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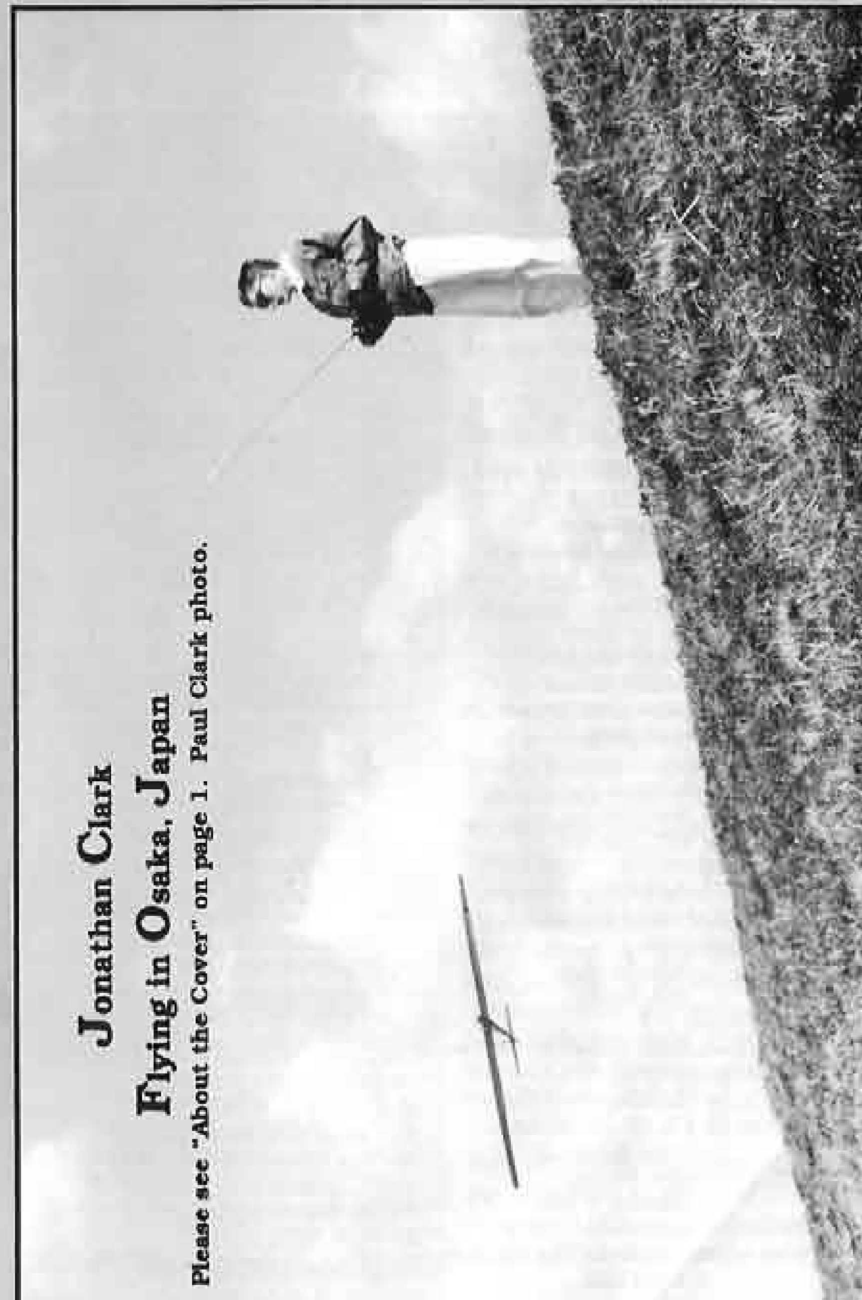
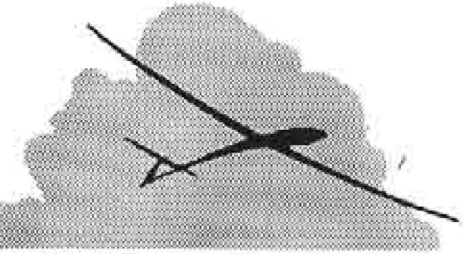


Jonathan Clark
Flying in Osaka, Japan
Please see "About the Cover" on page 1. Paul Clark photo.

