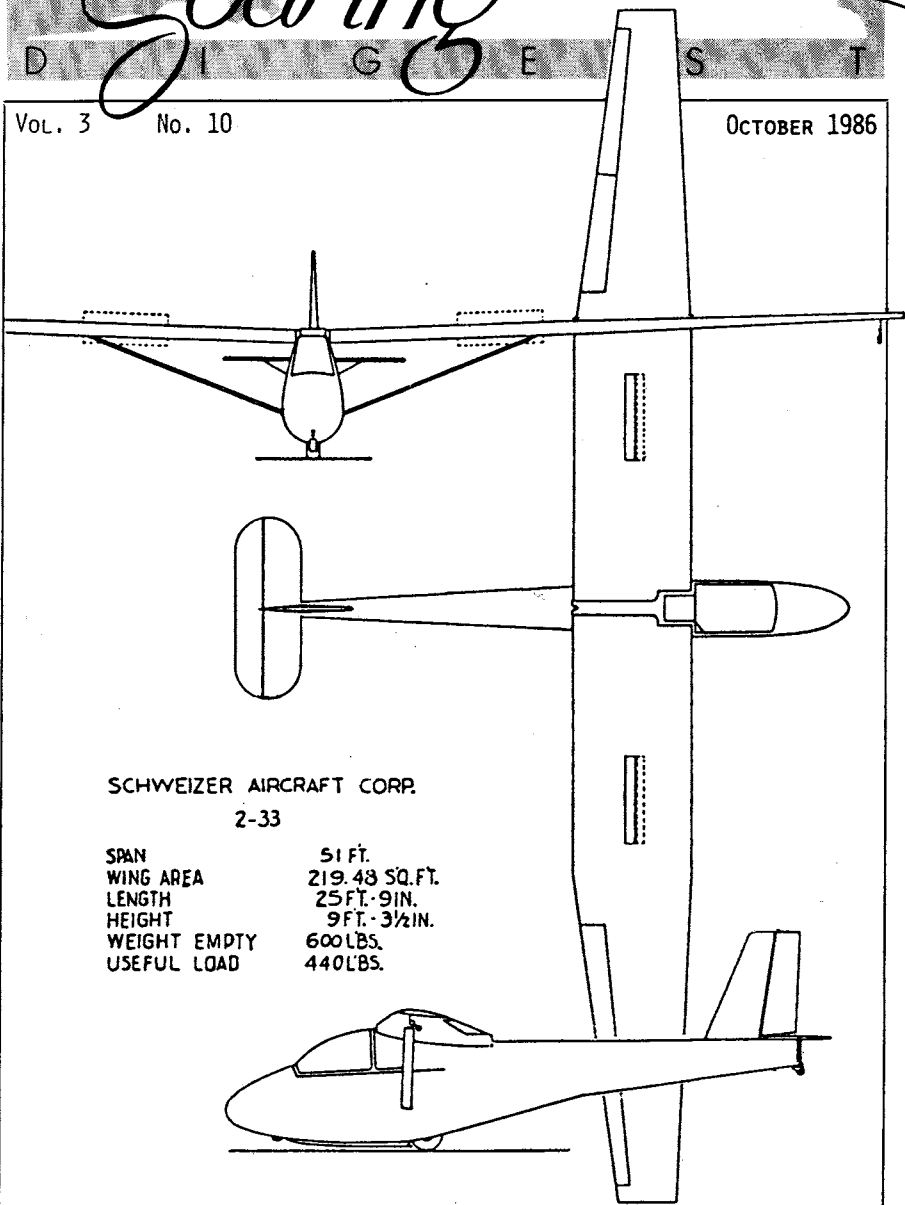




OCTOBER 1986

Vol. 3 No. 10



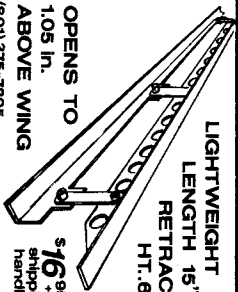
SCHWEIZER AIRCRAFT CORP.

2-33

SPAN	51 FT.
WING AREA	219.48 SQ.FT.
LENGTH	25 FT. 9 IN.
HEIGHT	9 FT. 3 1/2 IN.
WEIGHT EMPTY	600 LBS.
USEFUL LOAD	440 LBS.

SPOILERS

LIGHTWEIGHT
LENGTH 15"
RETRACTED
HT. 6 in.



OPENS TO
105 in.
ABOVE WING
\$16.95 per pair
shipping &
handling

R C DESIGN & DEVELOPMENT
3051 W. 9450 S. WEST JORDAN, UTAH 84094
(801) 375-7805



You are invited to join the
NATIONAL SOARING SOCIETY

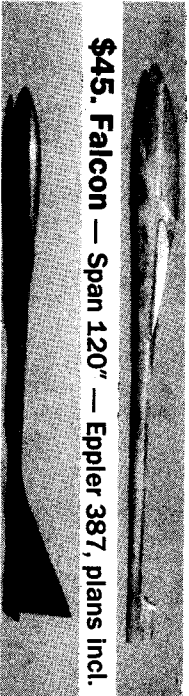
- OFFICIAL AMA SOARING - SPECIAL INTEREST GROUP -
- YEARLY NSS SOARING TOURNAMENTS
- NATION-WIDE "EXCELLENCE AWARDS PROGRAM"
- EXCELLENT BI-MONTHLY NEWSLETTER
- NSS FULLY SUPPORTS THE FBI SOARING TEAM & USF SOARING PROGRAM
- NSS IS INVOLVED IN THE ORGANIZATION AND OVERSEEING OF THE SOARING PORTION OF AMA MEETS (INCLUDING AWARDS BANQUETS)
- MEAL TOOLS ARE \$12.00 (SPECIAL FAMILY RATES)
- NSS OFFICERS ARE FROM ALL 11 DISTRICTS

For Information Contact
NSS Secretary/Treasurer
R. T. DICK CROWLEY
P.O. Box 40092
Aurora, CO 80044

VIKING MODELS USA

BUILDERS — DESIGNERS FIBERGLASS FUSELAGES!!

\$45. Falcon — Span 120" — Eppiler 387, plans incl.



\$45. Lynx — span 110" — No plans, no canopy

Please add \$5.00 shipping to above. Calif. residents add 6 1/2% sales tax. Ask for catalog showing our other products.

2026 Spring Lake Drive, Martinez, CA 94553 Tel.: (415) 689-0766

RC Soaring Digest
P.O. Box 269
Peterborough, NH 03458

Bulk Rate
POSTAGE PAID
PERMIT # 69
PETERBOROUGH, NH 03458

ADDRESS CORRECTION REQUESTED
FORWARDING POSTAGE GUARANTEED

© 1986 RC Soaring Digest. Printed monthly; twelve issues per year. Edited and Published by James H. Gray, 28 East Hill Road, P.O. Box 269, Peterborough, NH 03458. Telephone number (603) 924-6759. Subscriptions: \$16/yr. in USA; \$20 (US) per year in Canada and Mexico; and \$24 (US)/year elsewhere in the world via airmail. All rights reserved. Reproduction with permission of the publisher is permitted. RC Soaring Digest, Radio Control Soaring Digest, and RCSD are registered names.

Hi Start

Usually, about once a month -- and sometimes more often -- a reader makes a suggestion to improve RCSD. And usually it's a crackerjack of an idea that makes me think "Why didn't I think of that?" This month, the idea comes from Lee Kelso of Fort Wayne, Indiana. Lee told me that he's been flying sailplanes only since July of 1985, and has learned a lot from RCSD..."but, frankly, could still benefit from more basic information about R/C Soaring. Please consider a section devoted to questions and answers. I would be very pleased to see an issue containing some basic 'how to' information on aerobatic maneuvers."

Thanks, Lee, for the fine suggestion. I'll try to implement it in this issue with some inputs of my own...and solicit inputs from our more experienced readers for the future issues. As you've all discovered for yourselves, RCSD is a "do-it-yourself" magazine whose content is generated by YOU, not by me. Therefore, I'm asking YOU (in the plural sense) to submit information about some basic aerobatic maneuvers that Lee can perform with his sailplanes. Right now, he's flying a CRAFT-AIR GOLDEN EAGLE which he considers "about right" for his present skill level. I'm also asking you to submit questions that you may have about R/C soaring, and I'll present them in the next issue after receipt. If there are questions I don't feel very comfortable about answering, I'll say so, and ask for good, solid answers from the readers. With our readership running pretty close to 800 now, there are very few questions that can't be well answered by one of you at least, and probably by most. I think the Q & A series can be a lot of FUN, so let's try it and see.

