R/C Soaring Digest

September, 1994
Vol. 11, No. 9

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SLOPE SOARING A FABULOUS SITE

More Photos from the WSJ

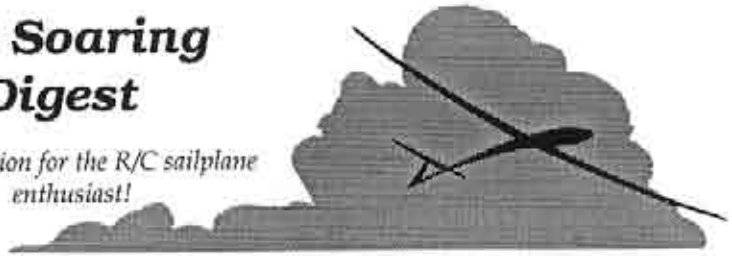
"Charlie Richardson of Vista, California is shown here launcher's vest, holding a C.R. Aircraft Raider during the Unlimited Slope Race at Kloris Butte in Washington."

Photo by Dave Caldwood.

Details on page 2.

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 contributed 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

A fast start...

This month, the "Soaring Site" column is scattered through the pages of *RCSD*. It would have been longer than usual and much of the material is appropriate to other sections/columns. Thank you for your support via letters, notes, FAX and phone calls; and now we're off to a fast start! ■

Happy Flying!
Jerry & Judy

Curt Nehring sent in the photo of himself holding the Mako. He says, "I'm now flying a V-tail Mako for Silent Wings Soaring Association (SWSA) in Covina, California. This is a "great" glider and I'm sold on the V's!!"

In the September issue of *RCM*, there is an article on page 166 called "The Adventures of Joe Shearweb "Glider Cop" written by Pete Young of the Harbor Soaring Society in Southern California. It is a fictional article about Sgt. Joe Shearweb and his partner, Hi Start, and their antics are well illustrated by, you guessed it, Curt Nehring's artwork! We almost rolled off our chairs laughing! Thanks, Pete and Curt. Wonderful job! We hope to see more!

The World Soaring Jamboree

B-29 on close pass after dropping the X-1.

Photos by Dave Garwood

More information and photos have been received from several folks who attended the World Soaring Jamboree. So, where to start??

About the Cover

The cover photo of Charlie Richardson was taken by David Garwood of Scotia, New York. Charlie is an active flyer from Vista, California, and an enthusiastic supporter of the hobby. He was one of the sponsors of the WSJ and made the long drive from Southern California to Washington state just to join in the fun. What did Charlie think of the WSJ? He says, "I had a good time. The flying was fabulous! In fact, some of the best flying we've ever had!"

B-29 drops the X-1 in recreation of the historic flight that first broke the sound barrier.

The B-29 with X-1 rocket plane slung below being prepared for launch by Hal Weber, Wayne Stanford, and Ed Mason and crew from the Nampa Model Aviators, Idaho.

Joe Conrad, WSJ Slope Race Contest Director, flies his PSS Mitsubishi Zero at Eagle Butte.

In the big field, big hill, big sky country of south central Washington, sometimes jackets help identify the players. From left to right are Joe Conrad, Jerry Slates, and Wil Byers.

Launch at WSJ scale contest thermal flying day. The ship is a DH-Sparrow and the pilot is Fred China. He is from British Columbia, Canada. The Sparrow placed second in Vintage Standoff.

And what did Dave Garwood have to say, coming all the way from New York? Dave wrote the following letter entitled: "Thanks for the World Soaring Jamboree".

"Not having been in the West since elementary school at Larson Air Force Base in Moses Lake, the trip to the WSJ was a cultural experience for me, and what an experience it was!

"The quantity, quality, and variety of flying was remarkable. The building and piloting expertise demonstrated at the WSJ was above and beyond what I've seen at any other event, and inspires me to build more carefully and strive to increase my own flying ability.

"Inclusion of soaring newcomers and novices was a magnificent WSJ theme. Event planners scheduled novice thermal, novice slope race, and F3J for newbies. Beyond that, watching Keith Thompson spend an hour with a first

Sixty inch slope race at Kiona Butte, with West Richland in the valley below.

Dave Garwood wrings out a Bob Martin Talon at Eagle Butte. Photo by Steve Syrotiac.

time flyer trimming out a new plane, and seeing Deiter Mahlein turn over his Rubber Duck to give a rookie a day of slope soaring made me think *this* is how we include new people in the hobby/sport.

"I had a terrific time as a competitor, an observer, and a journalist. I have the good fortune of writing about the event for *Flying Models*, scheduled for the November 1994 issue.

"It's clear that copious amounts of planning, preparation, and plain old gritty work during the event and behind the scenes were the foundation of the WSJ's smooth running success.

"You have made an extraordinary contribution to R/C soaring. Thank you for doing it."

Best Regards, (signed) Dave Garwood

Two top slope pilots watch the weather and the flying during the 58 MPH, gusting to 62 wind at Eagle Butte. Peter Marshall from British Columbia and Hal Weber from Idaho.

Flight observers at Eagle Butte include (right to left): Steve Cameron - Unlimited Slope Race Contest Director; Wil Byers - WSJ Event Coordinator, Dr. Richard Eppler - Aerodynamicist.

F3J (hand tow) Contest Director Jack Sile came from England to make his contribution to the WSJ, shown here addressing the pilots meeting. Mike Lachowski is in the background.

Sherman Knight, from the Seattle Area Soaring Society (SASS) club, is shown here on the thermal field. He pointed out that goggles help flatland flyers just like slope soarers by keeping wind and grit out of the eyes. Sherman prefers amber colored lenses which increase contrast and improve visual sharpness.

Well, Dave, we thought it appropriate to share your wonderful words because not all of the folks who were involved have seen your letter.

And about Dave's photos? Well, as you can see, they are typical David Garwood quality! Beautiful! Dave, thanks for sharing the photos, your support, and your enthusiastic dedication to the hobby! Need we say more?

Who was that runner??

In the July issue of *RCSD*, we asked if anyone could tell us who the F3J runner was. Both Jim Thomas of Woodinville, Washington and David Garwood of Scotia, New York instantly recognized the runner as Sherman Knight. Sherman was pulling for Jim Thomas.

Correction

In the July issue on the bottom of page 12, the photo caption is incorrect. Tony Elliott of Boise, Idaho called to let us know that it is his ASH-25. Our apologies to both Gary and Tony for the mistake! ■

Chip Bullen of Florida helps Greg Vasgerdsian program his radio for his 1/5 scale Rhoenbussard.

Waiting for wind at PSS event day at Eagle Butte. Left to right: Ken Stuhr, Rick Palmer, Peter Marshall, and Chuck Warren, the PSS Contest Director.

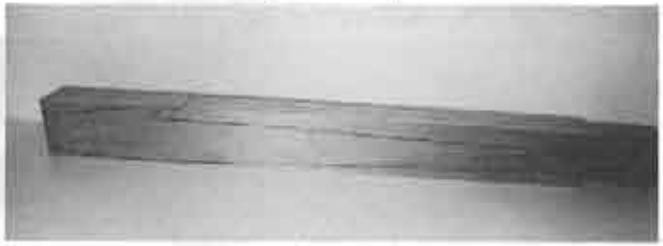
Jer's Workbench

Making a Plug Part II

Ok, last month I told you what I was going to do this month; so, now let's do it.

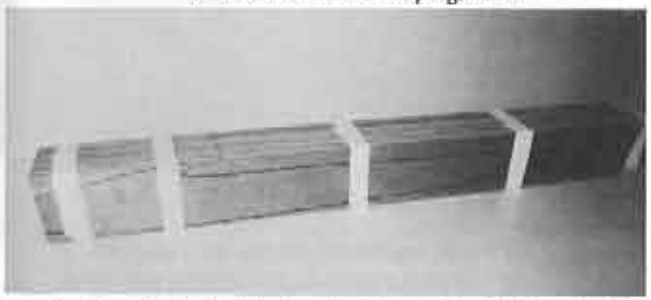
As you can see, I took my kiln-dried redwood 1X4 boards and glued them together using 24 hour epoxy to make a block of wood to the size that I needed. After the epoxy had cured, I then took the 4X4 block of wood and ran it through the table saw and squared up the edges. This cut isn't required, but it just makes things a bit neater to work with.

1. *Plug/block with patterns.*



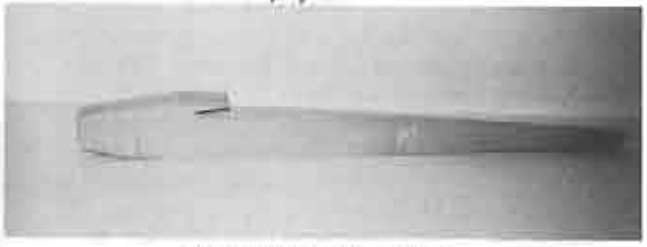
2. *Patterns traced onto plug/block.*

As you can see in photos 1 & 2, I made a set of patterns off of the drawing and then traced them onto the block of wood (note: the top and side profiles). Because these cuts will be 4 inches deep, I installed a 1 inch wide blade onto my bandsaw. By using a 1 inch blade at this time, it's not going to over heat and wander.



3. *After first cut, sides taped back onto plug/block so that the side profile can be cut.*

The first cuts that I did were for the top profile. (When cutting out these profiles, think about cutting a little over sized, so you won't have to fill with wood filler in case too much is accidentally cut off.) Saving the two pieces that were just cut off of the block of wood, I then taped them back onto the block so that I could cut the side profiles (see photo #3). After the side profiles have been cut, the pieces or scraps that were cut off are now no longer needed and can be dumped. What I now



4. *Rough cut, square plug.*

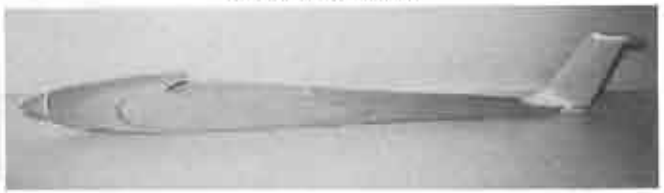
have is a somewhat rough cut, square fuselage plug (see photo #4). It may not look like much at this point, but not to worry as it will start looking like something soon.

Using a few simple hand tools (see photo #5), I rounded off the rough edges and the plug starts to take shape. With a small hand plane, small wood rasp, files, sandpaper, and a couple of hours of work, the fuselage plug was completed (photo #6). Next, I added the rudder (photo #7). Having done this before, I find it easier to make the rudder as a separate piece and add it onto the fuselage plug. You can make a plug, fuselage with rudder, from one piece of wood, but you may find it easier to do it this way.

Almost done, I added a wire loop to the nose (see photo #8), so that it would be easier to hang the plug when I paint it.

5. Only tools used to shape the plug.

6. Completed plug.



7. Plug with rudder added.

8. Finished plug with wire loop added, so that it can be hung while being painted.

Now it's time for the final sanding and finishing. The plug is finished by using Dupli-Color Scratch and Filler primer and Dupli-Color Truck and Van paint. Dupli-Color spray can paint is available at the local Western Auto store. An epoxy finish would have been better to use, but I wanted to show what the least is that you can get by with. Using a spray can type paint has one problem; it may or may not pull off of the plug when it's removed from the completed mold. A hard epoxy finish is best.

Now that the plug is finished, it's time to add some damns. Picture what the mold will look like from the inside. This is another subject and will be covered next month.

Wire Pushrod

Looking for a 40 inch long steel wire pushrod? Byron Blakeslee (BB Sailplanes) has them for $2.00 each plus $4.75 for shipping. Byron says that they are shipped in a PVC tube so that they won't get bent by UPS. His address is 3134 Winnebago Drive, Sedalia, CO 80135; Telephone (303) 688-9572. ■

On The Air With Cornfed

Fred Rettig
1778 S. Beltline Highway
Mobile, Alabama 36609
(205) 471-2507 (days)

"The Last Bite"

How many times have you sat down to eat a meal that had been well prepared? You know, one with all the trimmings, like Thanksgiving? The only problem is that you are so hungry that you just scarf it down. I mean really fast, kinda like two dogs eating side by side. Each is so worried that the other one might get his food, that they eat every morsel at breakneck speed even if they weren't that hungry.

Oh yeah, back to the meal. So, there you are, eating ferociously, only to look down and realize there are only a few precious bites left on your plate. Immediately, you make yourself slow down in an attempt to savor each remaining bite. Perhaps, you can regain that good taste, but it's too late. You did it again. You ate too fast. You are FULL! Bummer...

You know, I have come to realize that's how my flying has been lately. I climb up to the winch, hook up, and get a great launch. I mean a rain maker! Then, somehow, my thumb just gets a spirit of gluttony. I mean, that thing will just eat all the plane altitude in no time flat and I find myself down on the deck scratchin' for some lift and savoring every foot of altitude left. I even find myself talking to my plane. *"Come on Baby! Don't let me down. Just a little more..."*

Would you believe it started talking back? Yeah, strangest thing.

It said, "You dummy! If you would have trimmed me out right when you came off the launch, then all you would have had to do was click in a few clicks of up elevator, then go cruisin' around at minimal sink, cherishing each and every foot of altitude until you hit the lift. Sure, I know I don't look like a lot of fun easing around too slow, but you just put me in some lift and I will show you some fun! Then you won't be down on the deck wishing for some more altitude!"

I thought about what my plane told me. The more I thought about it and practiced it, the greater my air time became. Yeah, my flights got longer and I realized I wasn't scratchin' on the deck as much as I had been.

The moral of the story:

Slow down, listen to your plane, take time to sniff the air, and savor each foot of altitude until you hit lift. Then, have fun with it! Oh, and I found that if I stick my thumb in a donut hole before launching, it really seems to help!

Signing Off,
Cornfed

P.S. Say your prayers and spend some time with the family.

ATTENTION: Tim Renaud of Irvine, California. Congratulations on your marriage. May God bless it with peace and happiness and may it last into eternity. ■

Three Times and You're Out or Hand-Launch Topics

...by Scott Smith
2 Sugarpine, Irvine, CA 92714
(714) 651-8488
evenings after 7:00 PST

SULA Contest Summary

SULA has a beautiful site at Cal State University, Dominguez Hills, near Long Beach, CA. The last handlaunch contest was in 1979; Joe Wurts attended that one... as a teenager. Merrill Farmer, the CD, wants to make this contest a major annual event.

For his first try, he did real well: 26 entrants including many top fliers: Wurts, Jolly, Van Gundy. I came in 9th.

A Dream Come True

Wurts' river of air explanation (see my July 1994 *RCSD* column) paid off big for me this time. With Art Markowitz throwing for me, in the first round I picked my air and snagged a thermal by myself on the first try for a 9:52 flight. In the same heat, Wurts had the misfortune to pick a "teaser" thermal that he had to abort and launch again. The result was a cherished dream-come-true for me: I BEAT JOE WURTS ONE-ON-ONE!!!.

At the end of the round, after I finished screaming and doing cartwheels and flips all over the field, Joe, knowing what this meant to me, came over and offered his congratulations. He's a true gentleman.

In the third round, I went up against Joe again.

This time he buried me.

Normally This Happens to Me

Like several pilots in this contest, John Smith (no relation to me even though Smith is a rather uncommon surname) crashed his Commoner into a bank of trees on the downwind edge of the field. After he and his timer got the plane down, John noted some slight damage but saw that the controls still "waggled". Prompted by his timer who noted that there was still substantial time in the round, John ran with his plane back to the throwing area and threw again. His plane launched high, turned back with the wind, and landed right back into the tree. Again they got the plane down. Again the controls still waggled. Again John ran back to the field and threw; there was still time in the round. And again, believe it or not, it crashed into the same tree!

By this time, those of us who had caught this drama were ROFL (for those of you who don't surf the Internet or Compuserve, this acronym stands for "rolling on floor, laughing"). Who says hand launch is not a great spectator sport? Being your dutiful handlaunch reporter, I went over to John to find out what happened.

John, showing great poise under immense stress, calmly pinpointed the cause of the problem: the servos had been knocked loose in the first crash rendering the airplane uncontrollable.

Sure, John, and I've got a great story about frying my plane in the electrical wires. Truly, there are many paths to fame.

Grenade Launch

While the contest was going on, Mike Reagan and Paul Trist Jr. of AeroVironment wanted me to be sure to see their new project. AeroVironment is the company founded by Paul McCready (I'm sure I got the last name wrong), the man who led the effort to fly the Gossamer Condor and Gossamer Albatross human-powered airplanes. Mike and Paul are working on a solar-powered "model airplane" that will cruise for days at the 60,000 foot level carrying scientific experiments as payload.

In any case, sure enough, when the contest was over, Mike drove a pickup truck into the middle of the field. In the back corner of the truck bed, a metal pipe stuck up in the air. At the top of the pipe was affixed 3 strands of 5-foot long 3/16 surgical rubber tubing. Mike and Paul then showed everyone the plane: 36" wingspan, 9 oz, 200 sq. in. 70% wing taper, 2055 airfoil (chosen for least drag), straight trailing edge w/ ailerons and elevator. Mike and Paul had sanded down a solid balsa block for the wing. Your light but otherwise "typical" small slope glider. Oh, and the towhook was placed 1/4" behind the leading edge.

Photo of RX-1 catapult R/C glider. Mike Reagan designer/pilot. Photo by Paul Trist, Jr.

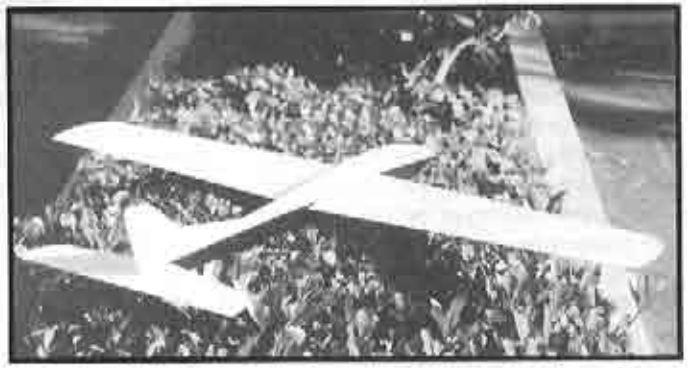


Photo of RX-1 catapult R/C glider. Photo by Paul Trist, Jr.

They hooked this glider to the end of the surgical tubing, pulled back about 5 times length, and let go.