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

About the Cover

Paul Clark of Osaka, Japan sent in the photo of his son Jonathan Clark.

"Jonathan is flying his kit bashed Slope Skeeter (by Dad, Paul Clark). It has Sullivan cables/Chuper style, and no rudder. Flies on a breath of lift; built at 425g or 15 oz., but ballasted to 525 or 18 3/4 oz., JR 341 servos, and CG is moved forward for penetration. Flying off the Yodo River levee regularly is a great father/son activity!"

Paul is interested in flying LSF style in Japan. For those of you in Japan that have an interest, please contact Paul Clark at 2 - 35 Suikoen Cho, Hirakata Shi 573, Osaka Fu, Japan. His FAX number is 6-954-4144 (country code 81). *More photos are on the next page.*

Masters of Soaring

The following announcement was sent in by Don McColgan, Secretary SWSA, Claremont, California.

The Silent Wings Soaring Association, SWSA, will host the sixth annual Masters of Soaring competition May 14 and 15, 1994 at the SWSA field in Covina, California. The 1993 contest was held at the Toledo Weak Signals field hosted jointly by the Toledo and Detroit clubs.

To participate in this contest, a flier must have achieved LSF level V or level IV and all contest points for level V, hold a national record, or have won a major two day, national, or regional contest. This contest typically draws the country's top fliers and presents a very challenging format. Contestants can expect ten tough rounds to compete in during the two day event.

SWSA President, Pete Olsen, will be sending invitations to previous contestants and accepting the applications of anyone who qualifies. Pete may be contacted at

(909) 597-2095 or by mail at: 15409 Oak Grove Court, Chino Hills, CA 91709-2448.

World Soaring Jamboree

According to Wil Byers, "Lots of people have been asking where they can stay for the WSJ. So, if you could include a couple of telephone numbers for the event hotels it would sure help."

Tower Inn (The hotel for registration and the hosting hotel.)
1-800-635-3980

Red Lion Hanford House
1-509-946-7611

Cavanaugh's Inn
1-800-THE-INNS

Shilo Inn
1-800-222-2244

Silver Cloud
1-800-551-7207

Super 8 Motel
1-800-800-8000

"Please have the registrants say they are coming for the WSJ. And they probably should register soon. After all we only have 500 rooms. HA!"

Comments on Wing Design

The following comments on wing design are from D.N. Penton, DeQuincy, Louisiana.

"You <u>can</u> approach the theoretical optimum taper ratio, <u>with proper section selection</u>, and have the best of all worlds - lowest C_D, C_{Di}, inertia and excellent stall characteristics. Proper section selection is, among other parameters, that the rate of change of curvature of the tip section should not exceed that of the root. If the same section is used, root and tip, .5 taper ratio, the air mass near the tip experiences a 100% increase in local acceleration, a poor choice for <u>any</u> R_N range. This negative pressure anomaly, at and near the tip, is a mandate for early separation.

"A frequently seen recommendation to use washout to cure tip stall may be a solution of convenience, but it only partially addresses the problem and contributes to other inefficiencies. The following approach to wing design has produced excellent results and should be applicable to all R_N ranges:

Paul Clark at Tottori Sand Dunes National Park, west coast of Japan.

Paul Clark is on the left and Jonathan, on the right.

Super Ridge Runt, Slope Skeeter/kit bashed Skeeter, Gnome, Impulse, and Sparrow. Paul Clark photo.

<u>Procedure</u>

(1) Select aspect ratio
(2) Select taper ratio
(3) Select root section for R_N range
(4) For tip section, thin the root section. Use root section template as a curvature limit guide. Use thickest section that meets criteria.

"Some comments regarding sweep: from Noel Falconer (Soartech #9, pg. 95), "Sweepback acts like dihedral. Like, not as; the effect depends on the lift, in magnitude and direction."