In this month's issue there will be a potpourri of items that may or may not interest everyone, but - as usual - I try to bring a bit of interest to everyone. For example, there'll be a bit more on the Nats Special Awards; a very nice article with good solid info from Pete Richardson of California; a nice article on a "low start" for hand launch gliders by Pancho Morris from Texas; a new airfoil from Bruce Abell of Australia; some 'Soar-ces' of parts and materials; a nice lead-in to R/C soaring by Dick Crowley of Premium Hobby Products; and - well - just read on and see what's up for October.

I'd like to encourage you to send in 'photos and three-views of your designs and other interesting items to share with the readers. In fact, we're still trying to find an award-winning 'photo for cover use...bringing with it a FREE subscription to RCSD for 1 year.

Happy Soaring,



1986 NATIONALS - SPECIAL AWARDS

SID AXELROD Memorial Scholarship Award: Mike Garton - Senior
DICK BLACK Trophy: Chris Matsumo - Open: 930 Seconds
HI JOHNSON AWARD: Leon Kincaid - Open: 4150 Points
MCNEIL CUP: Robert Sifleet - Open: 840 Seconds
GEORGE MEYERS Craftsmanship Award: Dennis Crooks - Open
MULVIHILL Trophy: Frederick Blom - Open: 1113 Seconds
LEE RENAUD Memorial Award: Paul Carlson - Open: 12190 Points
SIG Memorial Award: Curtis Youngblood - Senior: 117 Points
SOARING SOCIETY OF AMERICA Award: Roderick Ioerger - Junior: 483 Sec.
STOUT COMMERCIAL Trophy: Richard Doig - Open: 29 Min. 11 Sec.
STOUT INDOOR Trophy: Louis Satter - Open: 14 Min. 26 Sec.
MATTY SULLIVAN Memorial Award: David Brown - Junior: 37 Points
TULSA GLUE DOBBERS Trophy: William Hutchins - Open: 399 Seconds
JIM WALKER Trophy: Terry Fancher - Open

As you know, not all of these awards represent RC Soaring, yet I feel that it's important to give credit where credit is due. All of modelling is worthwhile fun, and accomplishment should be recognized, especially when the individual excels on the field of contest. The HI JOHNSON and LEE RENAUD awards are specially coveted by RC Soaring Pilots. Congratulations to Leon Kincaid and Paul Carlson.

PERSONALITY PROFILE.....Pete Richardson

Pete Richardson is probably totally unaware that I am going to do this to him -- but I really feel that he deserves mention and special attention here because of his many accomplishments. Pete and I had a short correspondence back in the spring of this year, and I was very interested in what he told me about his original design sailplanes. I asked for more information, and the result was the letter reproduced (in part) here. The 'photo of Pete with his VULTURE III sailplane will appear in a future issue of M.A.N. hence is unavailable here. The picture shows Pete in his wheelchair, holding the VULTURE Mark III. The only other photo I have is that of the VULTURE Mark III on the ground - so I've included it here. Now, to Pete's letter; I think you'll find it interesting. JHG.

"...First of all, I've been in love with airplanes and flying since I was a little kid. I got started in R/C soaring back in the summer of 1976. My brother took me to a hill where he had seen some sailplanes flying. Shortly after that I went to Hobby Shack and bought a three-channel radio and a foam SPIRIT OF '76. This plane lasted a few months, but finally died when I put a power pod on it and tore the wing off at about 500 feet of altitude! I had an old SUPER SINBAD up in the closet, so I put my radio in it and flew it until the fuselage longerons were too crunched to repair. Then I flew a BUNNY for awhile - and I still have it. Up to this time, I was slope flying only, but in 1977 I transitioned to thermal flying primarily. My thermal 'planes in order were an original MONTEREY, an ALBATROSS, an OLY II, a 10-foot OLY, a 100-inch LEGIONAIRE, and the VULTURE.

PROFILE (continued)...

"In 1976 I was also a freshman at UC Irvine studying mechanical engineering. I located as much information as I could on low Reynolds Number aerodynamics. I found some in NACA, NASA, AIAA reports, and a little bit more from other sources (books and other technical societies). UCI did not have any aerodynamics courses, but did have a course in fluid dynamics which was too general, so I taught myself aerodynamics through books and reports. One project of mine in '77 or '78 was a sailplane employing boundary control by suction. The suction was applied to the upper surface of an Eppler 374 airfoil. There is a large amount of information available on the subject of boundary layer control, so I was able to calculate the pressure and volume of air to be sucked away from the surface. A small squirrel-cage type of pump was all that I needed. I used the F3B tasks as performance criteria, and for the project I wrote a computer program that gave me L/D versus speed for the input of sailplane dimensions and airfoil. I then used this program to optimize the configuration of the sailplane, and I derived equations for airfoil drag vs. Reynolds Number, and although they were crude they were close enough. Due to the absence of a computer, I have not fooled with this program for a long time, but I do plan to buy a computer soon ... when I will do an update of the program with better drag predictions. My senior project was on the surface roughness of wind turbine blades (which are in the same Reynolds Number range as our sailplanes). Speaking of wind turbines, I ran across a survey of low Reynolds Number airfoil data for wind turbine blades - compiled by a man in Texas for the DOE. Its size was about 10" by 12" by 3" thick. Eppler, Wortmann, and NACA airfoils are included, along with others. It's available from the U.S. Government Printing Office in Washington for about \$35. I will look for the title, and also for my school reports and send you copies.

"Currently I am working as a mechanical/composite engineer at McDonnell Helicopter Company, and I am also pursuing a Master's degree in aircraft structures at Northrop University. Right now I don't have a lot of spare time to work on my projects, because on top of school, I have a two-hour commute to work each day. I am a slow builder, so my building suffers the most. I'm drawing the plans for a 1/6th-scale Pratt-Read 2-place sailplane. It will have a wing span of 109 inches, and an area of 921 square inches. The Pratt-Read is an interesting sailplane, and was designed as a trainer for the U.S. Navy in the early '40's. It still holds two absolute height world records - multi-seat - at 44,255 feet in 1952 (2011 feet lower and 9 years before Paul Bikle's amazing altitude record which stood until this year); and a women's altitude record set in 1955 at 39,994 feet! Also, two men set an endurance record flying a Pratt-Read along the Pali cliffs in Hawaii,

PROFILE (continued)...