There is no adequate description of the flight; though "rocket" and "afterburners" come to mind. Imagine a straight line 30° from horizontal out as far as the eye can see, this monster's initial trajectory. When the plane was several hundred feet out, Paul gave it some elevator and it immediately went into a screaming vertical climb. At the top of the climb, Paul made to do some axial rolls before it finally ran out of steam. This little bird was peaked out at about 300 feet. Paul then made some very nice maneuvers as he flew the plane back to earth.

Paul then asked me if I wanted to try it, figuring that anyone who could so expertly write a hand-launch column must automatically know how to fly aileron. I should have told him that I hardly know how to fly an aileron ship at all and passed the transmitter to someone else. I thought about it for a second, decided what the heck, accepted his transmitter, and listened to his instructions.

He suggested strongly that I not touch the controls until the plane had burned off most of its energy. You can say that again, I remember thinking. He let the

plane go. I watched the plane disappear along its straight line path. Wait. Wait a little longer. It's still going in a straight line. Wait a little...okay now it seems to be slowing a bit (wrong!). I gave ever-so-slight elevator.

Immediately the plane went into a large vertical loop. Gads it was sensitive! Better straighten it out and the plane immediately went into a flat spin. Hurtling toward earth, I madly slammed the stick against its stops until the plane broke out of its spin and I somehow got it to fly level and straight. At that point, I immediately passed the transmitter back to Paul muttering that it was too hot for me.

Paul gave everyone who dared a chance to fly this thing. No one crashed, though every pilot was taken aback by the raw speed and sensitivity of the controls when the plane was going fast. Without a doubt, this was one of the most macho things I have ever encountered.

In unison, everyone agreed that this should be a class. No one could figure out a contest format though. Suffice it to say that you flatlanders no longer need to come to Torrey Pines or Eagle Butte in the early spring for world class bowling ball lift. Just make yourself a little plane strong enough to withstand a large slingshot and be prepared for the flight of your life! Just remember not to let anyone get in front of it during launch, as we figured the plane is doing at least 100 mph over the truck.

And don't drink any beers before attempting this.

Spring-Loaded Finger-Hole Cover

Phil Bernhardt showed me his beautiful spring-loaded finger-hole door. I'm going to build one of these.

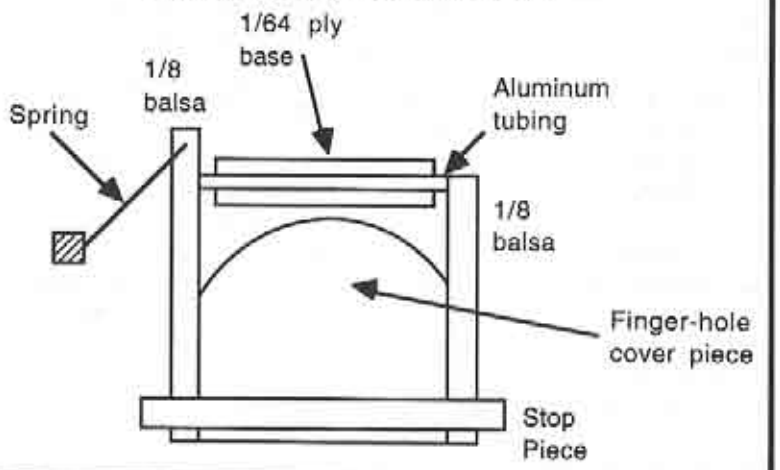
The drawing shows a top-view of the assembly shown from inside the fuselage. The 1/64 ply base provides clearance for the 1/8 balsa sticks to hinge up and down. The aluminum tubing provides the outer hinge piece for the inner wire which is attached to the 1/8 balsa sticks. The purpose of the stop piece, another 1/8 balsa stick, is to align the door when it's closed. Finally, the spring provides a light pressure to close the door.

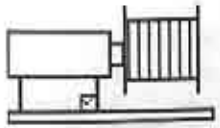
Very light and very elegant. I wish I'd figured this out.

Next Month

Oh, heck, I don't know. Things can't get much better than this. ■

Spring-Loaded Finger-Hole Cover





Winch Line

Gordon Jones, 214 Sunflower Drive, Garland, Texas 75041; (214) 271-5334 After 5:00 P.M. CST

Airfoil Data Listing

I found the following list of reference documents on InterNet and thought it would be a good list for those that are interested in airfoils and other reference data that is available The list is by no means exhaustive. It represents a cross-section of the available data. Please send corrections or updates to me and I will attempt to update this list periodically for everyone's use.

(1) Abbott, I.H., Von Doenhoff, A.E.,'Theory of Wing Sections (Summary of Airfoil Data)' Dover, New York, 1959.

Remark: also NACA Rpt 824. theory and profiles for NACA 4, 5, and 6 digit series airfoils.

(2) Althaus, D., 'Profile Polaren Fur den Modellflug (Windkanalmessungen an Profile im Kritischen Reynoldszahlbereich)', [Model airfoil polars (Wind tunnel measurements of airfoils at critical Reynolds numbers)], Institut Fur Aerodynamik u. Gasdynamik der Universitat Stuttgart. Neckar-Verlag, Postfach 1820, 7730 Villingen-Schwenningen, Germany, 1980.

Remark: Windtunnel data on many airfoils. Wortman, Eppler, NACA, Gottingen, Clark Y etc... 10000 < Re < 1000000.

(3) Althaus, D.,'Profile Polaren Fur den Modellflug, Band 2 (Book 2)', Institut Fur Aerodynamik u. Gasdynamik der Universitat Stuttgart. Neckar-Verlag, Postfach 1820, 7730 Villingen-Schwenningen, Germany, 1985.

Remark: More wind tunnel data. Some Eppler, Selig, Quabeck and many free flight airfoils, Bob White, Hofs ss Espada etc...

(4) Althaus, D., Wortmann, F.X., 'Stuttgarter Profilkatalog 1', F. Vieweg, Braunschweig, 1981.

Remark: Text in English and German. Vol. 1 is a new edition of a publication of the Institut fur Aerodynamik und Gasdynamik of Universitat Stuttgart first issued in 1972 in German. Includes bibliographical references. Contents: 1. Messergebnisse aus dem Laminarwindkanal des Instituts fur Aerodynamik und Gasdynamik der Universitat Stuttgart.

(5) Bender, H-W, 'Profilliste Profildatenbank (Airfoil Encyclopedia)', (on floppy disk), 1993. Hans-Walter Bende, Erlenhof 3,W-5309 (53340) Mekenheim, Germany

Remark: an attempt to compile all of the 'important' airfoils ever published. Cordinates, thickness, camber, and pitching moment data for over 2200 airfoils on computer disk. Available in the United States at an introductory price of $115 from, Herk Stokely,1504 North Horseshoe Circle, Virgina Beach, Virgina 23451

(6) Bender, H-W, 'Modellflug-Profilesammlung, Model-Technik-Berater MTB 17', Verlag fur Technik u. Handwerk, Baden-Baden, Germany, 1987. ISBN 3-88180-117-0

Remark: (Model airplane airfoil catalog) General catalog. Provides coordinates for many airfoils. Wortman, Pfenniger, Gottingen etc...

(7) 'Comprehensive Guide to Airfoil Sections for Light Aircraft', Technical Reference Manual, Aviation Publications, Appleton, Wisconsin, 1982. ISBN 0-87994-038-7

Remark: Many different airfoils from many different sources, wind tunnel

data at moderate to high Reynolds numbers (~3x10**6)

(8) Eppler, R.,'Airfoil Design and Data', Springer-Verlag, Berlin; New York, 1990.

(9) Girsberger, R.'Some new airfoils for F3B', Soar Tech #5, 1985, published by Herk Stokely, 1504 Horseshoe Circle, Virgina Beach, VA 23451.

(10)'HQ-Profile, Model-Technik-Berater MTB 7', Verlag fur Technik und Handwerk, Baden-Baden, Germany, 1983.

Remark: Airfoils of Dr. Helmut Quabeck.

(11) Miley, S.J.,"A Catalog of Low Reynolds Number Airfoil Data for Wind Turbine Applications". RFP-3387 VC-60, Rockwell International Feb. 1982. Us Dept. of Energy, Wind Energy Technology Division, Federal Wind Energy Program.

(12) 'NACA-Profile, Model-Technik-Berater MTB 3', Verlag fur Technik und Handwerk, Baden-Baden, Germany, 1990. ISBN 3-88180-103-0

Remark: coordinates and calculated polars for about 30 NACA 4-series, 6-series and GA(W)-1 and GA(W)-2. The booklet is laid out similar to the MTB 1/2, some (german) text, velocity distributions of all airfoils, drag polars and profile plots in various sizes.

(13) Selig, Michael,"The Design of Airfoils at Low Reynolds Numbers", Soar Tech #3, 1984, published by Herk Stokely, 1504 Horseshoe Circle, Virgina Beach, VA 23451.

Remark: first of the published Selig airfoils.

(14) Selig, M.S., Donovan, J.F., Fraser, D.B.,"Airfoils at Low Speeds (Soar Tech Vol 8)", Herk Stokely, publisher, address above.

Remark: The final results of the Selig/Donovan Princeton Wind Tunnel tests of airfoils at low speeds. Wind tunnel data on many different airfoils including all the new Selig-Donovan (SD) airfoils. A very complete volume.

(15) Simons, M.,'Model Aircraft Aerodynamics', 2nd. ed., Argus Books, London England, 1987. ISBN 085-242-195-0

Remark: 2nd. edition contains aerodynamic data on many airfoils in the appendix. Eppler, Selig, Wortman, NACA etc... Available from Zenith Aviation Books.

(16) Thies, W.,'Eppler-Profile, Model-Technik-Berater MTB 1/2', Verlag fur Technik u. Handwerk, Baden-Baden, Germany, 1986. ISBN 3-88180-100-6 Remark: Complete Low Reynolds number Eppler airfoils. single volume.

Miscellaneous Reference Data

(1) Proceedings of the Conference on Low Reynolds Number Airfoil Aerodynamics. held at Notre Dame Univ., June 1985. Thomas Mueller ed. UNDAS-CP-77B123 Dr. T. Mueller, Dept. Aero and Mech. Eng. Univ. Notre Dame, Notre Dame, IN 46556

Remark: 1st. conference held on the subject of low Reynold number airfoils. Many papers by all of the experts in the field. Eppler, Somers, Selig, Leibeck, Mueller, H.K. Cheng, Morkovin etc...

(2) Proceedings of the International Conference on Aerodynamics at Low Reynolds Numbers held at The Royal Aeronautical Society, London, Oct. 1986. published by the Royal Aeronautical Society, 4 Hamilton Place, London W1, England.

Remark: 2nd. international conference

(3) Proceedings of the Third International Conference on Aerodynamics at Low Reynolds Numbers. Held at Notre Dame University, June 5-7,1989. Avaiable from Springer Verlag as LCN54 Low Reynolds Number Aerodynamics, edited by Thomas Mueller. ISBN: 518843. (see below)Low Reynolds number aerodynamics: proceedings of the conference, Notre Dame, Indiana, USA, 5-7 June 1989 / T.J. Mueller, editor. — Berlin ; New York :Springer-Verlag, c1989. v, 446 p. : ill. ; 25 cm. — (Lecture notes in engineering; 54) "Papers presented at the Conference on Low Reynolds Number Aerodynamics, held June 4-7, 1989 at the University of Notre Dame"—Pref. Includes bibliographical references.

(4) Lissaman, P.B.S.,"Low-Reynolds-Number Airfoils", Ann. Rev. Fluid Mech., 15, p.223-239, 1983.

(5) Pfenniger, W., Vemuru, C.S., Mangalam, S., Evangelista, R., "Design of Low Reynolds Number Airfoils-II", AIAA 88-3764-CP.

(6) Eppler, R., Somers, D.,"A Computer Program for the Design and Analysist of Low Speed Airfoils", NASA TM-80210, 1980.

(7) Maughmer, M., Somers, D.,"Design and Experimental Results for a High Altitude, Long Endurance Airfoil", AIAA J. Aircraft, 26, No.2, Feb. 1989. (AIAA 87-2554).

(8) Somers, D.,"Design and Experimental Results for a Natural-Laminar-Flow Airfoil for General Aviation Applications", NASA TP-1861, 1981.

(9) Somers, D.,"Design and Experimental Results for a Flapped Natural-Laminar-Flow Airfoil for General Aviation Applications", NASA TP-1865, 1981.

(10) Pope, A.,'Basic wing and airfoil theory', 1st ed. McGraw-Hill, New York, 1951.

(11) Bauer, F., Garabedian, P., David Korn, D.,'Supercritical wing sections III', Springer-Verlag, Berlin ; New York : 1977. (Lecture notes in economics and mathematical systems; 150)

Remark: Two earlier books: [1] A theory of supercritical wing sections, by F. Bauer, P. Garabedian, and D. Korn; [2] Supercritical wing theory, by F. Bauer et al. ■

Do you want to know why?

...by Erik Eiche
Richmond, B.C., Canada

(The cover of the July issue of RCSD shows the cockpit detail of Erik's beautiful scale replica of the full-size OBS. How does he do it? Yes, we want to know why... Ed)

Over the years, I've been given a lot of credit for my scale models and I would like to share it with two people in particular. First, I would like to thank Martin Simons for providing a wealth of documentation like photos, 3 views, and lots of data in his book "The World's Vintage Sailplanes". Besides very interesting stories and anecdotes, Martin's book has all the information I needed to build scale models like Baby Albatross, Kranich, Fafnir, and the flying Observatory, OBS. My next vintage scale project is right in front of me on page 42, 43, and 44, and it is called the WIEN. Martin has done all the "footwork", the running around, the talking, the writing, etc., etc., which I could not have done in a hundred years. All I have to do is relax and convert his 3 view drawings into 1:4 construction drawings. It's simple, super convenient, and painless. I hope to meet Martin one of these years, and thank him in person.

The other person I want to share the credit with is my dear wife. A lot of people try to win the jackpot. Well, I did, 47 years ago when I married her. I doubt they make girls like her any more. Besides the housework, washing, and cooking, she also does the shopping, banking, taxes, and many other things I am supposed to do. Is there anyone who envies me?

Oh, there are a couple of more things I should mention. Most of the wood cutting and the sanding is done in my workshop in the house. There is no complaint about dust or noise. Where do I store my models? Hangar #1 is her utility room and Hangar #2 is the rec. room.

Life has taught me not to take anything for granted but to appreciate all the good things.

Now you know why... I call myself a very lucky guy! ■

This Old Plane

...by Fred Mallett
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Survivability

The plane ticked a wing on a bush top, spun several times kinda like a poorly thrown boomerang, and crumpled into sticks on the beach below. The plane was flying again after a 10 minute slope, top repair job. (It is nice to have a van to work out of the wind.) How? By using the "weak link" building technique. Also called the "crumple" method.

The weak links are designed, or re-designed into the plane. One place for this technique is the wing holddown. In the case of the plane mentioned above, two 4-40 nylon bolts on a 60" slope racer (a NightHawk) leaded up to 40 oz. The bolts sheared off, with only a blemish on the wing tip from the cement riprap. Had the usual 1/4" bolt been used, or the dowel in a hole method, you could guarantee a bit of bench time to repair. Very likely a broken fuselage would have resulted.

This month's column will address airplane preservation in general, rather than describing one plane in particular. Survivability comes in several forms.

ONE: Reduce the forces involved, by building a very light, small plane. The Silhouette, a fast agile slope ship, and most HLG's fall into this class. With very little weight, and short moment arms (in the case of the Silhouette) there is little breaking force involved, and the plane often survives. I have seen a stock Silhouette do 3 cartwheel landings (crashes) in one day, and fly away. I hate to mention how many times I have watched my HLG's act like Olympic gymnastics hopefuls. This is the bounce method. Picture 1 shows an example of this with the Sky King sloper, all 40 inches and 11 oz of it. It bounces real good.

TWO: If the above factors don't fit into the design (i.e., big/heavy planes), you can build in weak links. The goal is to have a pre-determined component fail to minimize damage, and repair times. Below are some examples of weak link locations, and methods.

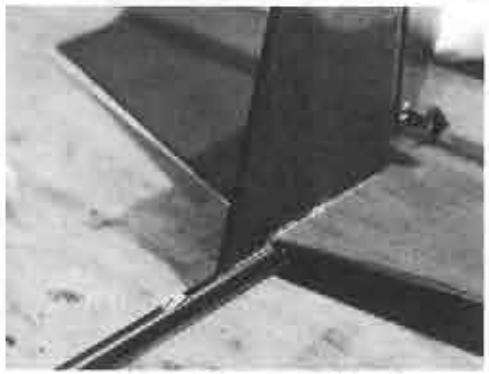
THREE: Build it STRONG. The bad part is that this usually means heavy(ier). We all know $E=mc^2$. So does mother earth when a plane hits. The hard part in designing with this method is, "Where does extra weight stop being strength, and start being enough mass to break another component?" The best example of this I have seen was an F3B pilot who had his thumb fall off the stick (so he said ;^) on the second turn in a run, while the 118" leaded up, bird was pointed down, and banked hard, flying at warp 4. The first bounce was as high as I can throw a HLG, the remaining cartwheels were mild by comparison. He launched the plane again 10 minutes later (had to stop shaking first). That was one strong plane.

FOUR: Don't fly it (Know anyone with a hanger queen?), or don't crash it. If you (think you) never crash, flip to another article, and stop reading this one.

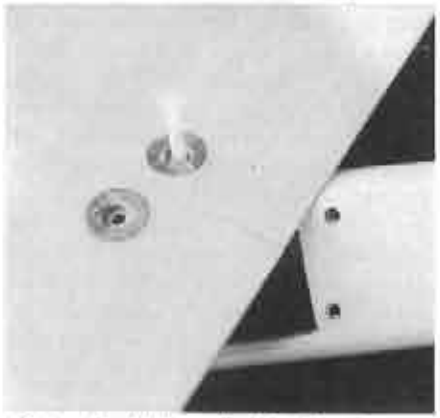
Tail feathers:

My preference for tail preservation is to not attach the tail very well. Sounds bad, huh? Actually the methods used depend on the type of plane. For V-tail slope and HLG, I often use no reinforcement when epoxying, or C/A'ing the tails on. Use a fine line of glue, also. This way the tails pop off on a bad landing or crash, but the

Picture 1 - Sky King pitcheron sloper.



Picture 2 - Re-attachable tails.