"So,

Effect is more pronounced at low speed (high C_L).

Effect is more pronounced at high G's (high C_L).

Yaw/roll couple is speed dependent (low C_L, negligible couple)."

A Question from Florida

Wildey Johnson of Boca Raton, Florida has a question that he needs help with in designing his next plane. He says, "When my Jouster rides a thermal to high altitudes, I bring it back by putting it into a spin. Although this is an unpopular method of losing altitude, I find it effective without stressing the aircraft or servos. However, some ships are poor spinners.

In designing a new sailplane, what parameters should be considered to ensure the ability to spin, and at the same time avoid any undesirable characteristics?"

Cross Country in Maine

The following request is from the DownEast Soaring Club.

"The DownEast Soaring Club of Portland, Maine is considering sponsoring an AMA sanctioned Cross Country contest this summer. The course will be a goal and return with a distance of 6 miles overall. There will be no LSF minimum rating required and re-launches with multiple attempts will be allowed. We would like your comments about such a contest. Would there be enough interest to run it? And if so, how would you like it run? Contact Steve Savoie with your comments at RR#3, Box 569, Gorham, Maine 04038; (207) 929-6639 (home).

Happy Flying!
Jerry & Judy

Servonomics

...by Pancho Morris
Mesquite, Texas

In today's world of flap and aileron, full function sailplanes and computer radios, it is no problem tying up two or three hundred dollars in the wings of each sailplane you own. If you have several airplanes, this can get very expensive.

A way to ease this problem, if you have several planes that you do not fly all the time such as back-ups or special duty ships, is to have the servos for flaps and ailerons easily transferable from one ship to another. The Airtronics Legend uses a system by which the servo mounts to the servo bay hatch which then is screwed into the wing. There are also some commercially made, after market products that do the same thing. Leave the connectors on the servos so that they plug into the extensions in the servo bay and make all your hatch covers universal and it is very easy to change servos from one plane to another.

This is also handy if you keep spare servos in your flight box, so that you can replace a servo at the field easily. I was very glad I had done just that when I blew a flap servo on the second round of our TNT state championship. It was easy to put in a new servo and be ready for round three.

This will add a few grams to your wings or maybe even an ounce, but the savings and convenience, I feel, are worth it. ■

LIFT OFF!

...with Ed Slegers
Route 15
Wharton, New Jersey 07885
(201) 366-0880 - FAX (201) 366-0549
9:30 AM - 5:00 PM (Closed Sun. & Mon.)

Rocket and Pocket Rocket

Every once in awhile, a really neat model comes along. The Rocket by Allen Development is such a model.

Allen Development is a company owned by Mark Allen. Most anyone who has been in sailplanes for awhile knows of Mark's accomplishments. But for the newcomer, some of Mark's designs are: Falcon 880, Falcon 600, Thermal Eagle, and his new all molded Eagle. These are just a few of his many designs, so it is no surprise that his Rocket and Pocket Rocket fall right in line with his other fine planes.

The Rocket and Pocket Rocket are made with the same construction techniques as Mark's molded Eagle: all molded hollow core wing, molded stab, rudder and fuselage. The white top and red bottom colors are molded in. A really neat feature is the "living skin" hinges on both wing and stab.

I would like to go into a nice step-by-step construction article, but there is no construction. The plane comes to the buyer with most of the work completed. The ailerons and elevator are pre-cut and the wing and stab are pre-mounted to the fuselage. All that has to be done is to install the radio gear and the power equipment.

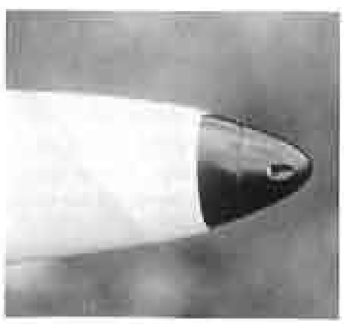
I have a couple of Rockets and Pocket Rockets, and I can definitely tell you that they are some of the best electrics that I have flown. When Rudolph Freudenthaler visited me (December 1993 *RCSD*), he flew mine and was very impressed. Since then he has called me to see if I can get him a Rocket. That should give you some idea as to how well it flies.