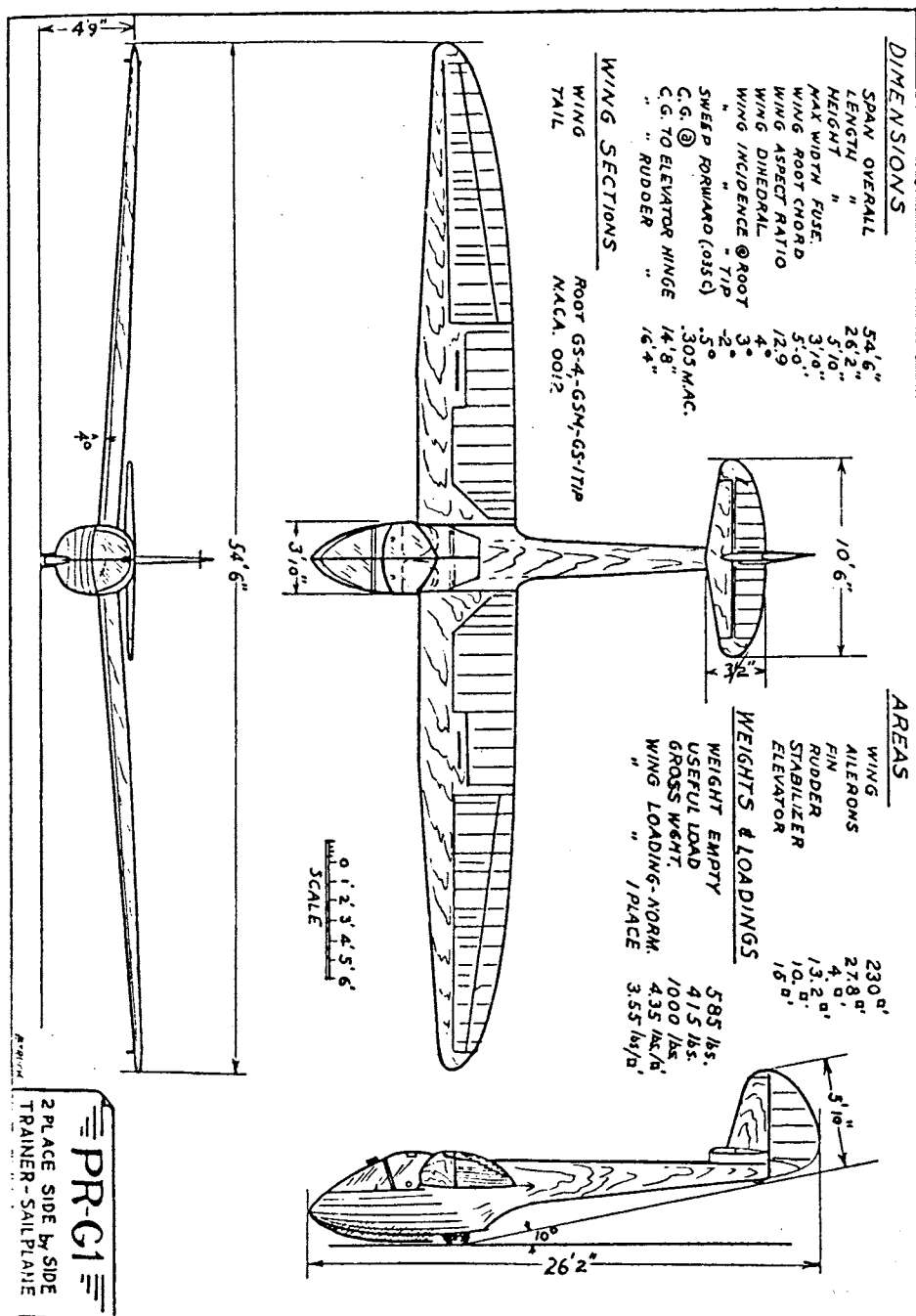
staying aloft for 71 hours and 5 minutes back in 1961 - and traveling 3500 miles!

"I like the Pratt-Read and the (Schweizer) 2-33 as R/C sailplanes for various reasons: I've not seen either one of them modelled by anyone else - which satisfies my yen to be different. Most scale models seem to be of high aspect ratio fiberglass ships, ARF, and costing too much. Many U.S. sailplane pilots such as yourself may have learned and soloed for the first time in a Pratt-Read. (That's true, Pete; I soloed in a war-surplus Schweizer TG-3 for my first glider check-out, and my instructor was a Pratt-Read owner! Much later, I flew the 2-22 and 2-33 sailplanes from Harris Hill where I had been a member of the Elmira Area Soaring Corporation and, later, the Harris Hill Soaring Corporation, since 1957.JHG). They are the current loves, and hold many fond memories for many contemporary pilots. They are a manageable size, unique, won't be confused with a Gemini or Quattro or LS-3, should be easy to launch and fly and land, and competitive in scale contests.

"This brings me to a construction article on one or both of these sailplanes. First in line on my building board are a second SINBAD, then the PELICAN (an original) or the 2-33. So it might be 9 months before I get to the 2-33. I'd like it to be a construction article, and I plan on taking pictures during the building - and also keep track of the various construction steps. The drawing is not dimensioned, so I'd have to fix that before releasing prints. (Note: Pete's drawing of the Schweizer 2-33 is about as 'scale' as anything I've seen; I think a FULL-SIZED one could be built from it... JHG).

"Before I end my babbling, I'd like to mention a couple of other things: I've purchased some Kevlar and carbon-fiber mat from Aerospace Composites and another supplier. The Kevlar will be used to reinforce the wing sheeting on the Swallow (another original). I plan to sandwich the Kevlar between 2 sheets of 1/32" balsa, and then apply this composite 'skin' in the usual manner. I've already made some samples, and find that the stiffness and strength in the grain direction is increased, as is the shear strength and stiffness...adding to the wing's torsional and flexural strength. Another benefit derives from the Kevlar's toughness: the sheeting is much more puncture resistant. The weight increase, using the Kevlar in the sheeting between the leading edge and the spar, is about three ounces over conventional construction. I don't have to worry about the surface finish of the Kevlar, since it's between the balsa sheets. The last subject is that of water ballast for sailplanes: one fluid ounce of water weighs one ounce. I'm working on a drawing that describes a possible method of storing and dumping water ballast for sailplane models. I'll probably never try it, but maybe somebody else would like to. Thanks for listening...

I'll round up the material I've mentioned and send it on to you."
 (Signed) Pete. If you'd like to correspond with this young man, you
 may write to him at: 933 Magellan Street, Costa Mesa, CA 92626.



POQUITO PRIMERO.....Matt Stoops

By way of introduction, I should say that the author of this construction article is 16 years of age, and had never built an RC sailplane before tackling this project. As you will recall from a previous issue, we did the flight testing with Matt...and part of my "price" for helping him with the test flying was an agreement (arm-twisting, in fact) that Matt would write up the construction phase of the project. Here it is.

"Being the first glider that I've built myself, the Poquito Primero, sold by BUZZ WALTZ R/C DESIGNS, was a very good glider to start out on. The glider itself has a 55-inch wingspan and a generous 465 square inches of wing area - and it's meant to be a hand-launch sailplane. The instructions were clear and easy to follow; many of the parts were already cut out or cut to length, and the glider itself was very easy to build. Upon opening the box, I found two rolled plans on pink paper, a very well written six-page instruction sheet, all the wood I'd need, and a plastic bag with all the small parts.

BUILDING

"The first step was to build the horizontal stab and elevator. This was very easy and straightforward. Step two was to build the rudder and fin -- and was as easy as the first step. Step three was the fuselage, and this is where I encountered a very minor problem: the cross sections of the bulkheads on the plans are not the right scale, so DON'T cut the bulkheads to their size! I didn't find any other problems with step three. Step four, the final step, was the wings. Like all the other steps, this step was easy to follow and build...although I did have a few minor problems. The first thing is that, at the beginning of step four, it was mentioned that the materials are cut to APPROXIMATE size. I didn't pay attention to this and, later, had to pay for the oversight by having to splice pieces of the trailing edge together. Just keep this in mind when building YOUR wing. I also had a problem keeping the trailing edge on because there wasn't a lot of area on the back of the spars...but I finally got it to stay with the help of a good amount of glue.

"After getting things sanded down (with help) it was time to cover. Having never covered before, I got a lot of assistance from Jim and one of his very helpful friends. The colors: white and - yes - PINK. Those pink plans must have gotten to me, and - it doesn't look that bad! (Matt's right; in fact, it looks GOOD...JHG).

"Last of all was the installation of the radio. Although I used miniature servos, I believe that with careful planning standard servos would fit. I did have to cut out quite a bit up front in the fuselage to clear my receiver (with servo connectors in place). A 250 ma. battery is a MUST. One last thing: the plans didn't make any mention of a tow hook, but I suggest putting one in...about two inches in front of the hand-launch finger hole is great. With the tow hook, you can get much higher launches and longer flights than by hand launching. I'm glad Jim thought of it

and thank him for putting it in. (I'd also like to thank him for his unending patience in this project." (Aww shucks, Matt, 'twarn't nuthin' ...JHG).

AN INVITATION.....

from the MADISON AREA RADIO CONTROL SOCIETY

Come and join us for the third annual National Sailplane Symposium, November 9 and 10, at the Ramada Inn East, Madison, Wisconsin.

We will have two whole days of show and tell about radio control sailplanes...

Our programs will feature nationally known authorities on sailplane design, aerodynamics, meteorology for soaring, glues and adhesives, cross-country soaring, building techniques, flying wings, and many other topics. Specific highlights will include:

Wooden Aircraft Structures and Bonding Techniques, by an engineer from the U.S. Forest Products Laboratory.

Thermals; a continuation of a very popular part of last year's program, again presented by a professor of meteorology from the University of Wisconsin.