Picture 3 - 4 4-40 nylon bolts for a 2 meter, 2 piece wing slope plane.

tails never get hurt; just a quick re-attachment and fly again. Picture 2 shows tails glued onto a Corn Dogger HLG with this method. The other choice is to use glass reinforcement to attach the tails, then they never fall off, but will break more frequently. On thermal ships, I don't worry about the tails, and attach them well, Thermal planes don't land backwards or cartwheel often. Then again, there were a few windy days,.....

Wing Holddowns:

Of course rubber bands are probably the best wing preserver, so long as you don't put too many on. I feel the old adage of 6 to 8 bands was developed by kit manufacturers to get us to buy more kits. With 6 - 8 on, you might as well bolt the wing down. With a HLG, I never use more than 2 NEW bands. It may appear sloppy, but when in flight there is only the weight of the fuselage pulling. I often highstart on 1/8" OD tubing with two bands and again, no problem. Four works fine for Gentle Lady type planes on a normal highstart or the slope. The goal here is to get some give when mother earth reaches out and grabs a wingtip on landing.

For slope ships, and foam core wings on thermal ships, in my opinion, the wing bolts that come with kits are way overkill. Kill the plane that is! Not to pick on anyone so I won't mention the plane name, but a kit I recently built with a 66" span 22 oz. slope/thermal aileron glider, came with 1/4" bolts. These bolts have a shear strength near 230G-force for a plane of this weight. Who has ever built a foam/obechi wing that would stand that kind of stress? For planes up to 35 oz. or so I recommend 2 4-40 or 6/32 nylon bolts. (I got a kit once with 4-40 steel bolts!!) This way the bolt will give, not the wing, or

holddown block. I heard the Aussie speed record for gliders was done with 2 4-40 nylon bolts!! For HLG's I use one 4-40 in the center, and a 2-56, or a 4-40 with the head cut off at the rear to prevent pivot. For contests, you hate to have to replace a bolt in the middle of a round, so a normal 4-40, or velcro works great. The problem with contests is that lots of planes try to fly in the same space at times. In this case a mid-air could separate the wing from the body. Not good. Dedicated contest ships usually don't use this construction technique. This is for play time planes. A pair of 8-24 nylon bolts will easily hold an open class wing on, if the wing is two piece, I put two bolts on either wing section (front and back) as seen in picture 3. To prepare for the holddown installation, a 3/8" dowel works nicely. Drill the hole in the wing, cut and fit the dowel to sit flush top and bottom, (easier done with the dowel out, than epoxied in), then epoxy the perfectly sized dowel in place. Next, drill the hole for the bolt, and countersink with a 3/16 wood drill so the head doesn't stick up. When the wing is ready, hold the wing in place and drill through the holes into the plywood crossbar installed in the fuselage. Move the wing and enlarge the hole to accept the blind nut. I like to do one hole at a time, so the installed bolt can hold the wing steady for perfect alignment of the second holes.

Another aspect to preserving a wing is to give it a way out. Many fuselages have a vertical stop in front of the wing. This is a way to guarantee damage in a straight in crash. I usually re-design to get a nice sloping ramp for the wing to follow in the event of a crash. Let the wing break free of its holddown, and slide away. (You did use plugs that will release for the aileron servos, right?) Many low wing slopers have vertical front edges to the wing saddle. This will often break a wing in half in a straight in crash. Modify this to a ramp, and use small bolts for the wind holddown, and you'll be laughing after a crash. In my opinion, wing leading edge dowels that fit in a hole in a vertical former should be outlawed in beginner craft. They pretty much guarantee a nasty repair job on the wing or fuse or both, in the event of an "oops" at low altitude.

Ballast:

There is nothing like flying with a big old chunk of lead in the bottom of a slope ship. There is also nothing quite like the debris left behind when a 20 oz. chunk of lead has pulverized a path through your radio gear on its way through the nose after a sudden stop.

A couple ways to minimize this:

Using lead shot in a bag in a ballast compartment is one way. If the lead breaks the compartment it scatters out, reducing shock. (This is bad for the ducks in the area though.) Another is to bolt in a film canister, drill right through the side, then bolt it in. Open the cap and fill'er up with split shot, or lead shot. Be sure to get all the free floating lead out after a crash though, as it causes some weird flight characteristics if you have a few split shot rolling around in the fuse. A few friends use roofers sheet lead cut to size and formed to the fuse shape, then through bolted with nylon bolts and nuts. In a splat test, the bolt will shear, and the open sheets of lead seem not to do much damage, either from the individual pieces not packing the wallop of a lead ingot, or that they are bent to the fuse shape and the bolt absorbed some impact. Either way, it seems to work.

This is just a small list of ways for building planes that can take some abuse. If you have better or more ways, let me know. If there are enough, we will revisit this subject in the future. Good luck, and many crumple landings to ya. ■

on the Wing

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A Novel Control System Mechanism

An unconventional model from Holland provides an idea for enthusiasts of tailless planforms...

We often receive inquiries about trimmable control surfaces. In addition to the standard aileron and elevator or elevon complement, the designer may wish to have a "trim tab," as this can be quite handy when trimming a tailless sailplane for best performance within a specific flight regime. Until this idea appeared in DELTA, however, every mechanical system we had seen had two problems; drag from various mechanical components protruding into the airstream, and "system slop".

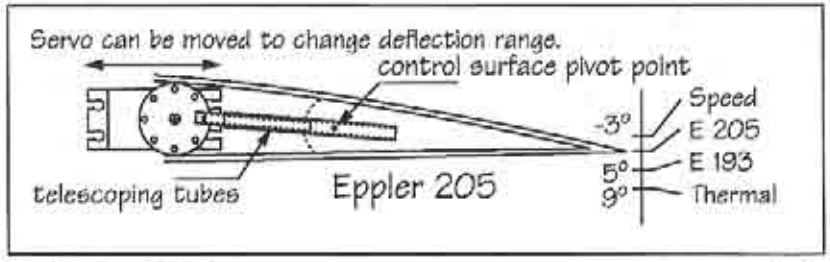
In order for the servo to transmit its relatively large forces to the control surface for appropriate deflection, some sort of mechanism must be designed and built which will provide the needed control surface deflection range and an appropriate mechanical advantage. The most obvious way of accomplishing this is to put a rather large arm on the control surface, and attach a smaller than usual servo wheel to the servo. But a long control horn is anti-aesthetic, produces a large amount of drag, and disrupts the local airflow over the control surface. We have found such control systems also lack rigidity.

The control system sketched here, however, has some real advantages. There is nothing protruding from the wing or control surface, so it is aerodynamically clean, and there is a minimum of slop in the physical system. Additionally, a standard servo wheel can usually be used. This system consists of a set of telescoping tubes which are attached at one end to the control surface and at the other to the servo wheel.

The diagram shows the component layout used within the wings of Arend Borst's Onnozel, a "noseless" V-tailed sailplane designed for F3B. As you can see, the range of deflection for camber changing is just 12° — three degrees up and nine degrees down — but the total range of deflection is greater. The control surface can be moved in very small increments while being held rigidly in position at all times.

Readers implementing this control system should begin by either drawing the system geometry on paper or by building a mock-up which allows adjustment of servo position. Less control surface travel, and finer adjustment, can be obtained by moving the servo further away from the control surface pivot point, while more travel can be realized by moving the servo closer. Since the entire mechanism must fit inside the local internal height of the wing, a bit of experimentation is certainly in order.

We would very much appreciate hearing from any readers who utilize this idea in a tailless sailplane. B²Kuhlman, P.O. Box 975, Olalla WA 98359-0975. ■



Designing the Raptor 135 Part 2 - Airfoil Selection and Performance Analysis

...by Dave Squires
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Last installment in the April issue of *RCSD* I covered the history of how the design idea developed in my head and how it came to be a real project. I provided the performance polar data table and graph as well as the three view line drawing. This installment I am going to get into more detail. I will be covering airfoil analysis and selection and how the performance analysis was done.

Airfoil Selection

Airfoil selection is a tricky process if you are looking for the highest performance and attempting to do something "different" to advance the state of the art of sailplanes and soaring. I suppose I should really be an aeronautical engineer. I am not, however. I am just another R/C model builder who loves flying and wanted to design a "big" model. I have learned a lot about airfoils from Soartech 8. If you don't have a copy of Soartech 8 and you are serious about modelling, then get a copy. You will learn a lot. I also learned a great deal writing my airfoil viewing and editing program, AFEDIT. I used this program to modify airfoils in my search for the airfoil for the Raptor sailplane.

Since I am not an aeronautical engineer I decided not to get too "original" in selecting or designing an airfoil. I just don't know enough to do a competent job of it. So, I started with an existing airfoil to see if moderate modifications will give me what I want. The next question is: How do I determine what I want or what is needed in the airfoil to do the job?

The basic requirements are listed below.

Airfoil Requirements:

The requirements for the wings of the Raptor 135 are as follows:

1. Aspect ratio of 34:1; 22 inch root chord, 10 inch tip chord; Constant taper. Straight leading edge TE tapers forward.
2. Span of 13.5 meters (44.3 feet). Each panel 21 feet long. This gives a wing area of 56.3 sq ft.
3. Wing to be approximately 3.5 to 4 inches thick at the root for adequate spar strength and to minimize spar tension. This sets the airfoil thickness range between 16% and 18% with a 22 inch root chord.
4. Lift vs drag curve to show mild stall characteristics and give 40:1 L/D or better in the finished sailplane, or lowest drag airfoil possible within these constraints.

I looked at many different airfoils before settling on the one to be used on the prototype glider. It was a long process. As you will see, I settled on one airfoil first, then found out it did not really give me the performance I wanted and I had to change airfoils. But to keep the story in sequence I will cover selection of the first airfoil, then the second.

First, I ordered the airfoil analysis program Airfoil-ii from Airware in Connecticut. This program is basically Dr. Richard Eppler's program developed at NASA and converted and compiled to run on an IBM compatible PC. You may have read other reviews of this program in other publications. I will not review the program in any detail here.

It is a scientific style of program that is not the easiest to learn to use and understand. The human interface is not the best and is somewhat cumbersome to use, at least compared to what I am used to. It is not very user friendly if judged by today's standards. It appears that it was written by Phd scientists for use by Phd scientists. So be forewarned if you plan

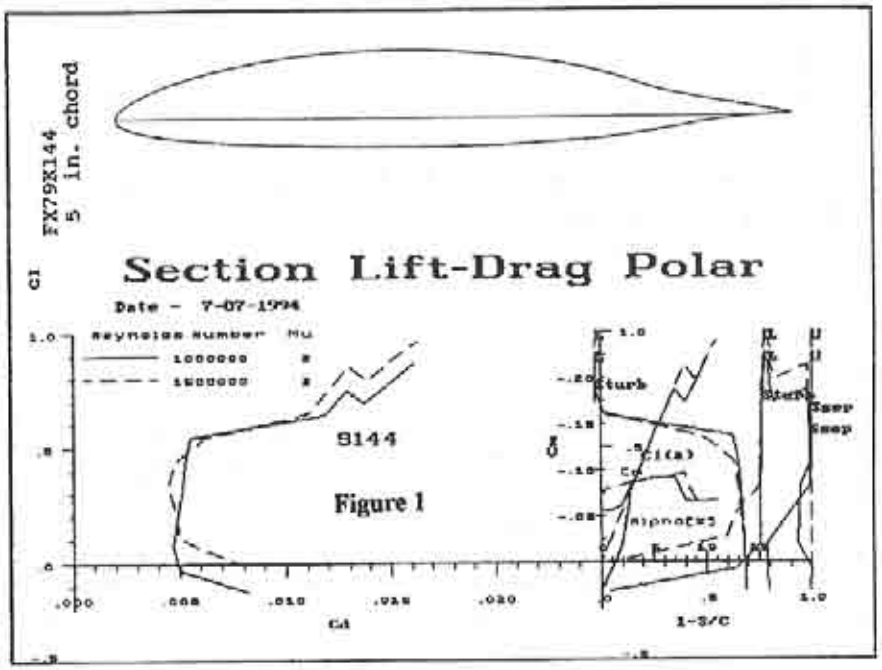

Figure 1

to buy the program. It will take some getting used to.

In any case, computer "wind tunnel" analysis was necessary, so I sent in my $400 for the program. It took me awhile to figure out how the program really worked. You practically have to be an aeronautical engineer to really interpret the results properly. Once you get the hang of it you can get some very useful data from the analysis that is very close to real wind tunnel data albiet usually a little on the optimistic side. It is fairly accurate for reynolds numbers of 1,000,000 and above.

I am an electronics engineer, so I had a bit of a learning curve to climb to get competent enough using the program to understand what was going on. I did this mainly by running many known airfoils through it and plotting the results. By comparing the results I began to understand what was important for laminar flow and what to look for. I also learned what seemed to not matter very much or could be ignored in the output. I am still really a bit of a novice at using this program. But what the heck, you have to start somewhere.

I used the coordinate input option to read in known airfoil coordinate files and analyze them. One of the better full size airfoils I considered was the Wortmann FX79K144. It is a strange looking airfoil intended for use with flaps. It is the lowest drag airfoil I have run on this program so far. It is quite amazing as well as a little strange looking. See Figure 1 for a plot of the FX79K144 and the polar plot from Airfoil-ii. In essence it is an airfoil that in the "neutral flap" position appears reflexed, that is, upward flap deflection. I would have used this airfoil except that it is 14.4% thick. I needed an airfoil that would give good low drag numbers and higher lift and be at least 16% thick due to the high aspect ratio I planned to use. This seemed to be a very tall order and I did not know if it was even possible. I needed a minimum of 16% thick to get the minimum 3.5" thickness at the wing root for structural

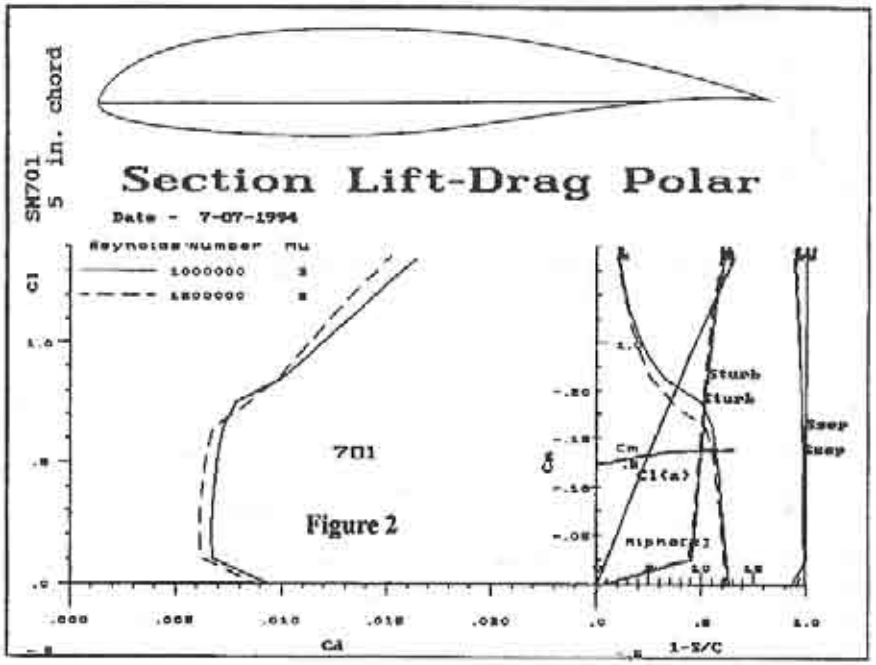

Figure 2

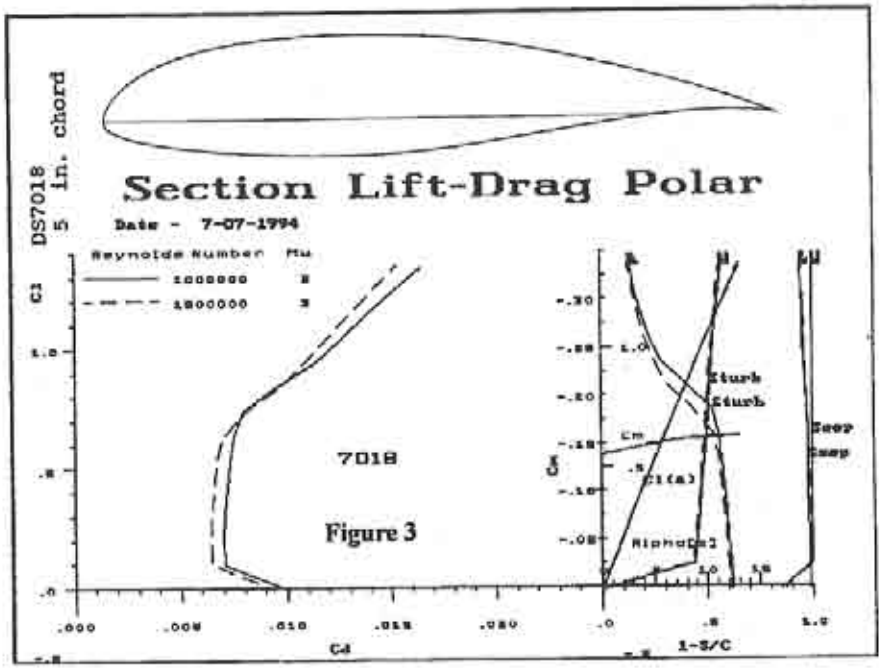

Figure 3

reasons to minimize flex in the high aspect ratio wings and not put too heavy a load on the carbon spars. The extra thickness is also needed to increase torsional stiffness to avoid high speed flutter.

I used my program AFEDIT to scale the FX79K144 up to 18%. However, Airfoil-ii showed that it did not work well with that much of a change. I tried other radically different original shapes and some were not too bad, but not good enough. (As you will read later, I scaled the FX79K144 to 16%, took out the reflex, and it does work at this thickness.)

Then I got the fall issue of *Sailplane Builder*, a publication of the Sailplane Homebuilders Association. It had a review of the SM701 airfoil designed by Somers and Maughmer for the World Class competition that ended last year. The published polar data looked pretty good and it was 16% thick. This was closer to my 18% maximum thickness target. They had published the Airfoil-ii output showing the velocity distribution and polars. It was designed to have a gentle stall to provide good handling at low speeds for tight thermalling and be forgiving of pilot errors. It also had to have low drag at cruising speeds for cross country flying.