For years I have been converting sailplanes into electric, but after talking with Mark, it was decided that the Rocket might make an excellent glider. I ordered from Mark a Rocket with the wing cut out for flaps. I just mounted a spinner to the nose, installed radio gear and a tow hook, and wound up with one of the best 2 meter sailplanes I have flown. The all up weight of 31 ounces makes it a great thermalling plane. The one thing that it does better than any other 2 meter I have flown is launch. Zoom launches are higher than any other 2 meter I have flown to date. With only a few weekends of flying, it is already obvious this is going to make an excellent competition 2 meter sailplane. I might have to start looking at some of my other electrics to see how they would do as a glider.

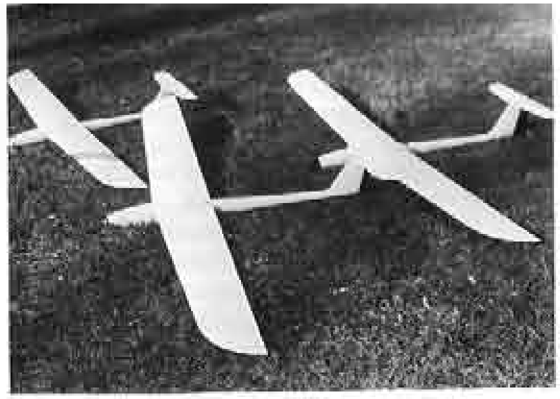
If you are interested in a Rocket, please contact Mark at Allen Development, 4234 Petaluma Blvd. North, Petaluma, CA 94952; (707) 778-2252.