Basic Aerodynamics, especially for new sailplane enthusiasts; a session which will set the stage for more advanced discussions on sailplane design.

Foam Wings; Fiberglass Fuselages; Variometers; Contest Strategies; World F3B Championships in Australia.

As in previous years, there will be plenty of time for hangar flying, and you are invited to bring your sailplanes for display and discussion.

Early arrivals are invited to join with MARCS members for an informal get-together at the Ramada Inn, Friday evening at 8 P.M.

An informal group dinner is set for Saturday evening.

Fifteen bucks, paid at the door, covers admission for two days and lunch on Saturday. Registration begins at 8:30 A.M. on Saturday, with the program starting promptly at 9:45 A.M.

To make motel reservations, call or write to the Ramada Inn East, 3841 Washington Avenue, Madison, Wisconsin, 53714. (608) 244-2481.

The Ramada Inn East is located just WEST of the junction of Highways 151 and I-90-94. For further information, call or write: Dr. Carl Mohs, 5024 Lake Mendota Drive, Madison, WI 53705. (608) 238-2321. You can mention the symposium for a special rate at the Ramada Inn.

OSHKOSH B'GOSH!...

Lee Murray attended a couple of days at the EAA Convention, and sent some very interesting photos of some of the planes and sailplanes and motorless gliders on display. He also attended a couple of the symposia...one of which was particularly interesting: a discussion of composites and their use in fabricating aircraft components. An applications engineer for DuPont was lecturing and passing out printed information about the use of KEVLAR (registered Trade Name of E.I. DuPont de Nemours) for their aramid fiber product line, and a neat "how-to" brochure describing and illustrating the steps for producing your own Advanced Composites Flight Case (which looks something like a Field Box, but is used by pilots to store their charts, logs, etc.). Anyone who may be interested in this brochure or other material should write to: Du Pont Company, Composites Division, Chestnut Run, CR702, Wilmington, DE 19898.

*Experimental Aircraft Association Homebuilders Convention...over 750,000 attended the week-long affair, held each year in August.

Note to the above: ***

Oh yes, incidentally, the larger fold-out illustrated brochure describes a step-by-step techniques used to make a flat composite sandwich structure by the vacuum-bag method. The step-by-step guide would make an excellent wall chart. Ask Du Pont for yours.

HAND LAUNCHING IS FOR THE BIRDS.....Pancho N. Morris

If you're over the age of 40 or so, and are as sadly out of condition as "Ye Ed.", you'll want something just a wee bit better than a flabby arm to launch that "hand-launch" sailplane. In this article, Pancho Morris of the Eastfield Boomers, a club in Mesquite, Texas, gives us an alternative..perhaps even a "better idea" in view of the fact that not all arms are the same... and brings consistency to the sport. Too bad, ringers, you're day is done! Pancho said in his introductory letter: "We had a contest using an even shorter version of these last Sunday... trying to improve performance by some of the guys who feel they can't throw well enough. It worked quite well: these launchers gave the same height as a good throw. Eight fliers flew our man-on-man dual elimination format. By the way, the Southwest Soaring League and the Eastfield Boomers will be hosting the TNT (Texas National Tournament) next year in Dallas...it will be the third annual event. I'll keep you posted."

Low-Start Your Handlaunch

Hand launch gliders are coming on strong as one of the most popular new waves in the RC modeling world. With the advent of micro equipment new possibilities have opened up. People are throwing everything from 1 meter span feather weights to 14' behemoths (have you seen Dodson's tape on the Windsong!). We now have an official class- Class A- in the AMA rule book. This limits the planes to 1½ meters with no weight or function limit.

As with any new class, competition events are being developed for this new class. In our club we have been flying a man on man dual elimination, best 3 out of 5 per match, event that has worked out well.

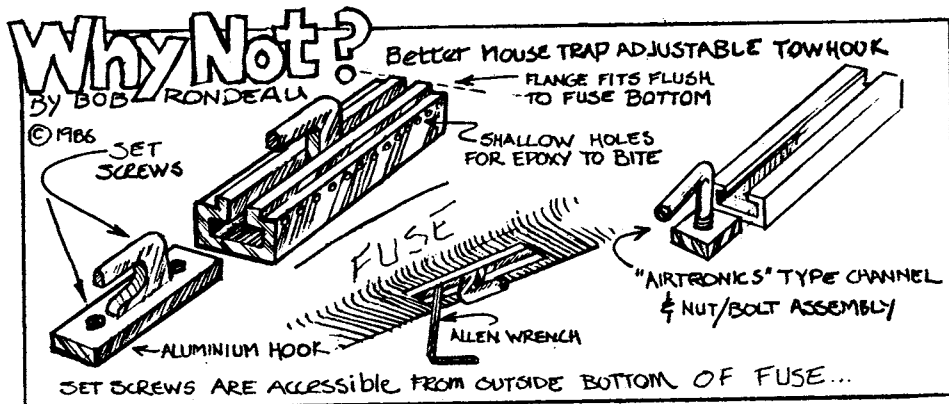
The greatest thing about these planes, however, is their potential for just fun flying. Any open space now becomes a flying site because you don't need lots of room for launch equipment. Small slopes become mini slope sites. Before work, lunchtime and after work become flying times. These planes are easy to keep in the car for impromptu flying when the site and time arises.

The one drawback of these planes is that you can throw your arm out fast or at least get mighty tired. If you have a rag arm like me you can't throw very high. The solution to this is a mini

high start. I call mine "Mini-Flinger"(not to be confused with a great kit by Larry Jolly). It consists of about 15 ft. of $\frac{1}{4}$ " flat rubber, the kind used for rubber powered planes, and 40 ft. of string. At the tow end you can use a small parachute or just a bright colored streamer. This gives a real nice launch. Higher than a good toss from my limp arm and yet not near as high as even one of the "Up Start" type launchers. From this height you get a short but enjoyable flite and have a better chance of finding lift than from a hand chuck from a tired arm. You get to practice your low altitude thermal work and can fly a good deal and not hurt yourself in the process. You don't have to walk very far for the chute, either.

We have been looking into incorporating these mini high starts into a multi task contest format for Class A sailplanes to somewhat neutralize the fellow with the "Gorilla" arm and yet not take Hand Launch, which is the name of the game, out of it completely.

With this "mini-flinger" a short walk to the neighborhood schoolyard or park after work makes a relaxing way to unwind from a hard day. Try it, you'll like it!

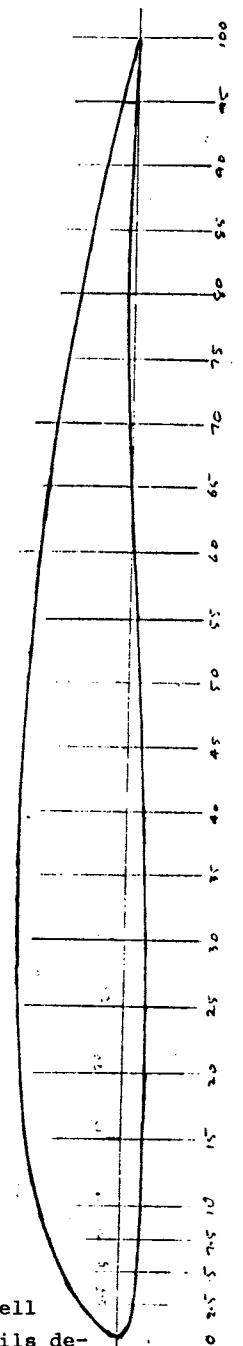


Dealers!
 RCSD available at discount on bulk orders.
 Write or call (603) 924-6759
 Box 269, Peterborough, NH 03458

