAR TOONS, 469 N Central Ave. Ste. #261, Upland, CA 91786; (714) 920-1261. Please allow 3 - 4 weeks for delivery.

For Sale - Personal

Almost new FUT 4NBL TX & RX CH 26...$50.00 PPd. Call Brian at (216) 848-0394.

RnR Products NOVA Unlimited Slope Racer, all glass kit, N.I.B. Dan, evenings, (415) 594-0644.

CHUPEROSA HL/aileron/poly, SD7037...$39.00; LJMP CHEETAH 110", aileron version of Pantera ...$145.00; MINIMAX 700, 2 meter, machine cut, excellent kit ...$45.00; VORTEX, competition 2 meter, see Sept. 1991 *Model Aviation* (Vortex/Gobblin)...Partial Kit $45.00, Full Kit $112.00, Gobblin HL $40.00; Competition Products MARIAH ...$160.00; Sealy LUMINA with extended center panel to take wing full 2 meters...$110.00; MINI-MIRAGE HL partial kit...$25.00. Call Tom Gressman at (414) 367-2419 after 7:00 P.M. CST.

Wanted

Want to buy glass or plastic fuselage for AQUILA. Also, want fiberglass fuselage from old Astroflight ASW-17 kit. Bill Baker, 1902 Peter Pan St., Norman, OK 73072.

Kit or plans for Scott Whitney's PARAPHASE HL glider. I can have the plans back within a week. Rick Durden, 705 Rockbridge Road, Birmingham, Alabama 35216.

Wanted to Trade

Good crossbow - Barnett WILDCAT II for glider of equal value. Contact Jerry Gaines, 60 Kremis Rd., Greenville, PA 16125; (412) 475-3957.

California Slope Racers (CSR), November 2 & 3

...by Rich Beardsley, CSR Director

The California Slope Racers have really had their trouble getting any races in this year. The weather here on the coast has been so out of the ordinary!

On the original date, we sat and watched the wind at the traditional site in Davenport, near Santa Cruz, blow lightly out of the south. Unable to hold even one heat in two days, we decided that we would try again later in the year at the Miguelito site, near Lompoc, California.

I arrived Friday afternoon to set up the course and found the wind blowing from the south. So, I set up the race course on the south facing slope. Saturday morning we were greeted with light winds from the south, but by the time registration was completed and we were ready to race, the wind had dropped below the required 7 MPH. After spending the next two hours watching hand tossers play, the wind decided to switch to the normal direction out of the northwest. We changed the course and were able to get in one round before the evening lull.

Sunday dawned bright and clear with only a very light wind from the northwest. We spent another morning watching Joe Wurts fly his F3B Eagle, the glider he won the race with, and those that brought their hand launchers play. Joe's Eagle had an RG 15 airfoil, and I believe he said the span was about 107". Joe was able to keep the Eagle up in the lightest lift, and was actually able to run the course in less than 7 MPH winds.

At noon we decided to hold the raffle in hopes that we might awaken the wind gods. There were lots of great items contributed by many companies, too many to identify them all. There were radios from HI-TECH and Futaba as well as a boxful of hot glue from Sheldon's in San Jose.

The raffle seemed to be what was needed to get the wind to come up enough to race. The conditions were light, so the amount of ballast, if you used any, made a large difference. Those that were well acquainted with their racers became very obvious during the day. Smooth flying and knowledge of slope lift were the watchwords of the day.

We were only able to get in two more rounds on Sunday, so the ISR was decided on three rounds, and the results were: 1 - Joe Wurts, 2 - Rich Tiltman, 3 - Brent Lytle, 4 - Many Tau, 5 - Roger Mara, 6 - John Pappas, 7 - Keith Mc Clellen, 8 - Scott Tooher, 9 - Bob Ratzlaff, 10 - Rich Spicer.

I would like to give a special thank-you to the wives, girlfriends, and friends that were so kind to spend a lot of their day helping us run the race. Without those dedicated people, we could not run the ISR. Thank-you, all!

CSR'S first season is now in the books. For the experimental year, even with the fickle weather, I think we proved that there are a large number of people interested in slope racing - California Style - with 4 gliders in the air! The membership stands at 108, and we had at least 30 pilots at every race date. During the year we tried some new ideas that appear to work. Joe Wurts and Daryl Perkins, of World Championship fame, came up with the idea of using lights at the turns instead of flags, so that there would be less chance mistaken turn signals. This idea has really worked well, with Roger Mara building a great set of lights that have been proven at the ISR. We are also using a two division format with the top pilots in Division I and the newer pilots in Division II. This format allows CSR to hold races without having to rely on outside workers. I plan to do a construction article on the light system, and an explanation of the two division format in the near future. (I'll have to write that one from Papau, New Guinea, where I'll be working until March 1, 1992.)

If you are interested in joining CSR, or would like to know more about the club, please send a self-addressed stamped envelope to: John Dvorak, 1638 Farringdon, San Jose, CA 95127.

The top 10 Division I pilots will be able to use their season finishing position as their racing number for the 1992 season. Hope to see all the regular faces, and a few new ones, in the coming season.

See you at the start gate! ■

Placings for the 1991 season determined by 5 races with one throw-out race were:

	Div I	Div II
1	Richard Tiltman	Roger Mara
2	Joe Wurts	Imruze Khan
3	Richard Spicer	Pat Driscoll
4	Ray Kuntz	Scott Tooher
5	Mark Grand	John Pappas
6	Ted Kowalke	Steven Lair
7	Steve Lewis	Jim Lytle
8	Brent Lytle	Bill Levenson
9	Keith McClellan	Jay Brehm
10	Bob Ratzlaff	Tim Guey

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Address_____
_____
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Return to:
R/C Soaring Digest
P.O. Box 6680
Concord, CA 94524
U.S.A.

Please allow 4-6 weeks for delivery by Bulk & 3-4 months for surface.