I typed in the coordinates that were published in the article and then converted it to the Airfoil-ii format using AFEDIT. I then did an analysis run on Airfoil-ii. I got the same answer as published in the article. This gave me the right starting point. I then loaded up the SM701 in AFEDIT and scaled it to 18% thick. With AFEDIT you can scale the camber and thickness together or independently. I used the option to scale both simultaneously so that all parameters would hopefully track each other. So the camber and thickness were scaled by 1.125X or increased by 12.5%. The 1.125 is 18 divided by 16. I called the new airfoil the DS7018. The 'DS' is my initials and the '18' stands for 18% thick. The '70' indicates something of the origin from the SM701 to give some credit to its creators.

I then translated the DS7018 coordinates to the Airfoil-ii format and did an analysis run. Now, this is where the real surprise came in. The output plots looked almost identical to the SM701!! The exception was that the lift was higher before the drag started to increase at higher angles of attack. Both sets of airfoil polars are printed here so you can do your own comparison. (See Figures 2 and 3.) I thought this was pretty amazing. I talked to Stan Hall about this and he confirmed that it was possible. He said that he learned a long time ago that a thicker airfoil does not necessarily mean higher drag than a thinner one. It all depends on the profile and if and how much laminar separation occurs. This means that a thicker airfoil with no separation problems will have lower drag than a thin airfoil with laminar separation bubbles. It appears that thickness is a secondary concern with full size airfoils. Laminar flow is the primary concern.

Now, I also needed an airfoil that would do pretty well at low Reynolds numbers so that I could use it on the third scale model rather than change to some other airfoil. This way I could get a better idea of how the full size plane will handle from how the model handles. If the model did not exhibit bad stall spin tendencies or tip stall tendencies, then the full size plane also would not exhibit these bad tendencies. I realize that perhaps this is a bit much to ask, but I am bound and determined to try anyway. I'm crossing my fingers on this one. My bet is that the model will spin like crazy and tip stall unless a different airfoil is used for the tip section of the wings.

The Reynolds numbers for the model at the wingtips, which have a chord of only 3.33 inches, will be about 50,000 in slow flight. This is pretty darn low and very 'iffy' for the high wing loading that will be required. The wing area for the model

is 6.26 square feet total (901 sq in). The all up weight will be about 14.6 lbs. This gives a wing loading of 2.23 lbs per square foot or 37.3 ounces/sq ft. This will not allow very slow flight or landing speeds. Best glide speed will be about 29 mph and minimum sink at about 25 mph. I estimate the stall speed to be about 20 mph. This will seem pretty fast to anyone used to flying floaters. It will stall where floaters are flying backwards. It will be much like flying an unlimited slope racer with full ballast. It will really move out. This means that if you put the nose down it will really cover ground with redline at about 92 mph. Remember, I am building a model to DYNAMIC scale, so everything has to be scaled properly. I could fly it at 9 or 10 lbs for fun flying, but that would be cheating for full size flight characteristics evaluation using the model.

The DS7018 airfoil seems to do OK at the low Reynolds numbers, but the wind tunnel program is inaccurate at these low numbers. The assumptions and equations tend to break down and give overly optimistic results. Only flying will tell as I don't have access to a real wind tunnel to find out what the actual polars are at low speeds.

The Plot Thickens (or I change my mind)

In engineering you always want to keep double checking what you are doing. Well, I had this gut feeling that the DS7018 was giving me results that were too optimistic. So, I went back through the process and found an error in the spreadsheet starting at the third column of data. One parameter that was supposed to be a constant across all columns suddenly changed. This gave L/D results that were too high. Everything else looked good except that I wondered about the airfoil parameters used in the spreadsheet analysis (see below). I fixed the error and changed the selected data up one data point on the lift vs drag curve. The maximum L/D changed from 42:1 to 37:1. I wanted over 40:1 L/D so this got me looking into the FX79K144 again. I wondered if it would work if I were to effectively take out the reflex in the airfoil to make a new airfoil with no flap deflection. So, I proceeded to write a function for AFEDIT to do just that. It turned out to be pretty easy to implement. A FLAP UTILITY function is now part of the program.

I do not want flaps on the full size glider. It may be that it would be suitable for standard class racing competition. Flaps are not allowed in this class. So this is the reason that I wanted to take out the negative flap deflection of the FX79K144. Perhaps in another model of the Raptor, wings with flaps could be retrofitted.

I played with the flap chord and the angle of deflection to get about a perfect deflection from the FX79K144 to a non-flapped version. This happened at +9 degree deflection and at 19.2% of chord from the TE. A slight editing of an upper surface and lower surface coordinate to get the "hinge line" bump out, scale it up to 16% thick, and presto, a new airfoil is born. I then translated the coordinates to the Airfoil-ii format (Eppler style), smoothed it and ran Airfoil-ii to get the "wind tunnel" lift vs drag polar data. See Figure 4 for the new DS46160 airfoil and the lift vs drag polar graph. This curve is for a Reynolds numbers of 500,000; 750,000 and 1,000,000 only for simplicity.

Performance Analysis (Full Size)

Of interest here is the sailplane performance polars or graphs. I don't know where the term "polar" came into usage (shows my ignorance), but it is just a graph of the sink rate at different airspeeds. "Polar coordinates" have nothing to do with anything here. So we need to calculate the lift, drag, sink rates, and airspeeds for different coefficients of lift and drag for the airfoil to be used. We

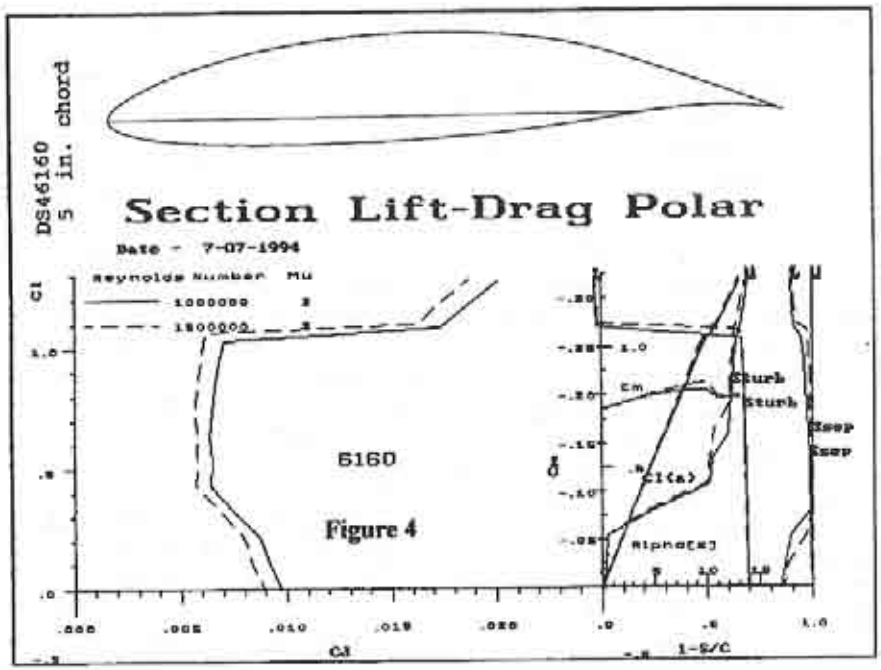

Figure 4

also need to know the parasitic drag contribution of everything else except the wings. Total up the drag and total up the lift and calculate the sink rate and the airspeed then plot the graph. Sounds easy enough until you start thinking about it. I would have no idea how much drag the fuselage and tail section would contribute. I tried using PC-Soar, but it did not work for a full size sailplane very well. The numbers were completely unrealistic. So I began looking for a better way to get accurate results for a full size sailplane. As I mentioned in the first article, I ran into Stan Hall, renowned sailplane homebuilder and aeronautical engineer at one of the SBSS club meetings where he was the featured speaker.

After meeting with Stan Hall I took his step-by-step method and entered it into the spreadsheet program on my computer. It is tailor made for this purpose it turns out. All of the data entry is straight forward except for the required numbers from the airfoil polar data. I talked to Stan about this to get a better understanding of it. It turns out to be pretty simple. There is a parameter called 'B' and a related drag number that are required. It is an extrapolation of the slope of a Cl "squared" polar curve at the higher lift region to the Cd axis. The Cd axis is the horizontal axis or "coefficient of drag". I figured out a way to enter the airfoil Cl and Cd numbers from the appropriate points on the curve and the spreadsheet would calculate the correct number automatically. I used the curve for a Reynolds number of 1 million since this is an average number for a full size sailplane. I did this for the PIK20 example as well to get a correlation comparison from the Airfoil-ii results. I got the same answer as the example Stan Hall provided. This was encouraging and told me that I was doing it right. So I plugged in the numbers for the DS7018 airfoil and presto it shows a 42:1 best glide using the same fuselage cross sectional area as the PIK20.

OK! TIME OUT!! TIME OUT!!

I wrote most of this article before I did the double checking I explained in the "plot thickens" section. Rather than rewrite the whole article to 'sanitize' it I decided to leave it intact and add the changes to show my mistakes so others could learn from them as well. Though not a huge error, it shows the subtleties that can be encountered and that the design process is not necessarily a smooth one as you may be led to believe by the usual polished articles that are published.

So we now know that the DS7018 airfoil is NOT going to get the 42:1 L/D I first thought. This is where I change my mind and decide to use the new airfoil I modified from the FX79K144. I called this the DS46160 airfoil as explained above. The maximum camber is 4.6% and it is 16% thick, hence the 46 and the 160. You know by now where the DS comes from, ...ego, pure and simple.

Fuselage Cross Sectional Area Calculation

I calculated the real cross sectional area of my fuselage profile and it is less than the PIK20 example. I really doubt that it is less because I have designed a larger than normal cockpit to accomodate a 6'4" pilot. Using the PIK20 fuselage cross section I get 41.34:1 best L/D at 50 knots with the DS46160. I plan to use winglets on the Raptor 135. This will reduce the induced drag of the wing and increase the L/D 2.5 to 3 points to perhaps close to 43:1 or 44:1. So 44:1 may be possible to achieve with winglets. This would be outrageous in a short span 13.5 meter light weight sailplane. It could possibly compete head to head with a 15 meter Discus or Ventus even without flaps. We shall see if it is for real or not. It sure makes the process more exciting with the possibility of 43 to 44 to one glide ratio in a 13.5 meter plane. Now I want to get it done to find out.

The fuselage cross sectional area is required for Stan Hall's method of calculating the performance. It is needed for the drag calculations to determine L/D.

To calculate the cross sectional area of a compound curved section like a sailplane fuselage, I used a manual "integration" method. For those of you who know calculus, integration is the method of calculating the area under a curve by a mathematical algebraic manipulation to give an exact result. In the case of this cross section I know the curve, but not the equation for it. Since integration fundamentally breaks up the area into small rectangles and sums the area of each one an approximation can be done using a manual equivalent on graph paper. Doing this you get little extra triangles added or missing that constitute the error. The error can be minimized by ending the rectangles at the midpoint of the vertical line at the end of the rectangle instead of the bottom or top of this line. Use a fixed short side dimension for all sections and use say 20 to 30 sections vertically. The long side becomes variable. Calculate the areas for all sections and add them up. The ones near the top and bottom will have the most error and you can estimate any correction and figure this in too. Add all of the areas up and you have the total area to within one percent or so. This is close enough.

The table of performance polar data using the DS46160 airfoil are shown in Table 1. These are the spreadsheet results with some columns removed so that it will fit on one page. In essence the method calculates the lift total and the drag total and then calculates the lift/drag result, airspeed, and sink rate for each coefficient of lift point. Each coefficient of lift point corresponds to increasing angles of attack. Best glide comes in at about 0.9 to 1.0 coefficient of lift. Minimum sink at a little higher lift than this. Each equation depends on the result from the one before. So the process is a progressive one. The performance polar graph is

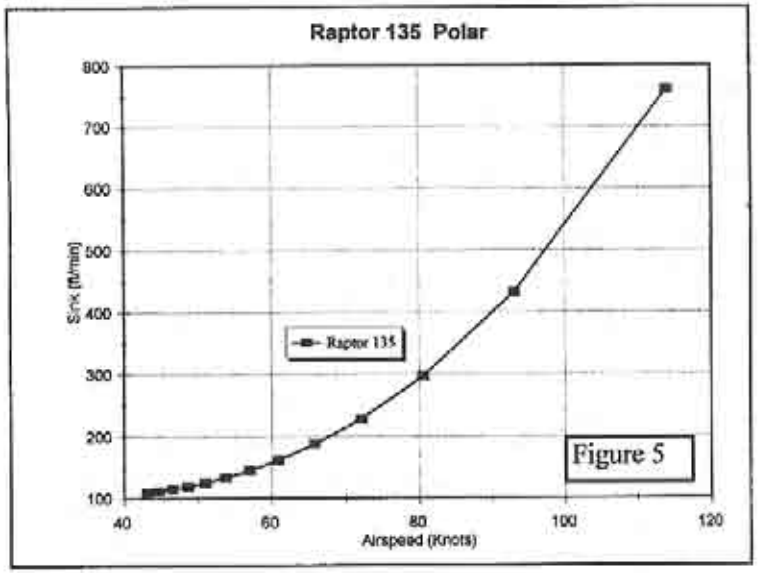

Figure 5

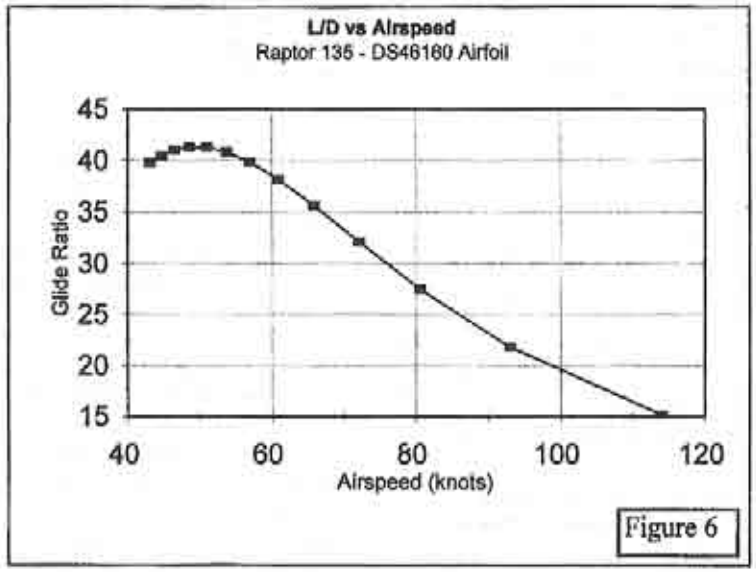

Figure 6

shown in Figure 5. Figure 6 shows the L/D vs Airspeed plot. Due to the inability of the spreadsheet program graphing capability to invert the "Y" axis the polars are inverted from what you might be used to. The spreadsheet instant recalculation feature is really nice to do "what if" changes and see the results immediately. You can change the fuselage cross section for example and see the effect right away.

I did this sort of thing trying different airfoils. I tried the SM701, DS7018, and the FX79K144 and the DS46160. The SM701 gives about 37.0:1 L/D, the DS7018 about the same and the FX79K144 and DS46160 about 41:1, assuming no winglets. It is interesting to note that the thickened versions of the SM701 and the FX79K144 give nearly the same performance as the original versions of the airfoils. This is fortunate for me as I need

the added thickness for structural reasons. A 15 meter version of the Raptor using the DS46160 shows a 44.7:1 best glide ratio at 47.7 knots. I did some comparisons using known sailplanes and I get results a little pessimistic compared to the real plane using this peformance calculation method of Stan Hall's. This indicates that the numbers are likely to be accurate if not underestimating the performance. Winglets would kick it up to 47:1 to 48:1. The calculated minimum sink rate would be 98.5ft/min. This is pretty awesome in a 15 meter standard class sailplane... nearly a perpetual motion machine. The further I get into this project the better it looks. Usually it happens the other way around. I did find some errors, but it has not torpedoed the project. It still looks very good.

Stan Hall's Performance Analysis Method

Stan Hall was kind enough to give me permission to provide his performance analysis approach for publication here. So here goes.

This is a step by step method that you can do by hand if you don't have a computer. This method works beautifully on a computer with a spreadsheet program. It would be good if you knew some algebra as well. I will try to explain this method as clearly as I can so you can make use of it.

What you will need:

- airfoil polar data at a Reynolds number of 1 million, not just the graph. You could, I guess, use a plot and measure the numbers from it, but it would not be as accurate.
- the fuselage cross sectional area as explained above.
- to calculate a couple of parameters from the airfoil data. (B and Co)

I will show you how to do this.

Once you have all the required data, you simply have to follow the step by step approach and calculate each parameter in sequence.

Some assumptions:

1. The fuselage style is similar to that of any high performance modern fiberglass sailplane so that the drag contribution is reasonably accurate.
2. The planform does not depart radically from the 'standard' type of fiberglass sailplane. If you try to use this method for a flying wing or a canard all bets are off.

Calculating B and Co

This part can be really confusing if you don't know your math. All you really need to know is algebra, but an understanding of calculus would really help. I will try to explain it as simply as I can in a step by step approach so that all you have to do is add, subtract, multiply and divide. First of all you need numbers for points on the polar curve for a reynolds number of 1 million (full size analysis). You need a minimum of two pairs of points. Start with the ones near a coefficient of lift of about 1. Slightly over or under is ok. Then pick numbers that are near Cl's of 0.9. 0.8, and 0.7. Put these in a table where Cl is coefficient of lift and Cd is the coefficient of drag at that Cl point. This is where Airfoil-ii is really handy. The output provides these numbers and I just pick them out of the file, write them down and enter them into the spreadsheet.

Ok! Here is where we get into the algebra part of doing this. We need to find the slope of the polar curve with the Cl points squared near the 1.0 Cl point. This done by the following method.

You need at least two sets of data points on the curve. We have the following numbers from the DS46160 polar data.

Data point A:Cl = 1.031 Cd = .0070
Data point B:Cl = 0.936 Cd = .0068

The calculation of 'B' and Cdo uses Cl squared

Delta Cl = Cla x Cla - Clb x Clb = 1.031 x 1.031 - 0.936 x 0.936 = 0.1869

Delta Cd = Cda - Cdb = 0.007 - 0.0068 = .0002

For the mathematically inclined: B= dCd / (dCl squared)

Now imagine projecting the line through the points (with Cl numbers squared) down to the Cd axis. This crossing point is the Cd at zero lift or in other words Cdo. It is not the real drag coefficient at zero lift. It is a projected coefficient. This is the number that we want. To calculate it use the following formula:

B = (Cd2 -Cd1)/((Cl2*Cl2) - (Cl1*Cl1))
Cdo = Cd2 - Cd2*B

B = (0.007 - 0.0068)/(1.063 - 0.0876) = 0.0002/0.1869 = 0.00107

Cdo = 0.007 - 0.007*0.00107 = .00699

I know it seems a bit complicated. You have to use this formula for a computer spreadsheet. Read Cdo as Cd zero. B is the slope of the Cl squared vs Cd curve. We now have the two required numbers from the airfoil polar data; B = 0.00107 and Cdo=0.00699 for the DS46160 airfoil data used here.