1.50 WHILE THEY LAST
RCSD decals!
BACK ISSUES!
 \$1.35 each plus postage.

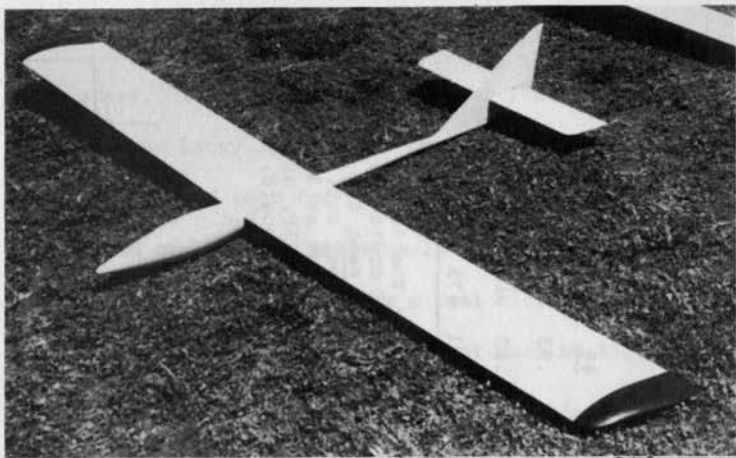
STATION (% CH):	0	2.5	5	7.5	10	15	20	25	30	35	40	45	50
UPPER 35% ORD. (+)	0	.28	.42	.54	.62	.73	.78	.81	.83	.84	.83	.81	.78
LOWER ORD. (-)	0	.13	.15	.16	.17	.175	.18	.18	.17	.15	.13	.10	.08
UPPER 30% ORD. (+)	0	.30	.45	.56	.65	.75	.81	.83	.84	.83	.81	.79	.76
STATION (% CH):	55	60	65	70	75	80	85	90	95	100			
UPPER 35% ORD. (+)	.74	.70	.65	.58	.50	.41	.34	.24	.12	0			
LOWER ORD. (-)	.06	.02	0	.03	.04	.05	.05	.04	.02	0			
UPPER 30% ORD. (+)	.72	.69	.63	.59	.50	.41	.34	.24	.12	0			

Note: The lower set of ordinates is the same for each upper set. High point at 30% used for TIP, and 35% for inboard.



ABELL'S AIRFOILS.....Bruce Abell

This is B.A. 24 in a series of RC sailplane airfoils designed and tested by Bruce Abell, 17 Ferguson Street, Cessnock 2325, N.S.W. AUSTRALIA. It is intended for thermal soaring, has a 10% thickness/chord ratio (max) and features good climb-out on winch launch, good lift characteristics up to moderate speeds, and fair penetration. Note: Ordinates not computer-smoothed yet... these are from measurements only. Two sets upper ordinates given: one for high point at 35% chord; other for high point at 30% chord.



Viking Models new FACTOR, to be added to catalog in near future.

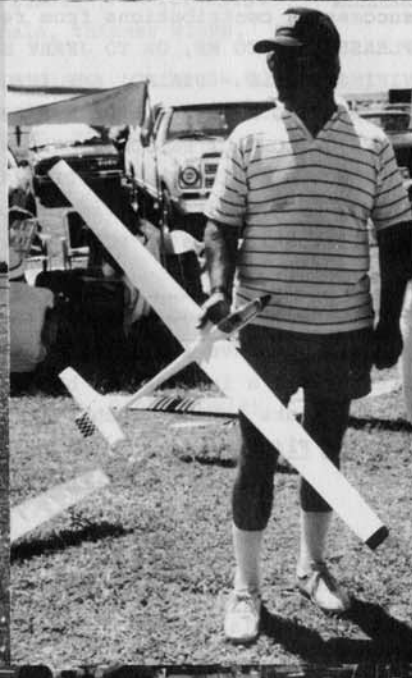
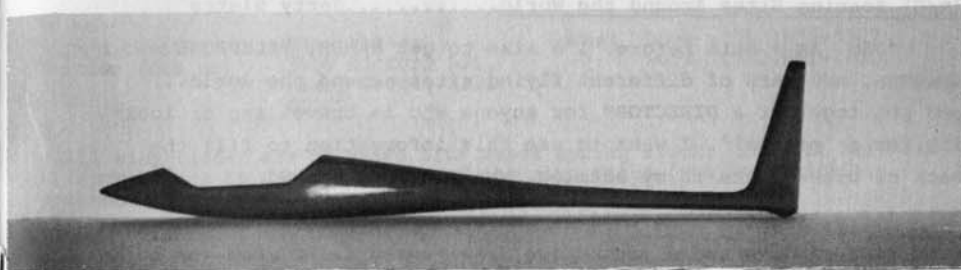
SMOOTHIE, sleek fiberglass fuselage devoid of wing-root fairing, allowing choice of wing/airfoil. No clear canopy, has a fiberglass hatch. No plans available. To be added to catalog soon. (Viking Models USA)

Leigh Hodgdon (South Bay Soaring Society) holds scale LS-3. Glass fuselage, foam wings. Flies well for a "little guy". WSC's.

Dichondra-grass sod farm - site of the "World Class" Western U.S. Soaring Champs. Temps hit 103 degrees F!

Some of the "line-up" of men and machines. WINDSONG very popular.

Western Soaring Championships CD'd by Kevin Webb (white hat) Photos courtesy of Jerry Slates held near Modesto, California.



(R/C) Soaring Sites Around the World.....Jerzy Slates

"Jim: As I said before, I'd like to get NAMES, TELEPHONE NUMBERS, AND MAPS of different flying sites around the world... and put together a DIRECTORY for anyone who is travelling or looking for a 'pen-pal'. I want to use this information to fill the back of blank pages in my catalog. What do you think?"

Jerry, I think that this is another of those GREAT ideas from RCSD readers and contributors like yourself. So, the key to success is contributions from readers -- worldwide. Readers of RCSD: PLEASE SEND TO ME, OR TO JERRY SLATES (WHOSE ADDRESS IS IN THE VIKING MODELS - USA AD) ANY INFORMATION YOU MAY HAVE ABOUT GOOD R/C SOARING SITES. PLEASE FURNISH LOCATIONS, BEST WAY TO GET THERE, NAMES OF CONTACT PERSONS, MAPS AND CHARTS, AND OTHER INFORMATION THAT WOULD BE HELPFUL TO ITINERANT GLIDER GUIDERS. Jerry will put it all in his catalog...and maybe we can put some of the more inspirational ones in RCSD, too. How about it? Good idea? YES!

SOAR-CES

If you have a need for wing blades (joiners) lend an eye to Stan Watson's information below. I think you'll be glad you did. (With thanks to the October 1985 issue of S.O.A.R. Newsletter Soaring Flight.

WING BLADES

Wing blades are a low-weight, high-strength method of mounting sailplane wings. They can be permanently installed in a wing (especially useful in small, thin wings) or installed in aluminum receivers (milled channel stock) in thicker wings where there may be a possibility (slight) of bending. When rods bend they are a real problem to remove from a fuselage. When blades bend (run-away winch, extreme shear forces at high altitude) they can be reversed in the wing channel or replaced.

Wing blades have been proven to be "user friendly". There is virtually no problem that can't be resolved in their use, and the total weight of a blade system is about half to two thirds of the weight of a rod system of comparable strength. (The additional depth of a blade gives the real advantage over the rod.) Finally, the blade is installed in such a way as to allow the wings to swing forward upon impact, reducing damage to fuselage and wing.

Making fuselage blade boxes is a "low tech" process. Aluminum sheet stock is milled at the appropriate angle and then bolted or welded together to allow the blades to pass each other, therefore using the entire width of the fuselage for structural strength and resistance to "dihedral creep" over time. Standard blade boxes are available from several sources within the club. I suggest that they be milled about ten thousandths deeper than the thickness of the stock to allow for errors in alignment of the wing boxes. I recommend that both wing boxes be installed simultaneously in your wings on a large work bench using a single blade connecting both panels to assure equal incidence in both wings. Doubling the blades gives added strength to thin wings. Make certain the wings are held on securely with two sets of fasteners. Large, 4-piece wings use 1/2" blades for tips, saving them in crashes!

Send check & Stan Watson Phone: home (312)335-3327
order form to: 3402 Hickory Ln., work (312)651-1100
Hazel Crest, Ill.
60429

All wing blades are polished blue steel spring stock, Rockwell hardness appropriate to use and always of the same value (not too brittle, not too soft, just right for the application.)

-----			Total
Please send me:	_____ 1/16"x1/2"x9 5/8" blades. 2 for \$3.50		\$_____
	(suitable for smaller models, thinner wings, wing tips, FAI models)		
	_____ 1/16"x5/8"x9 5/8" blades 2 for \$4.00		\$_____
	(suitable for larger models, thicker wings, cross country models to 180" span, etc.)		
	_____ as above, but longer lengths, to 13" 2/\$5		\$_____
		\$2.00 Postage/handling	\$_____
Call me for longer length, custom cuts, thicker/wider stock, fuselage blade boxes, milled channel, etc.		Grand total.	\$_____

Your Name _____
Address _____

WELCOME TO THE WORLD OF SILENT FLIGHT.....Dick Crowley

Dick Crowley IS Premium Hobby Products out Denver way...and he is also an officer of NSS. In fact, formerly President of our National Soaring Society. He is an accomplished RC soaring pilot, and a frequent competitor in contests, where he has done very well. Dick has recognized the very basic NEED for beginners to have some insights into building and flying their sailplanes, and has provided the following advice with every sheet of items for sale that he puts out. Welcome Dick Crowley!

By now you probably have selected a sailplane kit that will fit your requirements as to size, price and your ability to fly.

We will just consider that you have very little experience in our great hobby, so you "hot doggers" don't feel that we are talking down to you.

If you are still building or just selected a kit hopefully you have chosen one that is not too advanced for your building skills or your flying abilities. Often we are attracted by the sleek lined long winged, glass assessoried, etc., etc., aircraft. Actually our most effective sailplanes are somewhat "ugly" meaning that the wings are "bent" twice. Once for the dihedral at the center of the wing and then again about 1/3 from the wing tip which is called the polyhedral. While not adding anything to the looks these features add greatly to the stability and control while in flight. So, don't "modify" till you are more familiar with aerodynamic principals (whatever that means). Basic aircraft usually don't have fancy controls or exotic features.

Three things to remember: 1) Follow the kit manufacturers instructions. He tested the best way to do it. 2) Build on a smooth/flat surface. You must build straight and level or you will build in an unwanted control surface, and you will always be compensating for that error when flying. 3) Build light - today we are blessed with some outstandingly strong, light and dependable adhesives. Choose the proper ones for your application - then use them sparingly.

As you build your sailplane keep in mind the type of radio equipment and the size of its components you will be using. I recommend using name brand equipment with at least four (4) channels or functions. Be sure to select a radio that is designed for the aircraft frequencies 72 mhz only (or if you are a "ham" on the 53 mhz band). The location of the radio in your aircraft is very important because it serves two major concerns. 1) Aircraft balance, and 2) access to your control system with its related components. Follow the kit manufacturers plans and instructions!!!

After you have constructed your "bird of glory" and you have covered it with a light plastic covering and followed all of the instructions your final "tune up" work begins. One of the bad features of heat shrink coverings is that they can distort a large flat surface if you are not extremely careful. So, you must "sight" the wings in particular making sure that you do not have any unwanted warps or twists. If you find that you do, remove them by using heat and a little reverse twist. Make sure all flying surfaces are flat and level!!

Now, prior to seeing if your "bird" will fly you must balance the entire aircraft. Start at the manufacturers balance point. (This is very important especially if you are new to our hobby). Put a mark on the outside of the aircraft with a magic marker or tape, then with the wings attached and otherwise ready to fly pick the aircraft up at the balance point you have marked. Move out about two bays on the wing (will probably be on or near the back side of the wing spar) then lift the aircraft using one finger on each side. Initially the tail will probably fall to your work bench - obviously this means that you are "tail heavy". Never fly in this condition!!! Try to move your radio equipment as far forward as possible with the battery up front. If this still does not get it into balance you must add "lead" otherwise known as "ballast" to the nose area till it does balance.

When everything is balanced you are ready to fly or are you?? Do the controls work properly no binds and going in the proper direction L/L - R/R - UP/UP - DN/DN etc. everything straight and level? If so and the battery is charged it probably is ready to fly. How far can you throw it?? or is the hill small enough that you don't mind walking down to retrieve your aircraft?? One more item is needed - a "tow hook". The little gadget that goes on the bottom of the fuselage and hooks onto a launch system. Initially use the system recommended by the manufacturer which is usually a hard wood plate on the bottom of the fuselage using a bent screw hook. (Many other exotic systems are available but walk don't run). Again, find the balance point or the point that the kit manufacturer recommends and locate your hook there. It is "safe" and you can expect normal launches usually without any radical moves on launch. As you become more confident with your launches you can consider moving the tow hook back toward the tail (never move it more than 1/4 inch at a time).

Now that everything is ready ask for help on your first launch! More aircraft are damaged and pilots discouraged by making one (or more) mistakes on the initial flight. Ask someone you know who can handle your new "bird" to launch it for the first time which you watch very closely, ask him to explain what he is doing and why. Your aircraft should be launched on a rubber type launch system (most commonly used) with a moderate amount of pull (depending on the size and type of aircraft) at about a 40% angle just letting it lift out of his hand, not with a heave from behind his shoulder like an olympic javelin thrower.

All launches are to be into the wind (4-9 mph is great) for best results. Your sailplane should climb at a moderate angle and speed. If you built it properly it should only require slight rudder control. If it goes up at a sharp angle and begins to "wander" get the nose down as fast as possible, land and make adjustments (not properly balanced, radio not trimmed, tow hook too far back, ballast moved). When your helper is satisfied that your bird is ready for you ask him to supervise a few of your flights and give suggestions, but remember you must react fast!!

Remember if your tow hook is too far forward you will get low, safe, flat launches. Avoid using the elevator when low and slow, if you try to get more altitude it will probably stall (stop flying) and crash. Adjust your tow hook farther back as your confidence and ability develop. Move the tow hook back till the aircraft starts to wander (move around in unwanted ways) you went too far. Advance it about 1/4 inch and try again. Remember whenever you get in trouble on launch get the nose down and regain control! Naturally you are the best judge of where your tow hook should be located so that you can enjoy your sailplane to its fullest.

Finally we get to the launch system. There are basically four systems used:

TYPES

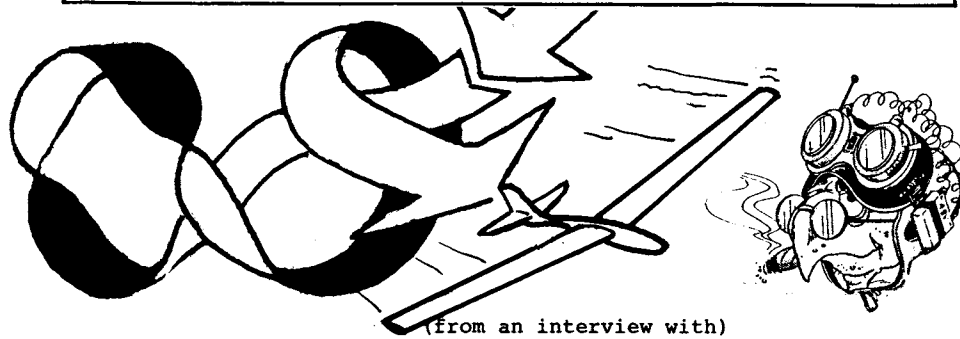
1. HAND LAUNCH Throw it off a hilltop (very hard!)
2. HAND TOW Have a "sprinter" pull it up using a long line.
3. ELECTRIC WINCH A device made out of an electric motor, battery, and various heavy cumbersome support items - usually very costly and usually used by organized clubs.
4. RUBBER TUBING AND LINE Often known as a "hi-start". This is the most common system used, while also being the most cost effective too. Various sizes and lengths of tubing and line are used depending on the size of the aircraft and where you want to fly. Just pull it back and let it go!

SOFTWARE COMPUTER PROGRAMS

AIRFOIL PLOT PROGRAMS for
Commodore 64
Commodore 128
Radio Shack Color Computer
TRS-80 Model 1
IBM PC/XT/AT and
other MS-DOS computers
Macintosh

OTHER PROGRAMS FOR COMMODORE
64 AND 128 COMPUTERS ONLY
Sailplane Performance
Contest Scoring

For more information, send
SSAE to:
Chuck Anderson
202 Inglewood Circle
Tulahoma, TN



(from an interview with)

Simple Sailplane Aerobatics...The Old Buzzard

The Old Buzzard was found sitting on his perch, "shoulders" hunched, wings folded, neck drooping...apparently half asleep... with eyes that seemed to be turned inward, reflecting on better times. The gnarled and dead tree trunk supported the single branch on which the Buzzard perched, and - as I drove up in the RCSD Caravan - he did not even twitch or give any notice that he acknowledged my arrival.