You who want to put this in your spreadsheets the formula above is the one I used. Cd2 and Cl2 should be close to the Cl=1 point if possible. Cd1 and Cl1 are the next pair of points down on the curve to get reasonable results. The Cd and Cl numbers would be replaced with the appropriate row and column locations for the airfoil data that you have entered.

The main parameters we are interested in are the lift of the wing, the drag of the wing, the drag of the fuselage plus tail, and the airspeeds and sink rates at which these occur at coefficients of lift between 0.1 and 1.2 in increments of Cl of 0.1. Stan Hall used increments of Cl of 0.2. He did this because he was assuming hand calculation was to be used and the coarser increments reduce the calculation effort. With the computer I can use the finer resolution because the spreadsheet calculates all the numbers in an instant. Talk about saving time! Once you have the Lift and Drag numbers and airspeeds at all the Cl numbers you can now plot the performance polar either by hand or by using any graphing ability of the spreadsheet program. I used Quattro Pro 5.0 for Windows.

I have given the procedure for a single Cl so that the formulas for each step can be given without taking up the entire page. You would repeat the process to generate columns of data for each coefficient of lift. Once this is done plot the sink rates on the vertical axis and the airspeed on the horizontal axis for each Cl. You now have the sailplane performance polar graph. Again see Table 1 for the performance data for the Raptor 135, which shows multiple columns of the above process. So there you have it, a fairly simple way you can get accurate performance analysis results for a full sized glass sailplane without being an aeronautical engineer. Many thanks to Stan Hall for his help in giving me the above method and pointing me in the right direction.

Some Conclusions

The performance gain with higher aspect ratio is not a linear function. Partly due to the larger percentage contribution of the fuselage drag compared to the contribution of the wing alone. This is one reason a Nimbus 3 has a 60:1 glide. It has 25 meter wings and a 32:1 aspect ratio. The fuselage is small compared to the span of the wings. The calculations show that I am probably pushing the limits of what can be gained by increasing aspect ratio in a short span plane. I have reduced the wetted area by using a skinny tailboom. The thin tailboom also reduces the weight, which is the main reason to make it thin.

Exotic composite materials must be used

Below is the given data of the Raptor 135:

Description	Variable	Actual Number
Span	b	44.3 ft
Wing area	S	56.3 sq ft
Aspect ratio	AR	(44.3*44.3)/56.3 = 34.86
Airfoil DS46160	B	0.00107
Airfoil DS46160	Cdo	0.00699
Total tail area, horiz + vert	SE	8.25 + 9.17 = 17.42 sq ft
SE/S		0.3782
Fuselage Cross Section area	AF	3.52 sq ft
AF/S		0.062522
All-up Weight (wing load * area)	7 lbs * 56.3 sq ft	= 394.1 lbs

Performance calculation for a single coefficient of lift (Cl = 0.8)

Description	Number
Cl	1.1
[1] Cl squared	1.21
[2] Cdo	0.00699
[3] B	0.00107
[4] B * Cl squared	0.001296
[5] Cd wing profile =[2]+[4]	0.008286
[6] Cd induced = (0.334/AR)*[1]	0.011593
[7] K =1 mid wing; =0.25 shoulder	0.25
[8] K* Cl squared	0.2025
[9] 1 + [8]	1.2025
[10] AF/S = 3.52/56.3	0.062522
[11] Cd(fuse) = 0.052*[9]*[10]	0.0039095
[12] SE/S = 19.54/56.3	0.3094
[13] Cd (tail) = .008* [12]	0.002475
[14] Cd(total)= [5]+[6]+[11]+[13]	0.0262638
[15] L/D = Cl/[14] = 1.1/0.02656	41.88
[16] Vhoriz= sqrt(W/(Cl*S*.0012))	72.822 feet/second
[17] Vhoriz mph = [16]*.682	49.66 mph
[18] Vhoriz kts = [16]*.592	43.11 kts
[19] Vsink fps = [16]/[15]	1.7387 fps
[20] Vsink fpm = 60*[19]	104.32 fpm
[21] Vsink kts = [19]*.592	1.041 kts

to keep the weight down while maintaining high strength and stiffness. Torsional stiffness to avoid flutter becomes a major concern and multiple shear webbing sections or ribs to tie the wing skins together must be used. These things all add weight and begin to make the weight target more difficult to reach. Calculations show that the 220lb empty weight is still realizable. The wing panels will weigh about 50 to 55lbs each giving 110lbs maximum for both wings. The wing skins alone will only weigh 26 pounds for both the top and bottom surfaces. The fuselage plus horizontal stabilizer must be at or under 110lbs. This is achievable if the retractable landing wheel and frame can be made from aluminum instead of steel. Given that the all up weight is half that of a 15 meter glass ship

TABLE 1

Raptor 135	Airfoil -> DS46160		Wing Loading 7lbs/sq ft				
Cl --->	0.200000	0.400000	0.600000	0.800000	1.000000	1.100000	1.400000
1	0.040000	0.160000	0.360000	0.640000	1.000000	1.210000	1.960000
2	0.006993	0.006993	0.006993	0.006993	0.006993	0.006993	0.006993
3	0.001071	0.001071	0.001071	0.001071	0.001071	0.001071	0.001071
4	0.000043	0.000171	0.000386	0.000686	0.001071	0.001296	0.002100
5	0.007035	0.007164	0.007378	0.007678	0.008064	0.008289	0.009092
6	0.000384	0.001536	0.003456	0.006144	0.009601	0.011617	0.018817
7	0.250000	0.250000	0.250000	0.250000	0.250000	0.250000	0.250000
8	0.010000	0.040000	0.090000	0.160000	0.250000	0.302500	0.490000
9	1.010000	1.040000	1.090000	1.160000	1.250000	1.302500	1.490000
10	0.062424	0.062424	0.062424	0.062424	0.062424	0.062424	0.062424
11	0.003279	0.003376	0.003538	0.003765	0.004058	0.004228	0.004837
12	0.306870	0.306870	0.306870	0.306870	0.306870	0.306870	0.306870
13	0.002471	0.002471	0.002471	0.002471	0.002471	0.002471	0.002471
14	0.013169	0.014547	0.016844	0.020059	0.024193	0.026605	0.035217
L/D RATIO	15.187340	27.497292	35.621854	39.882386	41.334183	41.346246	39.753259
AS FT/S	192.696822	136.258644	111.254717	96.349411	86.177533	82.187054	72.833309
AS MPH	131.420597	92.926395	75.875717	65.710298	58.773078	56.037931	49.672317
AS KTS	114.077703	80.665117	65.882792	57.038851	51.017100	48.642896	43.117319
SINK F/S	12.688122	4.955348	3.123215	2.415839	2.084887	1.987282	1.832134
FT/MIN	761.287335	297.320859	187.392912	144.950322	125.093847	119.237506	109.928057
SINK KTS	7.511368	2.933566	1.848943	1.430177	1.234259	1.176477	1.084623

the loads on the landing gear frame are also half and an aluminum frame will probably work. Pushrods must be made of .035 wall aluminum tubing for lightest weight. Basically, the lightest and strongest materials must be used to make a safe and lightweight sailplane.

It seems that it is not necessary to use carbon cloth in the wing skins. Only the spar needs to be carbon. I will be building the spar at the same strength as a 500 lb empty weight 15 meter plane. The torsional stiffness needed requires overbuilding the spar. This will give me about a 23G strength limit for the wings. As you can guess the wings will be very stiff. I don't expect much flex at all.

Model Construction Update

At the time of this writing the fuselage mold for the third scale model is complete and the first fuselage has been pulled. The first one is always the worst and this one has some defects, but is not too bad. It is useable with a little patch work to fill some air bubbles along the seam line. I wouldn't try to sell it though.

The horizontal stabilizer mold is also done and the first stab has been pulled from the mold. It is a 28" stab that weighs 5.8 ounces. It uses the honeycomb core sandwich construction and is very strong. The rudder mold is also finished and the first rudder pulled from the mold. The wing plugs are in process at the time of this writing. To get the model in the air I will be building foam core wings for the first flights. The molded wings will come later.

The plan is to have the model finished sometime in July or August. The maiden flight will happen at Los Banos at the reservoir in California because of the large flat landing area and the strong lift that is prevalent there. I may need plenty of room for recovery from mistakes and to check the trim. Also, it is a large area with a wide lift band where the higher airspeeds will not be a problem. Anyone who wants to be there for the maiden flight drop me a card at the above address and I will let you know when the big event is going to happen. It should be exciting. ■

A Simple Wind Tunnel to Demonstrate Lift vs. Drag

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

Here is a simple but effective one-evening project which can be used for yourself, for your club, or as a science demonstration. It demonstrates the relationship of lift versus drag at various degrees of angle of attack. It can even be used as a simple research tool for relative comparison of various airfoils, turbulators, flaps, etc.

Construction is easy and can be shaped according to the materials you have and your final purpose for the device. Make a simple one first and then later you can improve on it if so desired.

The device consists of the following (Fig 1.):

1. A table fan, caged for safety. You can use a variety of fans to demonstrate the effect of various air speeds. Next to the fan should be an...
2. Air-straightening device. You can make one out of cardboard or use a bottle separator from a wine box. This creates a straight, smooth air flow. (The fan otherwise would make a twisting swirling air stream that plays havoc with the wing being tested.)
3. A gallows-shaped wooden support, fastened to the table with a U-clamp. On the other extreme end there is a protractor and a vertical metal shaft of 1/8 inch diameter going through the wood. The upper end of the shaft has an arm attached to it. (Use the control arm of a nose wheel from an engine plane.) This will automatically serve as the pointer on the protractor.
4. The metal shaft extends downwards and has a universal joint at its bottom end. This can be a U-joint from a model boat shaft or, in a pinch, you can use a piece of rubber tubing from your high-start.
5. The bottom end of the U-joint has a simple wooden attachment which is fastened to the wing section being tested. You can devise something that will enable you to quickly re-attach various airfoil/wing sections.
6. The actual wing section being tested. This could be a 6-inch chord(wide) by 18-inch long straight wing, the cross section of which is the airfoil being tested. If you don't want to be too exact, you can bend up some bristol board into an airfoil shape and attach it to a wooden "spar". If you want to be precise, use wire-cut foam and vacuum bag it for a very exact airfoil shape.
7. From the airfoil down, a long slender wooden dowel (1/4" dia.) extends almost to the floor. Make a pointed tip at the bottom end.
8. A sheet of paper taped to the floor. When the fan is not running and the wing is attached to the dowel, the dowel tip should point at the "origin" of the graph axes.

Alignment

Align the device so that when the wing is pointing straight into the air flow, the pointer at the protractor points to zero degree of angle. The X-axis on the paper on the floor must be parallel to the airflow. Now start the fan.

Operation

As soon as the fan starts, the wing will be swept back slightly and the dowel point will move along the X-axis. This indicates the drag of the "wing" at zero lift. Now rotate the pointer to one degree. You'll notice that the wing deflects and the dowel pointer climbs above the X-axis and along it, which means that more drag as well as some lift have been created. Mark the location of the pointer on the paper and write down next to it the angle of attack at which it occured. Now

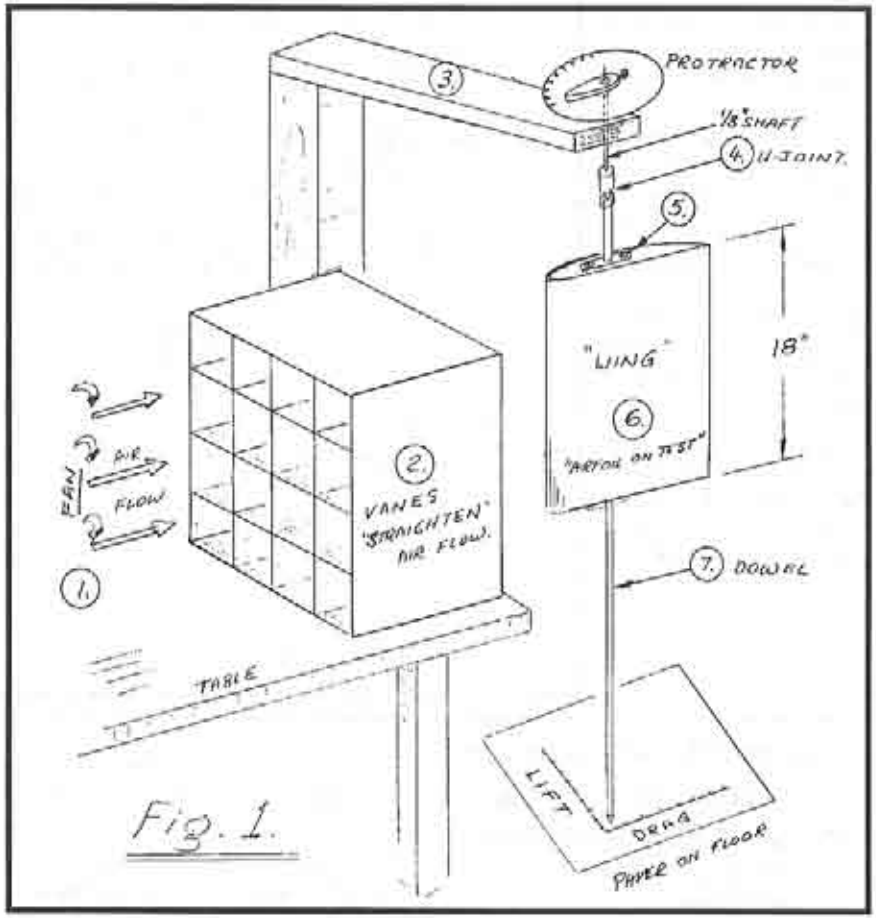

Fig. 1.

move the pointer to 2-degrees and again mark down the location of the pointer. Keep raising the angle and marking down the location of the pointer. After you get many test points, connect them with a smooth line.

The stall point

As you keep increasing the angle of attack (i.e., the angle between the airfoil and the airflow) you'll find that the lift keeps increasing but so does the drag. Eventually you'll get to a point where the lift begins to drop but drag increases. This is the point at which that airfoil will stall at that particular airflow. Fig. 2.

Improvements

You can improve the performance of the device by paying attention to certain points. For instance, make sure that the 1/8" metal shaft is fairly tight in its wooden bushing. The wing sections you test should be exactly the same size (chord and span) as well as weight from one to the other if you want relative accuracy. The pointer at the bottom can be made telescopic (two dowels side-by-side, held together by a rubber band) so that the pointed end is always almost in contact with the paper underneath. The structure should be high above the table so that the wing and the pointer can be as long as possible to eliminate errors caused by the angularity as the wing deflects under the U-joint, etc.

Change the fan to faster speed and mark the test points on the same paper. One fan-line can be red, the other blue and so on. This gives you important information abaout the importance of air velocity.

The degree of sophistication you want depends on whether this is a simple project or a semi-scientific tool for more serious research.

Compare the data you get with that of previously published data for various airfoils. Have fun, develop your own airfoils! ■

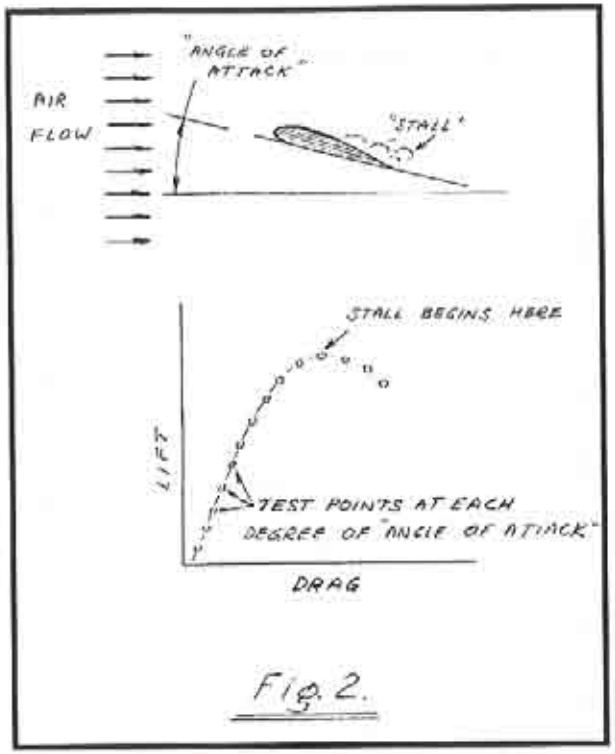

Fig. 2.

A Sport Flyer's Review Building and Flying Slegers International "Night Hawk"...

...by Harry Edwards
Pleasanton, California

I call this a "sport flyer's review" because it is just that. I don't fly in the 60" slope class, don't fly F3B, and am no thermal duration God either.

But I do enjoy all aspects of RC soaring: slope, scale, and thermal flying. In short, I am a sport flyer, so this review will reflect this simple bias.

I became intrigued with the Night Hawk as soon as I saw the first Slegers International ad which showed it off. After a call to Ed Slegers I learned that the Night Hawk was not only a Mark Allen design, but I also learned that the fuselages were being made by Daryl Perkins and the wings by Ron Vann. Ed's enthusiasm and "can do" attitude was great. I Faxed Ed my credit card number and my Night Hawk was on its way.

The kit arrived in a sturdy cardboard box. Inside, I found a beautiful fiberglass fuselage and two pre-sheeted (obeche) foam wing halves with carbon fiber reinforcement. This is what I had expected. What I *didn't* expect was the very complete hardware package, and the nice attention to detail. The wing tips and stab are pre-cut; even the aileron and elevator control horns were pre-cut from lite ply. A very nice touch. What I think really stands out about the Night Hawk is the fact that the kit is *totally* complete—you can build it without any additional hardware. How many kits can you really say that about?

Accompanying the kit was a 6 page instruction manual outlining the recommended construction sequence. No plans are provided, nor are they needed.


Cathy Edwards and Night Hawk.

Construction (perhaps *assembly* is a better term) is very straight forward. I made several minor modifications to the basic building instructions: I substituted nylon wing and stab bolts for the metal ones provided, and also used tapped hold down plates instead of blind nuts. These changes were based on personal preference. I also added a strip of carbon fiber reinforcement along the sides of the fuselage, extending from just past the nose to the training edge wing hold down plate. (I retrospect, I think that this is really unnecessary.)