RCSD: "Ahem; er, ah...Mr. Buzzard; sorry to interrupt your sleep, but I have an issue of **RCSD** to put out, and there are some questions raised by a reader that maybe you could help answer for me. Would you mind an interview?"

OB: "Rasp, mutter, barf" (stretching and preening slightly as he shifted his considerable weight from one talon to the other...one eye now fixed balefully in my direction)"so, yer in truble are ye, an' hafta cum to the Old Buzzard fer help? Jist like one o' them dumb riters - thinks he no's everthin' an' don't no nuthin!"

RCSD: "You're right of course Mr. Buzzard (thinking to worm my way slyly into his good graces) that's why I've come to see you; you are the world's acknowledged expert in land soaring, and we need your help!"

OB: (Slightly more erect, glaring at me with an expression that I couldn't quite fathom - except that it looked a lot like speculation about when I was going to keel over...in which case he would definitely be interested) "Cackle; brrraaack; 'bout time. Whut did yer wanna no?"

RCSD: "Well, Mr. Buzzard - what I'd; er, I mean we'd like to no - I mean know - is how you do simple aerobatics without flapping?"

OB (fully alert now, and sure he was addressing a complete idiot): "Error-batiks; hah! Ain't no sech thing; it's all flyin' boy, an' ya do whut ya gotta do when ya gotta do it. Now, like I wuz sayin' (retch, barf, stink) sumtimes ya gotta change derekshins fast, an' ya ain't got no room. Thers a cupla waze to do it."

RCS D: "Well, tell us a couple, OB" (feeling a bit more comfortable and on somewhat more familiar terms now that I'd got the Old Buzzard talking).

OB: "Ya kin loop, ya kin tern, an ya kin wingover, dependin' on things."

RCS D: "Like what things, Mr. B.?"

OB: "Wal; like f'rinstenz yew ain't got no altertood; let's say yer down low, but goin' at a purty gud klip. Yew kin pulup kinda smooth like an' go over on yer bak...an' here's whut seperates the chicks from the eagles...keep on a-cumin'; don't looz yer speed; pull back sum more an' keep on goin' around- an' yer ded meet!"

RCS D: "Dead meat?"

OB: "Yup, ded meet! Yew ain't changed no direkshun, yer low agin' an' yew ain't got yer spede bak yit. Now let's go bak...when yer on yer bak yew let yer noze cum down a bit like yew wuz gonna finish yer loop, then yer ROLL out with all yer got - an' mebbe servive."

RCS D: "What do you mean, maybe survive, OB?"

OB: "It all depends on yer speed an' how hi yer git, an' how fast yew kin roll. If'n yew got alerrons yew mite do it, but if'n yew got only ruder, yew ain't gonna make it. Ever hear of a shan-delly?"

RCS D: "If you mean a chandelle, Mr. B., yes...I've heard of it."

OB: "Okay; as yew cum up in the first part of yer loop, yer begin to tern (roll if yer got alerrons, an' jist hit yer ruder if yer ain't). Then yer glider'll lose speed but begin to go rightside up agin - but higher; as speed drops, push yer noze down. Praktes an' yew'll find yerself goin' the uther way an' higher than yew wuz. One o' them shan-dellys is nuthin' more than a steep climbin' turn. Fakt is, yew kin start yer roll 'bout the same time as you start yer loop...kinda like in all one moshun."

RCS D: "Oh, I see; you climb and change directions, too! Sounds neat. What about the wingover?"

OB: "I ain't finished talkin' 'bout the shan-delly yet (cackle, gargle puke). A climbin' tern is jist a e-z shan-delly, only dun slower an' not so steep. Now, if'n yer reel gud, yew kin come off the top of the loop an roll level from yer bak, doin' on o'them Imlemens."

RCS D: "Immelmans?"

OB: "Yep; needs lotsa speed, tho' -- an' alerrons. Most gliders ain't got the rollability (here the O.B. is really beginning to lose his accent, and is becoming visibly agitated...moving his wings and tail...clenching and unclenching his talons). But yer kin do a purty gud snap role in a glider, altho that don't change yer direkshin like

yew wuz askin' me. If'n yer take yer rudder an' give it twice't as much 'throw', and' giver yer elly-vater twice't as much throw, yew kin do a purty good 'snap' roll. Git sum spede up, like in a slite dive; then, quick as yer kin, pull full back an' full to one side; she'll go round faster'n yew kin think!"

RCS D: "The wingover, Mr. B.? What about that?"

OB: "Wal, young feller (now I'm pushing sixty, and the O.B. calls me young!) it ain't too hard, but yer gotta start with gud hite. Bring yer noze up an' hold it there, keep yer glider goin' strate up; she'll stall on yew. Keep your stick in the middle, an' jist asz she stalls, push yer stick far over to one side but still in the middle. She'll stop in her tracks, fall off to one side, an' hed strate down. Some peeple call it a 'stall-turn'. A wingover's like that, but yer don't stall. Keep yer speed up, feed in rudder as she climbs, keep her goin' up an' over e-z, then down the other side, rollin' the opposite rudder. She starts goin' up away from yew, an' finishes cumin' down right bak at yew."

RCS D: "Hmmm...I'm not sure I follow all of this, OB. Perhaps you kin, er--can explain a bit more."

OB: "Like I wuz sayin' boy, it's all flyin'. Yew do what yer gotta do when yer gotta do it. Any error-batiks is jist kombinayshuns od turns an' dives an' climbs--only they is all run tergether in one smoothe e-z moshun. But yer gotta remember one thing, boy...yew cain't do no error-batiks whn yew ain't got the hite."

RCS D: "Thank you, OB, for the interview. Do you have anything else you would like to say to our readers?"

OB: "Wal, only to keep yer spede up...an' if yer ain't got spede yew better have alty-tood - er hite -. Like them show girls say, position in life is evver-thin'. Don't never let yer spede or hite run out at the same time; alwaze keep one or t'other in the bank. Nuther thing: don't run outa spede, alty-tood or ideas at the same time, cuz yer gonna make yerself ripe fer us Ol' Buzzards!" (With something that could have been a smile or a sneer, the Old Buzzard re-arranged his stance on the limb, curled his beak, smacked a few times and began to snore...signifying that the interview was over. Nevertheless, as I departed the Buzzard Tree, I distinctly had the feeling that OB's eyes were stitching holes in my back).

LETTERS FROM MAX.....MAX CHERNOFF

"The drag vs. speed curve (E.R. Currington - RCS D a few issues back...JHG) enables designers to predict the speed range of a given configuration. The induced drag is due to downwash (eg., tip vortices...JHG) and varies with the Cl, whereas the profile drag does not vary as much within a given range of angles of attack. Since the weight of the aircraft is constant, Cl would necessarily decrease with velocity, and the induced drag coefficient would decrease accordingly. Because Cdo does not vary

much with increased velocity, the profile drag would increase proportionally with the dynamic pressure...which varies as the square of the velocity. drag; but, because of the nature of dynamic pressure, which sailplane flier will put a little downtrim on the elevator when encountering some uplift which amounts to a change in decalage and effectively increases the wing's angle of attack, causing an upward pitching displacement. This is the basis of gust analysis in large-scale aircraft. Some fliers put in down elevator instinctively.

"However, I have an opinion about a more suitable approach to stability considerations. Usually when a glider encounters an atmospheric gradient there is an oscillatory response followed by damping. The rate at which damping takes place is a measure of the aircraft's longitudinal stability. Lacking mass moment of inertia properties, and not being willing at this time to make a dynamic response analysis, I applied Eric Lister's criteria. He has combined equations with glider data to come up with suitable dimensions, and has indicated that the tail moment arms of most gliders are too small. For instance on the Olympic 650, the fuselage should be lengthened 8 INCHES, and for the SAGITTA XC, the fuselage ought to be 24 INCHES longer! (I hope the reader understands that Max's suggestions will produce a very longitudinally stable sailplane...a condition that many fliers do not really want! However, for cross-country flying at high altitudes greater pitch stability can be very beneficial, and can almost be likened to an "automatic pilot"...JHG). This calls for more efficient fuselage structural design, so I have redesigned the aft structure of the OLY 650 fuselage to make it longer, yet weigh no more, so that the c.g. can be kept in the same place without adding nose weight. Being a former free-flighter I found this easy to do. (Okay, Max, it's easy for you maybe; what about telling us how you did it?...JHG).