The stab bolts directly onto the top of the fuselage fin. This makes alignment problems a moot point. It also allows the stab to be very easily removed for transport.

The only time consuming element of building the Night Hawk is facing and sanding the aileron and leading edge surfaces with the supplied bass wood. I like to lay down a line of masking tape over the wing sheeting adjacent to the areas where the bass wood will be glued and sanded. This strip of masking tape provides an excellent "buffer zone" that will prevent you from inadvertently sanding through the wing sheeting. I sanded the bass wood surfaces with an electric palm sander, and finished with a sanding block and 320 grit — about 4 hours total.

Prior to covering the wings, I "polished" them with 400 grit sandpaper. Investing only an hour doing this gave me wings with beautifully smooth obeche sheeting.

I finished the wings and stab with Ultracote Plus. This is a self adhesive film covering that's a little like working with shelf paper. After a false start on one wing panel, the Ultracote Plus went on very easily, and with no wrinkles or bubbles or heat gun burns. Neat stuff. The fuselage was easily finished with Krylon sandable primer and a Glossy Red finish coat. Total building time was a very leisurely 16 hours.

I recommend that you build the Night Hawk with the removable stab. This feature makes transport very easy. I can assemble my Nighthawk in about 5 minutes. This is very convenient if you want to keep the plane in your trunk so you can slip out of the office for some late afternoon flying.

The radio installation for the Night Hawk is very straight forward. I used 3 Futaba S33 servos because that's what I had laying around. The wings have the aileron servo pockets pre-routed to aid installation. The radio area will easily tol-


Night Hawk Easily Disassembled.

erate a 400 MA (2/3 AA) battery pack and a modern 7 channel receiver in addition to the elevator servo.

Balanced at the recommended CG point, the ready to fly weight came out at 28 oz. This is 3 oz heavier than the instructions indicate, but still yields a wing loading of only 11 oz/sq ft. I'm sure that a light builder could get the weight down to 26 oz. without any difficulty.

This is usually the part of the review where the author says something like: "I tossed the glider off the hill and it flew great, etc..." Well, my first flight was less than spectacular. On my initial launch the Night Hawk wallowed in the air like a sick Gentle Lady. It was all I could do to get it turned around and back for some semblance of a landing.

I was very disappointed... had checked and doubled checked everything. I decided not to make any "field modifications" and to wait until I could get the plane back on my bench to sort things out. I flew my trusty Hobie Hawk the rest of the day, but my heart wasn't in it... I was wondering why the Night Hawk was acting so tail heavy.

That next Monday I called Mark Allen, the Night Hawk's designer, and related my experience. Mark immediately asked me if I had one of the early kits with a recommended CG of 4 1/8" from the TE. Well, yes, that's exactly where I had the CG.

Mark told me that was a typo and the correct CG point was 4 3/4" from the TE — a BIG difference! That night I rebalanced the plane. After setting the CG at Mark's recommended point, I also checked the stab incidence and found it off just a little. A simple shim of 1/32 lite ply took care of this. Might as well get it right on.

I can now say that flying the Night Hawk is a real joy. As long as you keep the RG15 airfoil moving, the plane will fly in remarkably light air. Smooth flying is really rewarded. I started using 2:1 aileron differential, but have since been using only about 1.5:1. Less differential gives me better rolls and doesn't seem to contribute to any greater adverse yaw. Energy retention with the Night Hawk is really outstanding, even when flying without ballast. Mix-in flaperons for your turns and you can really bank 'n yank!

As an added bonus, the longer tail moment of the Night Hawk will allow you to thermal on a dime with very good pitch stability. The Night Hawk is ideally suited for inland flying sites that combine both slope and thermal lift.

I think that the Night Hawk will make a mark for itself in the 60" slope class. The quality and value of this kit make it a nice alternative to higher priced composite ARF's. Any flyer with aileron experience and minimal kit building experience will enjoy building and flying this great 60" glider.

For more information contact: Slegers International: (201) 366-0880. ■

Attention to all European readers...

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Beginner's Corner
Precision Construction
Part 1

...Ed Jentsch
2887 Glenora Lane
Rockville, MD 20850-3052
(301) 279-7611

"It flew right off the board!" Does that amazed exclamation ring familiar? When you hear it, do you suppress envy while complimenting the proud builder, both of you wondering why luck chose this particular time and place to strike. Luck? Really?

Model builders, even experienced ones, pay homage to Lady Luck, evoking pictures of her rolling dice while they labor mightily over myriad jigsaw-like pieces littering their building board. Why is that? Typical kit planes represent proven designs. If built "to spec", why shouldn't they fly "right off the board" as a matter of course? Why do we invoke external agents-of-fate when something that should happen always, happens at all? Human nature, it's wonderfully puzzling at times.

In model building, skill, not luck, determines success. And skill is not the province of a rare breed born with a silver exacto knife wedged between thumb and forefinger. Anyone, with patience and attention to detail, can do precision construction. This series of articles will explain how, thus relegating Lady Luck to a more proper role—holding your hand at the lottery ticket counter.

Before delving into how though, we must prepare ourselves with knowledge of what and why, else we lose sight of the forest in a misguided effort to perfect each twig. Worse, without understanding, we lack adaptability when faced with variations that don't fit our practiced methods.

A well-built model plane is an icon of both strength and balance. Strength prevents its succumbing to normal flight and landing forces. Balance constrains it to stay a straight and narrow path during launch and hands-off flight.

Strength arises from careful fitting of mating parts, use of proper adhesives, and judicious enhancements to the designer's more economical vision.

Four seemingly disparate things comprise what I refer to here as "balance". They are: symmetry, decalage, center-of-gravity (COG), and tow hook location. Get them right and you can, with impunity, take a newly minted plane directly from building board to winch.

Symmetry

With very rare exceptions, the left and right sides of a well-built aircraft are perfect mirror images, whether viewed from above, below, front or back. Without symmetry, some set of forces acting on the model will not sum to zero and the residual will relentlessly push the untrimmed model from its desired flight path.

Achieving symmetry is the essence of precision construction and its greatest challenge.

Decalage

Place the model's plan on a flat surface. On the side view, with a long straight edge and pencil, draw a line connecting the main wing's leading and trailing edges and extending toward the tail. Draw another line connecting the horizontal stabilizer's leading and trailing edges, extending it toward the nose. The lines will not be parallel. Decalage is the angle between them. It is a critical angle. Together with the COG, it imbues the model with pitch stability—an attribute much in favor with beginning flyers.

Maintaining the decalage angle specified by the designer is another fundamental goal of precision construction.

Center of Gravity (COG)

Look again at the plan side view and find the symbol for the center of gravity. It's usually drawn just below the main wing as a small ellipse or circle, segmented into quadrants with two opposing quadrants darkened. A finished, ready-to-fly model will balance front-to-back somewhere within the horizontal range represented by the symbol. Beginners should err in favor of a slightly nose heavy plane, meaning the COG will be more forward. A COG that is outside the limits shown on the plan guarantees major difficulties, if not disaster.

Store in memory this fact: all kit planes are tail heavy by design. Were this not the case, adjusting the COG would become a major engineering feat beyond the ability of ordinary mortals. A simple implication follows from this: if choice exists, install radio components closer to the nose, thus reducing the need for nose ballast, which increases weight, which increases wing loading, which increases flying speed, which increases beginners' terror.

Tow Hook Location

Return to the plan side view again and note the tow hook location. First, understand that its location relates to the wing, not to some point on the fuselage, although the difference is negligible in practice if the finished model deviates little from its design limits.

Either a single location, or a range may be shown. If a range, then like COG, its forward end is the beginner's target. Moving the tow hook rearward exposes the model to launch "pop-offs".

Looking Ahead

Precision construction has one **mandatory** prerequisite, a building board as faultlessly flat as the earth before 1492. Buy or make one, your choice, but, do not scrimp here; it's your most important tool and a worthy investment.

Spec-wise, the board should be flat within ± 1/32" and sized to accommodate the largest wing you may build. Its surface should facilitate mounting-pin penetration and removal. Prove it's flat. Use a sufficiently long aluminum ruler, on edge, to verify. Check that the board is neither bent or twisted.

Our virtual model for subsequent installments will be of built-up balsa construction and sport polyhedral, top-mounted wings. Nothing fancy, nothing high tech; a cousin to the Gentle Lady.

With this model we will learn how to achieve symmetry, how to ensure the correct decalage angle, and how to position the COG and tow hook. In other words, we will learn how to build precisely.

[1] Mine is a hand-picked 1_" hollow-core interior door, topped with 12" wide, 1" thick cork, laid atop a workbench, and shimmed to the required flatness. A local lumber yard supplied the door; Rahm's, of Bellflower, CA, supplied the cork. Total cost: about $100, including a hefty shipping fee for the cork. ■

ZIKA

Forward Swept Wings

...by Jef Raskin
Pacifica, California

Recently, Larry Renger (who works for Cox and is a tireless promoter of and innovator for model aviation) called me for some recommendations on the aerodynamics of forward-swept wing slope soarers. He had done his homework and had found a well-written article on the subject by John Rapillo serialized in the April and May 1988 issues of *Model Builder*. Larry wanted some confirmation of his conclusions about forward sweep. The article is gung-ho advocacy of forward sweep and presents all the good points, but is a bit reticent about the problems which I discuss here. Also, it was based on full-scale practice and hadn't been completely re-thought for model purposes. I wrote Larry a letter with my analysis and it was suggested that *RCSD's* readers might be interested.

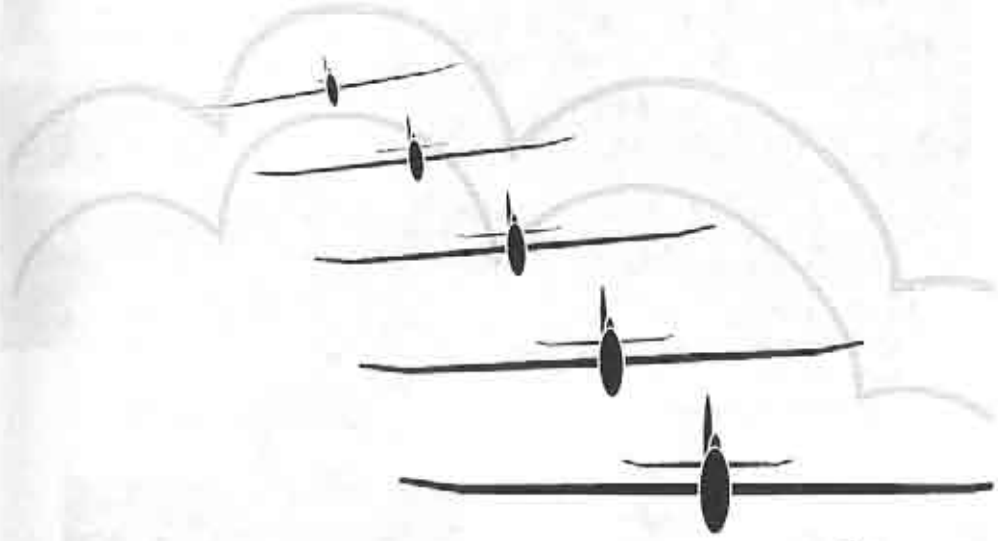
Rapillo starts out by reminding us that tailless aircraft can have sweep forward or backward and be completely stable. While Rapillo favors forward sweep when it comes to my hobby-horse, aerobatics, it is best to have no sweep, in order to avoid coupling roll and yaw. Sweeping a wing *back* does contribute to tip stalling, and one of the strong points of forward sweep is that the center stalls first leaving the ailerons at the tips in full control. But you can also control tip stall by limiting taper ratio or using washout. I avoid washout for aerobatic models since if it helps upright flight, it harms inverted flight. I prefer to decrease the taper to solve any tip stalling problems.

Discussing free-flight or thermal-style flying, Rapillo recommends washin at the tips of his forward-swept planes; this makes them much like a canard in their flying qualities, they will not stall or spin. But since the tips are heavily loaded in this scheme, the induced drag is higher than for a conventional layout.

My experience shows that in Rapillo's statement "A tailless airplane relying singularly on the qualities of a straight wing can be extremely sensitive..." the wiggle-word "can" is important. Straight wings can also be quite insensitive. My rectangular-planform R/C Anabat flying wing is so stable I made my daughter one which she uses as a *free-flight* glider. It has no sweep, washout, or dihedral at all and yet can be tossed out any way, even backwards and upside down and will quickly recover into level flight. Sweep, forward or backward, does make an aircraft longer and therefore, as he says, less sensitive, but it is by no means necessary for absolute stability.

In the second article Rapillo speaks of using aspect ratios from 6 to 9. My friend, Al Morse, has a great-flying R/C slope delta with an aspect ratio of 3. It is one of the best performing flying wings I have seen. My flying wings have aspect ratios between 4.5 and 5.3. At lower Re, lower aspect ratios are often *more* efficient due to their larger chord, but it depends on the individual case. I use no dihedral (Rapillo recommends 8 to 10 percent of span) again because if it works upright, it hurts inverted flight. Dihedral and higher aspect ratios are fine in a "floater" design though they both lower aileron effectiveness.

As Rapillo points out, forward-swept wings are less stable directionally and structurally more difficult to build. In addition to the aerodynamic twisting (structural divergence) effects he describes, forward-swept wings are more readily broken when the narrow tips hit the ground first. To me, this last is a superb reason for not using forward sweep. To be durable as a straight or rear-swept wing, a forward-swept wing must be heavier, thus incurring a penalty before it's off the drawing board. It also requires larger (and therefore heavier and draggier) fins than no-sweep or rear-sweep designs.



ZIKA

On airfoil sections, I must completely diverge from Rapillo's recommendations, which are based on full-scale practice. His figures come from tests done at Re=6,000,000. A big Reno-style R/C racing plane can reach Re=3,000,000. But sailplanes rarely exceed Re=500,000 (a 9 inch average chord model at 80 mph), where airfoils behave very differently. As Soartech 8's and other tests show, the 63- and 64- series foils are **terrible** at model Re. They do not give "significant drag reduction" as Rapillo suggests. The four-digit NACA foils are better. The symmetrical NACA 0009, the SD8020, and the WE3008 are all usable for flying wings with the WE3008 having the highest L/D and maximum coefficient of lift of the three according to Michael Selig's computer analysis. The 12 percent thickness airfoils Rapillo recommends are too thick except for very large models and I suggested that Larry Renger might want to use thinner airfoils, which he did. Al Morse's superb delta, mentioned above, has a 6% thick airfoil (NACA 0006).

Conclusion: Forward sweep does not offer enough advantages to offset its disadvantages, especially in a flying wing design. We have to pay too much in weight and drag to get its fine behavior in the stall, and other claimed aerodynamic advantages are minimal. Besides, good stall characteristics can be better obtained in other ways. Forward sweep is definitely OK if (you) choose it for its radical looks. I have no quarrel with those who say, "Hang the aerodynamics, after all, this is a hobby and I'll make planes however I like." Come to think of it, my 18" span scale slope biplane is very ill-advised aerodynamically, Re is too low and it's draggy, but it sure is cute... ■

Dieter Mahlien and the Dingbat designed by he and Jum Thurmond. This model performed exceptionally well in the heavy winds at Eagle Butte.

Del Brengman loves Canards. This picture shows one of his designs about to be launched.

NASSA News

Some Photos Taken at the WSJ

...by Wil Byers
W. Richland, Washington

Dr. Eppler seemed to enjoy himself immensely while helping Dieter with his land launch model.

This fellow puts out one of the best newsletters anywhere. Waid Reynolds of the Seattle Area Soaring Society helped put on probably the best organized slope races I've ever seen. Here he holds an ICARE ASW-20.

Drew and Ed Mason are son and father. And, they are super enthusiastic flyers. Here, Drew is readying to launch Ed's scale Corsair.

From Jolly old England, Rob Potts travelled to the WSJ with his very nicely done Algebra series airplane.

Don Pesnecker, the President of the Portland Area Soaring Society, is displaying his Easy Eagle. Don is a fellow R/Cer who is filled with enthusiasm. The kind of guy who helps this hobby grow!

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*.

ModelSaver™

...from Don Edberg, Dynamic Modelling

I am pleased to inform you of a NEW product, now available for your readers. The product is called the **ModelSaver™** and is imported from Japan by my company, Dynamic Modelling. The **ModelSaver™** has a bunch of great features, as you'll see below!

In a package that weighs just 1/4 oz (7 grams) and takes up little space even in the most crowded models, you get a package with a loud beeper that can —

- Save your model from an unnecessary crash by beeping and warning you of a low receiver battery. No more need to carry around a bulky ESV — it's inside your model all the time!
- Help you find your model if you land it in tall weeds or a cornfield! Just turn on the ModelSaver's™ sound beacon and follow it to the lost model.
- If you forget to turn off the receiver, the beeper warns you!

The **ModelSaver™** emits a loud sound when the receiver battery voltage is lower than 4.45V. *This warning can save your model from a dead battery!* (Upon request, a 5.55V threshold **ModelSaver™** is available for 5 cell receiver packs). It can also be commaned on at any time with an auxiliary channel. The **ModelSaver™** has negligible current drain: in its idle mode (sound off), less than 1 mA. With the loud buzzer operating, the current drain is just 25 mA.

The ModelSaver™ is very small, and fits nearly anywhere. Its dimensions are 1-1/2" x 1/2" x 3/8" (36 x 13 x 10 mm). The **ModelSaver™** is compatible with all radios and works with every R/C system made, AM, FM/PPM, or PCM. The **ModelSaver™** is available with Airtronics®, Futaba®, or JR® connectors. (Be sure to specify which in your order.) You may also order without connector (subtract $3).

The price for the **ModelSaver™** is US$35, post paid in the US. (Foreign readers should send US$40.) For further information, please write Dynamic Modelling, 4922 Rochelle Ave, Irvine, CA 92714-2941, or call 714-552-1812. ■

Winners: (R) Noel Roediger with Orao 2C, (L) Pete Melders with ASW 24E. Martin Simons photo.

NASSA NEWS

Australian Scale Soaring Weekend

April 23rd, 24th, & 25th 1994

...by Martin Simons

In many ways this was the best and most friendly scale thermal soaring meeting we have had since the series began in 1990. We have, it seems, found a good formula for the competition so that no one went away grumbling or feeling that they had not been given a fair chance.

Everyone had a lot of fun, as much flying or more than they could really handle, and ample opportunity to look at other peoples' models, see them in flight and exchange ideas and information.

Special thanks are owed to the Bordertown/Keith gliding club who allowed us to use their excellent on-site facilities, the clubhouse with sleeping accommodation, catering (by the very hard working and cheerful women of the club), briefing room and dining room, bar and of course the huge airfield where we operated our models from one strip while the full sized gliders were operating from another. At no time was there any conflict or danger in the air and a simple radio link was established which, though hardly used at all, would have enabled any possible emergency to be avoided.

A special word should also go to Lester Vine who, though being a keen sailplane model builder and pilot, dedicated himself for the entire weekend to operating a tug. Because of his devotion to duty, the other tug present was hardly needed. It says much for the aircraft, too, that it did more than eighty launches during the three days with hardly a hitch. The power unit for both tugs is the Xenoah G 62. One propeller was broken, a good deal of fuel and charging power was used, a tail wheel needed some attention overnight on Saturday, but otherwise the tug was in constant use.

The only cause for regret was that several people who have attended on previous occasions did not wish to enter or were prevented from entering this time. It is clear that this kind of scale competition does not appeal to everyone. Entries were down on last year. We were, nonetheless, encouraged by the arrival of several keen newcomers and a number of people turned up to see what was going on and promised to have their own models ready for next time. We were specially impressed by the excellent *Jantar*, shown incomplete by one of our new Victorian members who had been unable to finish it in time. We also know of an *ES 60 Boomerang* under construction and there are certainly other new models on the way. Let's hope we all get a chance to see them in 1995.

Static Judging

The competition began on Saturday morning with the static judging. There was every opportunity at this time for fun flying and trimming flights to be done, though no one took advantage of this period for such purposes. Perhaps they were unwise to let the chance slip by. It may have been that some competitors were reluctant to risk damaging their models before judging but they could have started flying immediately after their own aircraft had been scrutinised. Perhaps they were all too interested in seeing the other models being displayed on the table.

The judges were Peter Nicholls and Brian Stopp, both highly experienced instructors of the Bordertown/Keith Gliding Club. They, too, must be thanked, for they gave the best part of the whole day to their task. They adopted a very fair and objective approach which was much appreciated.

Qualifying Flights

After the static judging was over Peter and Brian moved down to the flight line and scored all the qualifying flights. Each sailplane was required to take off, release from tow, make three successive thermaling turns to the left and three to the right, perform a stall and recovery, carry out a voluntary manoeuvre, join the circuit and land. All aspects of the flight were scored. It was at this stage that some entrants wished they had, after all, done some trimming flights earlier in the day.

Ian Moreland's ASW 17, which had scored well in static, provided some unexpected excitement when its wings suddenly adopted a very high angle of dihedral, more than that observed in a gliding pigeon. The wings resembled a letter V, as several persons were inclined to demonstrate digitally later in the weekend. Ian did well to get the model down safely without further damage. It was found, after a struggle to de-rig, that the heavy steel strip wing joiners on both sides had bent in the vertical plane. There was no sign of twist or other distortion. The spring steel had simply exceeded its elastic limit. Both strips were the same. (We hope to do some small research to find out what the bending load causing this failure must have been. For future reference, note that the wing joiners commonly supplied with kits, may not be good enough!)

Needless to say, Ian's ASW 17 did not score very well and was not available for further flying. Richard Tapp had radio problems and did not fly.

The qualifying flights were all completed by 3 p.m. and it was decided to postpone the duration task until the morrow, the rest of Saturday afternoon and evening being available for fun flying.

A spit roast lamb, with some excellent roast potatoes and superb salads were provided by the club and very much enjoyed. The clubrooms were well occupied for the rest of the day. There was a rather eccentric pool table. Or was it the players who became slightly eccentric later in the evening?

The A.G.M.

A brief and informal Annual general Meeting of the Scale Soaring Association of Australia was held in the briefing room on Saturday evening and a small new committee was elected. Ron Carson, Max Newcombe and Joe Rufenacht have stood down because of business and family commitments. Peter Melders was elected President for the coming year, Ian Moreland was elected as Secretary and Treasurer, I shall continue as Newsletter Editor. The committee has powers of co-option.

Duration Task Flying

On Sunday the first take off for the duration task was within minutes of the advertised time of 9 a m.

Competitors had to try to accumulate 45 minutes of total time in the air, in order to score the maximum points. This turned out to be quite hard to do, especially for those who had two models in the competition.

There was a fairly steady breeze from the north west. Thermals did not exist early in the morning. I required ten launches with my Condor 3 to get this model to the required total.

In the afternoon, the wind strengthened, becoming a little too strong for the slower models like Ian Moreland's T - 21,

but there were some thermals about. Noel Roediger's magnificent *Orao*, by far the heaviest model in the competition, made two very good soaring flights with only a couple of 'topping up' launches needed to achieve the required total. Noel could afford to work thermals higher than most of us because he could make better headway against the wind on the way home. A high wing loading is an advantage in these conditions.

Longest flight of the day, over 24 minutes, was done by Dave Whitten. My PWS 101 required a last flight of 11 seconds at about 3.30 p.m., which, with a couple of celebratory loops, marked the end of the competitive flying. After this, fun flying continued until dusk.

The most spectacular incident of the day, which did not after all put John Copeland out of contention, was when, distracted by a triviality, he momentarily took his eyes of his DG 500 while it was on tow. The model got badly out of position, the tug motor was throttled back, the glider accelerated, caught the tow line round its wing and gyrated wildly before crashing. Remarkably, with some hasty patchwork and repair to an aileron, John was able to get the DG 500 into the air again and did accomplish his 45 minutes. He was not so fortunate with his ASW 22, which was damaged later.

Throughout, Lester Vine, assisted by Theo Inkenharg and Ian Moreland, kept the tug going. The other tug, belonging to Peter Melders, was called on when the other was refuelling or recharging batteries.

Award of Trophies

The award of trophies was arranged after the scores had been added up, and flying continued until dusk. Once again, an excellent casserole meal was laid on in the clubroom.

More flying took place on Monday, although many of the model fliers by then had departed.

What have we learned?

In large part, the success of this meeting was due to hospitality shown to us by the gliding club and the first class facilities for flying, meals and social activities on site. The CFI, Bevan Martlew, expressed himself highly pleased with the way things had gone and impressed by the standards of operational discipline showed by the modellers.

Venue for 1995

The gliding club has invited us to return and it seems very probable that our next competition, in 1995, will be at Bordertown.

Date

The date, in April, may be rather late in the soaring season. We were lucky with the weather. As one gliding club member said afterwards, at this time of year anything can happen, even in the excellent soaring country around Bordertown. An earlier date might be preferable next time, especially since the Anzac day holiday does not fall so conveniently on a Monday in 1995. It seems that two days is enough for us. By Monday morning, everyone who had participated in the competition had done a lot of flying. Those of us with two models had done two quite testing qualifying flights and ninety minutes soaring or attempted soaring. It was enough for most of us, although we did continue for a while on Monday.

Programme of Events

Although it was not exactly planned so, the way things worked out this year suggests that in future competitions it may be best to use the first day for static judging and formal qualifying flights, with the duration task flying postponed until the second day. This takes pressure off the static judging process, which, if done fairly, is bound to take time.

We did not do what we had intended, to have a separate judging panel for the qualifying flights. With our smaller numbers this year, this did not seem so important (except that our two volunteer judges did have to work very hard). In future it will be most necessary for the qualifying flights to begin early while the static judges are still at work. This means tugs and flight judges will have to be ready to start as soon as the first model leaves the display table.

Tugs, Tugs, Tugs!

Nobody at Bordertown used a winch or hand line for launching. It might seem our models have outgrown these launching methods. But really there is no reason why good, powerful winches should not be used, with extra long lines if required. It is, despite the doubts and fears of some folk, perfectly possible and safe to launch a big scale model by winch. After all, we saw the heavy *Twin Astir* carrying two people launched repeatedly by winch during the weekend. If the full sized sailplanes can be so launched, our scale models must be capable of it too. We are not restricted by the FAI Competition rule book. Granted, one can have accidents with the winch (I should know), but we had several incidents, resulting in damage, with aero towing too. Murphy can strike at any time and we should not forget winch launching.

Again, with a smaller meeting, one very reliable and powerful tug with a dedicated pilot and a single stand by, was adequate. With more sailplanes, we shall need more tugs and more tug pilots.

This time, since all launches were given by the same tug under similar conditions, there was no need for any height limiting devices to be used. This will not necessarily be so in future.

Charge for launches

The $2 charge made for aero tows has proved both necessary and acceptable to the contestants. Apart from the fuel costs and the expense of the journey, a propeller worth over $30 was broken during the weekend. Lester and his faithful crewman Theo, laboured mightily for more than two days and it is essential that such dedication should be recognised in a tangible fashion.

Self Launching

Two self launching sailplanes were competing, John Copeland's DG 500 and Peter Melders' ASW 24E. As it happened, neither used the motor, taking aero tows like the rest. There is no doubt, however, that future contests of this kind will see self launching sailplanes operating as they are intended. At present they are treated just like the rest but it may turn out to be necessary to give them special rules or, perhaps, to create a separate class for them.

The SSAA Committee Contact addresses and phone numbers

Peter Melders (President), 18 Blackburn Court, Elizabeth E, SA 5113. Phone (08) 2557210 A/H but before 8.30 pm.

Ian Moreland (Sec/Treas), 2 Snead Crescent, Fairview Park, SA 5126. (08) 2511424

Martin Simons (Newsletter Editor), 13 Loch St., Stepney, SA 5069. (08) 362 5476 ■

Editorial

The North American Scale Soaring Association (NASSA) news column is a bimonthly column that appeared in *RCSD* for the first time in December, 1992.

The original intent of the founders was to "utilize *RCSD* as the news provider" in order to keep the dues for joining NASSA as low as possible.

It has been pointed out that some of you that receive *RCSD* may only be interested in the "NASSA News" column. If you are currently a member of NASSA or want to be a member, we would suggest, if this is true, that you borrow a friend's copy of *RCSD* instead of subscribing. There is no requirement to subscribe to *RCSD* to be a NASSA member.

It has been our policy to help further R/C sailplane flying and, because we believe in the NASSA effort, we have not accepted any reimbursement for the NASSA column, announcements, or ads. Any advertising costs incurred by NASSA are based upon the advertising guidelines of other publications.

If you like scale, we encourage you to join NASSA in order to receive your NASSA packet which contains Scale Sources, Membership Roster, and Scale Articles. Their address is: NASSA, P.O. Box 4267, W. Richland, WA 99352.

Judy ■

NASSA NEWS

...by Gregory Vasgerdsian
Concord, California

By this time all NASSA members should have received your latest NASSA Scale Packet with Scale Sources, Club Roster, Scale Articles and a few other scale items of interest included. *Soaring* Magazine graciously granted us the right to publish something our vintage fans will love. In recent years there have been a number of new sailplanes made in Germany and Europe of which most of us over here are totally "clueless" about. We have some precious three views of these, which we hope to add to the NASSA mailings.

The club roster is at 134 members. We know there are more scale modelers out there! I'm sure many of you figure, "Why join when I already get all the news in *RCSD*?" Well, guess what? You aren't getting all the news, only the 134 current members are. We'd like all of you that are scale modelers to join NASSA, not for the Scale Packet but because of our goal to promote scale soaring. One of our main focuses is to support scale events at the local level such as paying for advertising for scale events.

The '95 Los Banos Scale Fun Fly is scheduled for mid to late April! A great site, and this time event organizers are planning for a three day event with a dinner, and pilot's choice awards for Modern, Vintage and PSS, plus the NASSA Pilot's choice award for the overall favorite.

There will also be the '95 NASSA Fun Fly at Point of the Mountain, Utah. This is a great excuse to see a beautiful part of the country that perhaps you've never visited! A world class site, with lots to do and see around Salt Lake City. Details on this one still to come.

Okay, Fall is coming up quick. What wondrous scale project are you going to have as your Winter Project? Hopefully the great scale articles and the NASSA Scale Sources List have you motivated! Whether you choose to spend more and build less, or spend less and build more, scale has a place for everyone. Remember, scale soaring is what you make of it – what you build, and how you build it. That about cuts it for this round! ■

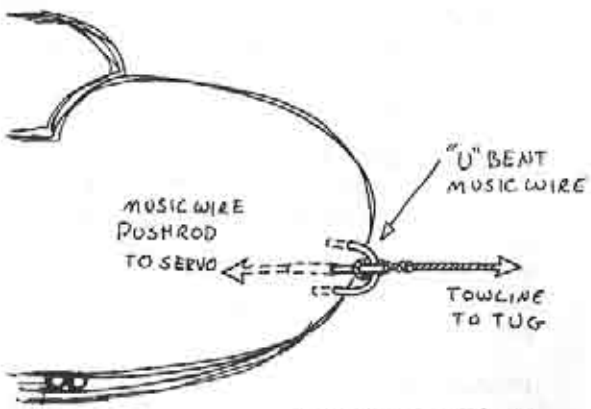
NASSA News

Glider Tow Release

...by Greg Vasgerdsian
Concord, California

Though Hobby Lobby offers a great tow release system at a low price, there is an easy way to make your own. Bend a piece of music wire into a "U" shape and mount at the nose of the glider. Drill a hole just next to it for a music wire pushrod which runs from a servo and ends just past the end of the "U". The pushrod should just touch the side of the "U". Run a looped tow line around the pushrod end and through the "U" as shown. When the Servo retracts the pushrod, the line is released. Clean and simple!

Note: the "U" does not have to be mounted at the very front tip of the nose, and this same release can be set up for the tug, as well. ■



Comments about the Mid-South Soaring Championships

...from the St. Louis & Louisville Newsletters

The following comments were sent in via FAX by Bob Sowder of Memphis, Tennessee. He says, "We are truly grateful for these kind acknowledgments and look forward to a repeat performance next year in Huntsville, Alabama!"

"Now I know what is meant by Southern Hospitality! These guys run a well organized fun contest. They are very friendly and made us feel at home."

"The sod farm we flew on was at least 15 times the size of our home field."

"One hundred competitors showed up from 17 different states, and they also had vendor exhibits from several of the sailplane companies so you could see, touch and ask questions directly of the designers and manufacturers. I personally spoke to Tim Renaud of Airtronics, Mark Levoe (Super V), David layne (Saturn), Rich Spicer (RnR), and Jerry Slates of Viking Models and *RCSD*."

"Saturday night they (MSSC) had a banquet with Memphis Bar-B-Q catered at the field for dinner. I told you they were organized!"

"They had a novice, sportsman, and expert category, so this contest was designed for everyone. They also had some great door prizes and raffle prizes."

"I must say that these people put up a great show... professionalism to the extreme."

"Since pre-registration was required, each contestant received a package including our flight group info., product advertising literature, a very nice name tag, MSSC decal, and tickets for dinner and door prize."

"I will try and make this a regular stop in the future and hope more of the club members will join in the fun."

"Every year, this contest has grown until it must rank as one of the premier in the country to attend."

"This meet is unique in that you fly in skill classes (Novice, Junior, Sportsman, Expert) instead of being lumped all together. I like this format as it pairs the less experienced pilot with others who have similar skills."

"Both clubs from Memphis and Huntsville should be commended for developing a very successful format and one I think will be copied by a lot of clubs."

(And now our favorite. It is addressed to a well known flyer who attended the contest. Our sincere apology for not including even a small mention of his name in the last issue! ED.)

"Dear Struts: I, Pat and the members of the Mississippi Valley Soaring Association wish to thank you and your soaring associates for the fine time we had at the recent MSSC contest. Struts, please thank all the people in your organization who worked so hard and successfully to have held one of the best run large contests that I have ever attended. We also thank the many sponsors and contributors for their fine prizes. One suggestion, Struts. We believe you need to lower your wing loading if you are going to improve your flight endurance. Thanks again, (Signed) Pat and Nelson Itterly."

(Who is Struts? He is a 50 lb. turkey and the Memphis Area Soaring Society mascot.. Rumor has it that he is still working on his AMA Scholarship, but he finds time to join in the fun as he loves sailplanes; he currently resides with Mike and Dana Kelly. ED.) ■

Schedule of Special Events

Date	Event	Location	Contact
Sept. 10	Fall Soaring Tournament	Memphis, TN	Mark Thomas, (901) 382-9570
Sept. 10	1.5M Hi-Start Contest	Washington, MI	Ray Hayes, (810) 781-7018
Sept. 10-11	F3J - Germany - Heerieden, Bavaria		Jack Sile, 0449-675190
Sept. 17	1.5M Hi-Start Contest	Washington, MI	Ray Hayes, (810) 781-7018
Sept. 17-18	SIG/EISS Glider Contest	Blakesburg, IA	Jim Porter, (800) 524-7805
Sept. 18	S.O.A.R. Contest	Illinois	Wayne Fredette, (708) 532-3904
Sept. 24	SASS Novice Classic	Seattle, WA	Sherman Knight, (206) 455-2345
Sept. 24-25	TNT	Austin, TX	George Parks, (512) 443-7029
Sept. 24-25	2m - Unl	Orlando, FL	Ed White, (407) 321-1863
Sept. 25 & Oct. 2	2m Postal - Details 5/94 RCSD -	Everywhere	Steen Hoej Rasmussen
Sept. 25	F3J SOAR-IN	Madison, WI	Cark Mohs, (608) 238-2321
Oct. 1	Fall Slope Fun Fly	Madison, WI	Al Scidmore, (608) 271-5500
Oct. 1	1.5M Hi-Start Contest	Washington, MI	Ray Hayes, (810) 781-7018
Oct. 1-2	CVRC Fall Soaring Festival	Visalia, CA	Phil Hill, (209) 686-8867
Oct. 8-9	2m - Unl	W. Palm Beach, FL	J. Wilson
Oct. 9	SASS Novice Classic	Seattle, WA	Sherman Knight, (206) 455-2345
Oct. 9	1.5M Hi-Start Contest	Washington, MI	Ray Hayes, (810) 781-7018
Oct. 9-10	S.O.A.R. Fun Fly	Illinois	Stan Watson, (708) 448-6371
Oct. 15	1.5M Hi-Start Contest	Washington, MI	Ray Hayes, (810) 781-7018
Oct. 15-16	Last Fling of Summer	Tulsa, OK	Perry Gilstrap, (918) 455-1203
Oct. 22-23	2m - Unl	Morriston, FL	Bob Wargo, (813) 938-6582
Oct. 23	S.O.A.R. Contest	Illinois	Wayne Fredette, (708) 532-3904
Nov. 6	S.O.A.R. Turkey Shoot	Illinois	Tom Blood, (708) 377-8641
Nov. 25-27	Tangerine	Orlando, FL	Ed White, (407) 321-1863
Dec. 3	Hand Launch	Poway, CA	Bill West, (619) 222-5296
Feb. 5-6	Southwest Winter Soaring	Gilbert, AZ	Iain Glithero, (602) 839-1733

If there are contests missing from this schedule, that you feel should be added, please ask the CD or a spokesman to let us know via phone, FAX, or a quick note.