"John Gunsaulus built a sailplane where the nose length ahead of the wing is non-existent. The result is a very stable vehicle which recovers from pitch upsets very quickly. The same thing happens with free-flight models which thermal quite easily. Their wing loading is not low - because FAI free-flight specs can result in wing loadings often higher than those for many R/C gliders. Thus you can see that wing loading is NOT a criterion for good thermalling performance. The free-flight idea is to bring a model to a thermal and then let it take over.

"The proceedings of the National Free Flight Society are full of technically interesting and valuable information, and I

would suggest that anyone who is interested in stability and control get the proceedings or, better yet, join the NFFS.

"I have done some analysis of existing configurations and have come up with conclusions regarding steadiness and stability in flight. In accordance with that, I am rebuilding my OLY 650 to conform to those conclusions. The analysis concurs with free-flight experience where stability is so important. I will see if it solves the problem that electrostatic autopilots correct. The biggest thing is to increase the length of the fuselage aft of the wing, yet keep it light so that the original c.g. can be maintained without adding nose weight. My IBM 'XT' computer has enabled me to work out these problems mathematically and quite quickly.

"In theory, I have worked out parametric studies of aileron gearing (differential...JHG) on adverse yaw; elevator response to flap deflection; and flap/aileron flutter."

Thank you, Max, for your inputs. I have a hunch that some of us will be interested in pursuing this matter further with you, and can only suggest that they refer any letters to me so that I can put them in RCSD. Stability and control is not everyone's "cup of tea" yet it is so important to good, steady, efficient flying. If good handling characteristics can be achieved while maintaining stability, the sailplane becomes a delightful and pleasant machine to fly. Yet, we can't afford to forget that there are pilots who strive for aerobatic qualities that can be at odds with the criteria you have mentioned in your letter. I'll be happy to print any affirmations or rebuttals....JHG.



Now available...

THE WORLD'S VINTAGE SAILPLANES 1908 - 45 by Martin Simons

Hard bound, 176 pages on quality paper, 248 beautiful black and white photos plus 65 color plates and nearly 100 finely detailed scale drawings. A magnificent collection of rare information on these classic old-timers.

A SPECIAL CONCESSION OFFER FROM THE PUBLISHER ONLY is available to all readers who send us 2 International Reply Coupons. (Ask at your Post Office.) We will airmail you a free color brochure, price details, and tell you how to order. Write now!

KOOKABURRA TECHNICAL PUBLICATIONS Pty Ltd,
PO Box 648 Dandenong 3175, Victoria, Australia

WANTED: HOBIE HAWK kit or plans; GRAND ESPRIT plans or kit. George Voss, 1403 Lincolnshire Rd., Oklahoma City, OK 73159-7709

CARBON MAT SAMPLE
.2 OR .5 OZ./SQ.YD.
SEND \$1.00 EACH TO:
AEROSPACE
COMPOSITE PRODUCTS
28 Crosswood Rd.
Farmington, Ct. 06032

EPOXY FIBERGLASS FUSELAGES
CUSTOM CUT FOAM CORES

ANTARES FUSELAGE Overall length of 44 inches. Designed for a plug in wing with a root chord of up to 12 inches. No molded wing fairings. Integral fin. Overall weight of 7 1/2 ounces.

Price: \$25.00 + shipping.



Replacement fuselages for existing kit designs plus generic fuselages for the designer. Sizes from 2M to XC Fuselages priced from \$25 for 2M & STD. to \$60 for XC.

Foam cores priced at \$15/set for 2M & STD. to \$30 XC.

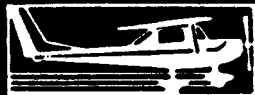
Call or send SASE for more details.

BOB SEALY'S QUALITY FIBERGLASS
 521 96th Lane NE 612-780-2737
 Blaine, MN 55434

SAGITTA 900 DOHLE SAGITTA XC
ANTARES OLY 650MERLYN XC
FREEDOM GEMINI PEGASUS XC

AIRCRAFT SCALE DOCUMENTATION
WORLDS LARGEST COLLECTION

Antiques, Military, Civilian, Helicopters, Sailplanes
color FOTO-PAAKS **KOKU-FAN 3-views**
 40,000 pictures in stock 2,000 drawings in stock
 26 page CATALOG Send \$2.00 & large S.A.S.E.



SCALE MODEL RESEARCH

2334 Ticonderoga Way
 Costa Mesa, CA 92626 U.S.A.
 (714) 979-8058

The name of the inventor of the "Z" bend is lost in the mist of antiquity, however he was most likely the inventor of the pushrod. In any event, the ubiquitous "Z" bend has been one of the most popular methods of connecting pushrods to bellcranks, control horns, and all sorts of mechanical contraptions. Never the less, it is not the best method of connecting control surface pushrods.

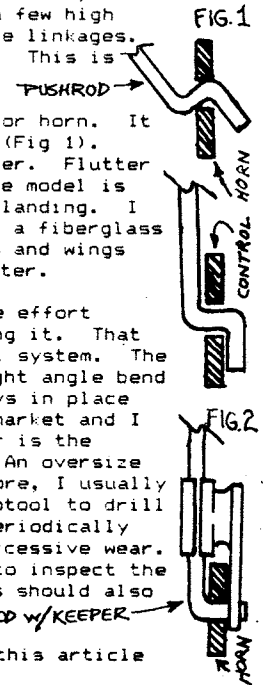
The "Z" bend is easy to make and costs nothing to install. There is even a special tool available for making "Z" bends painlessly and rapidly. (Those who have made "Z" bends in a large piece of music wire with nothing more than slip joint pliers will appreciate the painless part). These connections are fine for non-aerodynamic uses such as under the hood of your car. They are also good for throttle and nose wheel steering linkages, however they have one major problem when used in aerodynamic surface linkages. "Z" bends in control linkages allow the control surfaces to become too friendly, i.e. they like to wave at you and purr like a kitten. If you don't believe this, try a few high speed passes at low levels with sloppy control surface linkages. Frequently, you will hear a purring or humming sound. This is known as flutter.

The root of the problem is the hole in the bellcrank or horn. It must be oversized to allow the pushrod to be inserted (Fig 1). This slop makes the surface much more likely to flutter. Flutter is one of the most destructive forces that the average model is likely to encounter short of a high speed, one-point landing. I know! I have stripped servo gears and have shattered a fiberglass tail boom with flutter. I have also seen stabilizers and wings disintegrate in a few seconds after encountering flutter.

Since flutter can be so destructive, I feel that some effort should be made to minimize the chances of encountering it. That means elimination of all possible slop in the control system. The easiest way to accomplish this is to use a simple right angle bend with a pushrod keeper to insure that the pushrod stays in place (Fig. 2). There are several acceptable ones on the market and I have tried all that I have seen. The Goldberg keeper is the easiest to install and is the one I use most often. An oversize hole negates the benefits of using a keeper. Therefore, I usually cut a short length of pushrod and chuck it in my Mototool to drill the proper size hole. I also inspect all linkages periodically and replace any horns and bellcranks that show any excessive wear. If excessive wear is found, it would be a good idea to inspect the servo gears for cracked or chipped teeth. The hinges should also be inspected for damage or excessive wear.

So, in summary, the answer to the question posed by this article is no!

* 202 Inglewood Circle, Tullahoma, TN 37388; Tel.: (615) 455-5788



C.D.'S, CLUBS: SEND FOR LATEST PRICE SHEET ON PLAQUES, JACKETS, T-SHIRTS, RIBBONS, NAME PLATES, AND MORE AT PRICES YOU CAN AFFORD. EVERYTHING FOR THE PRIZE WINNER. GUARANTEED QUALITY AND OLD-FASHIONED PRIDE OF WORKMANSHIP.
Fast Service Reasonable Prices in wood, metal and plastic. Stock of standard plaques and trophies always available. Ask for rates on custom designs.

(813) 327-4767

WINNING IMAGE PLAQUES

5263 - 24th Avenue N. St. Petersburg, FL 33710