TNT!!

Well, the Texas National Tournament (TNT) is coming up the end of this month in Austin, Texas. On September 24 and 25, fliers of all skill levels (Junior, Novice, Sportsman, Expert) will be competing for trophies through 5th place in each skill level. Tom Jones has created an original hot new T-shirt; raffle donations already include radios, kits, and accessories.

Barry Kennedy has sent us a list of the local hotels that are available close by to the flying site, on Interstate 35. We hope those of you that are out of town get your reservations in early, as Austin does attract large groups and conventions.

Ramada Inn	Exit 262	(512) 869-2541
Georgetown Inn	Exit 262	(512) 863-5572
Comfort Inn	Exit 260	(800) 221-2222
Best Western	Exit 254	(512) 255-4437
La Quinta Inn	Exit 254	(512) 255-6666 Or (800) 531-5900
Doubletree	HWY 290	(800) 222-8733

For additional information, the contest director is George Parks and he can be reached at (512) 443-7029. According to the Heart of Texas Soaring Society (HOTSS) newsletter, *Hot Flash*, Mark Hees is also available to answer questions regarding the contest or accommodations and he can be reached at (512) 259-3156. Also from *Hot Flash*, check-in starts at the field at 7:30 am each morning, with the pilots meetings at 9:00 am. And it looks like they'll be there early, because the field is open on Friday the 23rd for practice!

Barry says that the site is at Georgetown and is a private, large, well mowed field. For those coming from out of town, there are sights to see such as the historic 6th St. and Blue Pubs. A local BBQ place will set up for lunch at the field, and folks like Tim Renaud and Fred Weaver will be there to join in the fun and fly! There will be a Dynamite TNT HL Champaign Fun Fly immediately following the contest on Saturday, which will be designed to wear out the contestants so that more folks can have a shot at winning the next day. Also, Saturday evening, there will be an informal get together at Pappasito's to dine on such favorites as Nachos, Grilled Shrimp, BBQ Babyback Ribs, or Sizzling Fajitas! Additional detail will be available at the site.

R/C Soaring Resources

The contacts listed here have volunteered to answer questions on soaring sites or contests in their area.

Contacts & Soaring Groups

Arizona - Central Arizona Soaring League, Iain Glithero, (602) 839-1733.

Arizona - Southern Arizona Glider Enthusiasts, Bill Melcher (contact), 14260 N. Silwind Way, Tucson, AZ 85737; (602) 325-2729. SAGE welcomes all level of flyers!

California - California Slope Racers, John Dvorak, 1063 Glen Echo Ave., San Jose, CA 95125; (408) 259-4205.

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

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

England (BARCS & Europe), Jack Sile (Editor), 21 Bures Close, Stowmarket, Suffolk, IP14 2PL, England; Tele. # 0449-675190.

Florida - Florida Soaring Society, Ray Alonzo (President), 3903 Blue Maidencane Pl., Valrico, FL 33594; (813) 654-3075 H, (813) 681-1122 W.

Illinois (South & Southwest) - Silent Order of Aeromodeling by Radio (S.O.A.R.), Jim McIntyre (contact), 23546 W. Fern St., Plainfield, IL 60544-2324; (815) 436-2744.

Illinois (North & Northwest) - S.O.A.R., Bill Christian (contact), 1604 N. Chestnut Ave., Arlington Heights, IL 60004; (708) 259-4617.

Iowa - Eastern Iowa Soaring Society (Iowa, Illinois, Wisconsin, Minnesota), Bob Baker (Editor), 1408 62nd St., Des Moines, IA 50311; (515) 277-5258.

Kansas - Wichita Area Soaring Association, Pat McCleave (Contact), 11621 Nantucket, Wichita, KS 67212; (316) 721-5647.

Maine - DownEast Soaring Club (Northern New England area), Steve Savoie (Contact), RR#3 Box 569, Gorham, ME 04038; (207) 929-6639.

Maryland - Baltimore Area Soaring Society, Bill Cavanaugh (President), 1428 Park Ave., Baltimore, MD 21217; (410) 523-0778.

Michigan - Great Lakes 1.5m R/C Soaring League & "Wings" Flight Achievement Program & Instruction. Ray Hayes, 58030 Cyrenus Lane, Washington, MI 48094; (810) 781-7018.

Minnesota - Minnesota R/C Soaring Society, Tom Rent (Contact), 17540 Kodiak Ave., Lakeville, MN 55044; (612) 435-2792.

Nebraska - B.F.P.L. Slopers, Steve Loudon (contact), RR2 Box 149 E1, Lexington, NE 68850; (308) 324-3451/5139.

Nebraska - S.W.I.F.T., Christopher Knowles (contact), 12821 Jackson St., Omaha, NE 68154-2934; (402) 330-5335.

Nevada - Las Vegas Soaring Club, Jeff Burg (President), 853 Shrubbery Lane, Las Vegas, NV 89110; (702) 459-8100.

Northwest Soaring Society (Oregon, Washington, Idaho, Montana, Alaska, British Columbia, Alberta), Roger Breedlove (Editor), 6680 S.W. Wisteria Pl, Beaverton, OR 97005; (503) 646-1695 (H) (503) 297-7691 (O).

Oklahoma - Central Oklahoma Soaring, George Voss, (405) 692-1122.

Texas - Texas Soaring Conference (Texas, Oklahoma, New Mexico, Louisiana, Arkansas), Gordon Jones, 214 Sunflower Drive, Garland, Tx 75041; (214) 271-5334.

Utah - Intermountain Silent Flyers (IMSF), Bob Harman, (801) 571-6406... "Come Fly With Us!"

Washington - Seattle Area Soaring Society, Waid Reynolds (Editor), 12448 83rd Avenue South, Seattle, WA 98178; (206) 772-0291.

What does it take to get on this list???

The enthusiast desire to volunteer, answer phone calls, and check your listing every month to make sure that it is still correct. In exchange, we promise that you may be pleasantly surprised to find out who is visiting your area and would like to stop and fly! And, nope, there is no charge! There are 4 new entries just this month!

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 $7.00, 1984 for $7.00, 1985 for $8.00, 1986 for $8.00, 1987 for $9.00, 1988 for $9.00, 1989 for $10.00, 1992 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, outside U.S.A. for $80.00. Last 4 (1987-1992) in U.S.A. is $45.00, outside is $50.00. Allan Scidmore, 5013 Dorsett Dr., Madison, WI 53711.

BBS

BBS: SLOPETECH, Southern California; (714) 525-7932, 2400 - 8-N-1

BBS: South Bay Soaring Society, Northern California; (408) 281-4895, 8-N-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, CA 95124; (408) 377-2115.

NASSA North American Scale Soaring Association

The North American Scale Soaring Association is an organization of scale soaring enthusiasts dedicated to the furtherance and enjoyment of scale soaring in North America. Membership dues are $10.00 a year or $5.00 after August 1st, and provide for sponsorship of NASSA Scale Fun Flys & Rallies, and for the implementation of a National Scale Building and Soaring Achievement Program. Join NASSA and join a network of scale soaring enthusiasts that influence the direction of scale sailplanes in North America. Please provide your address, phone #, and AMA #, and we will send you a membership card and membership roster. A bi-monthly column keeping NASSA members up to date is included in *RCSD*, with additional information available periodically direct from NASSA. Help promote and support the continuation of scale soaring by sending $10.00 (or $5.00 after Aug. 1st) to: NASSA, P.O. Box 4267, W. Richland, WA 99352.

F3B/USA • F3F/USA

RC Sailplane Technical Journal

F3B/USA is a bi-monthly publication dedicated to the sports of F3B and F3F. The journal is intended for the beginning as well as experienced multi-task soaring enthusiast. Articles cover a wide variety of areas including: technical data issues, description of techniques, and articles written by and about the top people in the sports.

Subscription Rates: $14 per year (6 issues)
For More Info Write: F3B/USA,
87 1/2 N. Catalina, Pasadena, CA 91106

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

The Vintage Sailplane Association

Soaring from the past and into the future! The VSA is dedicated to the preservation and flying of vintage and classic sailplanes. Members include modelers, historians, collectors, soaring veterans, and enthusiasts from around the world. Vintage sailplane meets are held each year. VSA publishes the quarterly BUNGEE CORD newsletter. Sample issue: $1.00. Membership is $15.00 per year. For more information, write to the:

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

T.W.I.T.T.

(The Wing Is The Thing)

T.W.I.T.T. is a non-profit organization whose membership seeks to promote the research and development of flying wings and other tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis. T.W.I.T.T. is affiliated with The Hunsaker Foundation which is dedicated to furthering education and research in a variety of disciplines. Full information package including one back issue of newsletter is $2.50 US ($3.00 foreign). Subscription rates are $18.00 (US) or $22.00 (Foreign) per year for twelve issues.

T.W.I.T.T., P.O. Box 20430
El Cajon, CA 92021

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

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Subscription Renewals

RCSD mails out one post card size renewal notice in the U.S.A. Outside of the U.S.A., the renewal notice is placed in an envelope.

How To Read Your Label for Expiration

214 1ST 94/01

214 - The first entry is the subscription number.

1ST - This is a first class subscription in the U.S.A.

3 - 3rd Class U.S.A.
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S - Surface (No longer offered.)
Other - Tracking codes. (V, for example means advertiser.)

94/01 - The subscription is good through the December, 1993 issue. It must be renewed prior to January 1, 1994, or it will be logged in as a new subscription.

Back Issues

We receive many inquiries every month about the availability of back issues for *R/C Soaring Digest (RCSD)*. So, we try to print sufficient quantities each month for those of you who wish to obtain back issues or want additional copies. We hope you enjoy *RCSD* but, if you are NOT satisfied, please return them for a full refund, no questions asked!

(Quanties are limited for some months.)

	1993	1994
January	❒	❒
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March	❒	❒
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October	❒	
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Editorial

We have had a few telephone conversations recently with subscribers who had not received orders they had placed with hobby related businesses within a "reasonable period of time". These subscribers had been on waiting lists that went anywhere from 7 to 11 weeks to many months...

Yes, we believe that there are dreaded waiting lists sometimes. It depends on the product. But sometimes the final sailplane or accessory, when they arrive, have been worth every minute of the wait, or so it may finally seem.

Last month we said we were on a waiting list for a new printer. We finally received the new Apple printer, but had to wait 5 weeks for it to arrive. However, it was definitely worth it and the distributor did indeed keep us posted, did not charge our card, and told us via 3 letters that we could cancel any time. No way! We stayed on that list in order to get one of the first ones that came off the line! We got exactly what we wanted!

By the way, one way to receive an order is via C.O.D. (Cash On Delivery). U.P.S., for example, charges a $4.50 processing fee to the sender. The person at the receiving end will be requested to pay either check or cash (varies with individual policy) in order to receive the parcel.

One important thing about C.O.D. is that the parcel can't be left on the doorstep. Someone must pay for it. (Yes, I have seen many packages left even when signature was required.) So if you are ever worried about your package up and walking away, try C.O.D. *Judy* ■

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.

Personal ads are run for one month and are then deleted automatically. However, if you have items that might be hard to sell, you may run the ad for two months consecutively.

Advertiser Index

For Sale - Business

GLIDER RETRACTS - high quality, 1/5, 1/4, 1/3 scale made in U.S.A. 1/4 are standard or heavy duty. Contact Bill Liscomb, 7034 Fern Place, Carlsbad, CA 92009; (619) 931-1438.

PRECISION COMPUTER CUT FOAM CORES for your sailplane. Any airfoil combination, washout, taper, sweep, skin thickness. No templates required. $32 for typical four panel 2M. For complete info. send SASE to: Wings!, 3198 Shady Oak Lane, Verona, WI 53593; (608) 845-7961, eve. or leave message.

"Pick a hobby as you would a lifetime companion." One of over 670 quotes and stories by Frank Zaic in **FRANKLY SPEAKING.** $6.95 plus $1.25 postage. Model Aeronautic Publications, Box 135, Northridge, CA 91328.

LET THE SUN KEEP YOU COOL!!! Solar-powered Safari Helmet with solar-electric fan will help you keep your COOL when it's *HOT!* White or tan. $39.95 postpaid. (Fl. residents add 6% tax.) Terrapin Systems, Rt. 1 Box 298 C-29, Morriston, FL 32668.

PRECISION AMAP WING CUTTER, replacement parts, and service. AMAP Model Products, 2943 Broadway, Oakland, CA 94611. Butch Hollidge, (510) 451-6129 or FAX (510) 834-0349.

OVERSIZE PUSHRODS - 47 inch long 0.052 dia. music wire with 40" polypropylene 0.125 O.D. tube. Perfect for elevator and rudder actuation. $2.00 each, plus $4.75 UPS per order. Shipped in PVC tube. BB Sailplanes, 3134 Winnebago Dr., Sedalia, CO 80135.

SILENT FLIGHT CLASSIFIEDS, the newsletter for sailplane and electric builders and pilots. Our classifieds sell your "experienced" planes and equipment. Latest info. for the sportsman and contest pilot. Yearly for $10.00, 12 issues, sample $1.50. SFC, 329 Little Ave., Ridgway, PA 15853.

1.5 METER HAND LAUNCH R/C SAILPLANE KITS - Sagitta, Aquila & Jouster, SD7032 or 3021, foam wings sheeted with 1/32 balsa. $49.95 + $6.00 S&H. Lil Bird (minature BOT), all balsa construction. $29.95 + $6.00 S&H. Mini Hi Start is $23.95 w/kit order. Sky Bench Aerotech, 58030 Cyrenus Lane, Washington, MI 48094; (810) 781-7018.

CANNON R/C SYSTEMS, world's smallest radio systems and ACE R/C, both in business since 1953, are your best choice for small sailplanes & electric models. Cannon servo weighs .35 oz., 4 ch receiver weighs .54 oz. Send $2.00 for price discount catalog. Sky Bench Aerotech, 58030 Cyrenus Lane, Washington, MI 48094; (810) 781-7018.

For Sale - Personal

Ace QUASOAR, NIB... $110.00; Top Flite ANTARES, NIB... $60.00. I'll ship USA. Larry Bixby (406) 892-3365, Montana.

Original HOBIE HAWK - vintage 1978 or so, in original box. Some cosmetic wear and tear, and UGLY color monocote, but structurally sound. Flies great, extra set of horiz. stabs. Want to sell ($175?) or prefer to trade for equally interesting scale, high perf slope or thermal duration plane. Call for details/pictures. Also, RTF PUSSYCAT w/removable wing tip for easy transport, good condition... $75.00 obo. Don Whiteside (510) 284-5383 or e-mail dwhiteside@AOL.COM, SF Bay area - Calif.

Rahm winch, Rahm turnaround, HD footswitch, 210 lb. test line & chute installed, 450 cca battery, 3 stakes, excellent condition, rarely used... $325.00, Southern Calif. pickup/delivery, only. Contact Manny (714) 492-9553.

CHUPEROSA HL, straight wing SD7037, requires 2 micro servos for rudder, elev, and aileron controls, good condition... $65.00; Ace Thermal Sniffer, works fine... $75.00; Playboy Sr. with ST 6 35 and 3 Futaba servos, a competitive oldtimer... $215.00. Would consider trading for Astro Flight FAI motor and suitable prop/speed control, etc. Mike Remus (219) 456-4955, Indiana.

Robbe ASW 24 kit with spoilers... $375.00; Müeller COMET 89T, 3m wing/SD8000, all servos, excellent condition, RTF... $975.00; Airtronics LEGEND with all servos, RTF, excellent condition... $475.00; Dodgson WINGSONG with 5 servos, excellent condition, RTF... $425.00. Bernie Coleman @ (704) 536-5260 (D), (704) 846-5219 (E), N. Carolina.

SPECTRUM, RTF, only flown for a couple of months, 3021 airfoil... $450.00 with all servos or $300.00 without; SURPRISE 2 F3E airframe, RG15 airfoil, fair condition... $150.00 with servos or $100.00 without; Plettenberg 320 - 4 turn used very little, excellent condition... $250.00; Flightec SEC-M, used very little, good for 50+ cont. amps... $65.00. Rob Smith, 1509 James Ave., Moses Lake, WA 98837; (509) 765-8003 after 6 pm.

Original HOBIE HAWK, virtually NIB (fuselage painted International Orange, tail surfaces sanded)... $225.00 or will consider trade. Ron Turner @ (416) 751-2525 after 7 pm, Toronto, Canada.

Thermal Eagle w/m.g. wing servos and Eagle Nest container. Ready to Rock & Roll... $615.00. Postage paid. Brian Smith (615) 393-4876, TN.

RnR SYNERGY III, RTF, no gear, white tops, red bottoms, comes w/match fitting SR 800 mah battery... $450.00. I'll pay half of shipping costs. Jose Serrano @ (310) 494-7388 after 5 pm, S. Calif.

All glass Multiplex DG-300 w/servos, excellent... $975.00; Robbe ASH-26E w/wing servos, excellent condition... $850.00; KA6E Multiplex w/servos, excellent condition... $850.00; all glass Rowing LS-4 w/wing servos, excellent... $1400.00; custom EAGLE RG-15, natural obechi, arrow shaft hinges, nice, w/wing servos... $600.00; Alpina MAGIC w/wing servos, fixed wheel, very good condition... $550.00; ASW-17, 3.5m w/flaps, Quabeck 2.5/13... $350.00. Call Ray Franz @ (714) 362-5545 (E), (714) 830-8928 (D), Calif.

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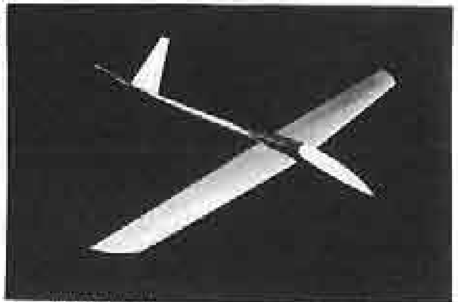

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