Good Flying! ■

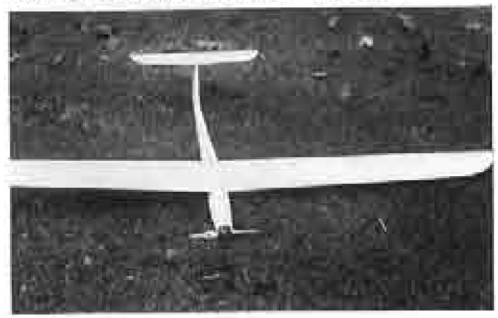
Pocket Rocket



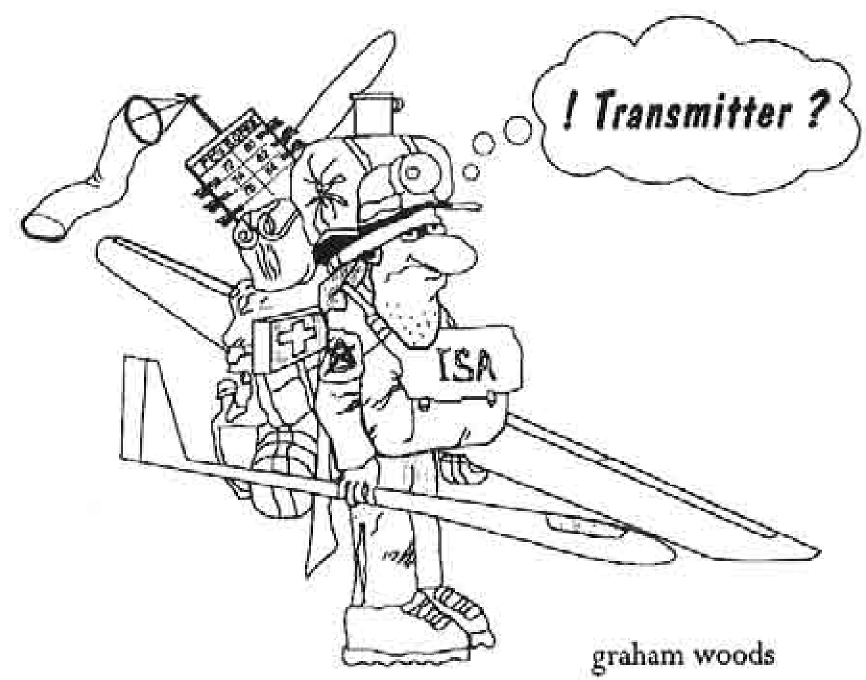
Thermal Rocket
Thermal Rocket nose



(L-R) Pocket Rocket, Rocket, Thermal Rocket



Rocket



The Case of the Swiveling Tail Wheel

Adventures with a FeatherCut

...by Mark Weiland
Aurora, Colorado

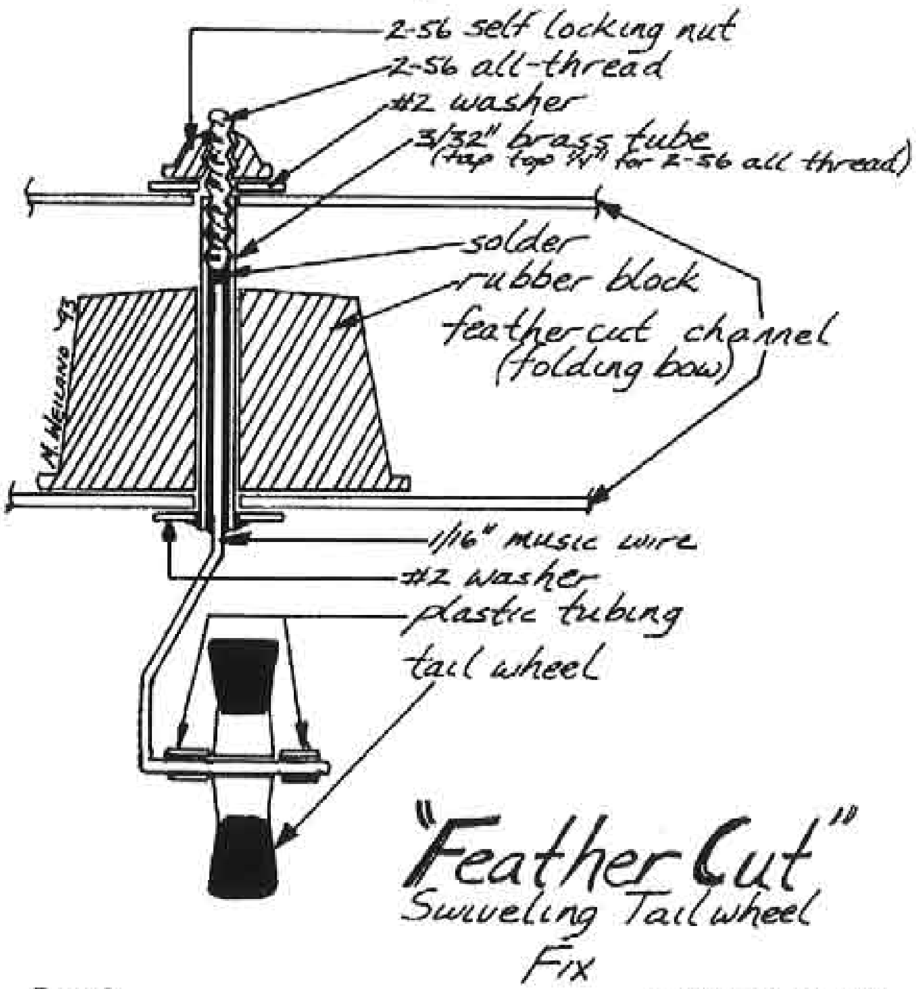
It was a dark and blustery evening as I unpacked my new FeatherCut from Tekoa. The creaking of the house created an eerie feel as the lightning sliced through the air. With my FeatherCut setup, I started to cut my first core, with results that were outstanding. Yet, being production minded, I found the tail wheel swiveled with a mind of its own. Could my new machine be haunted! Footsteps sounded behind me as I started to cut my next core. They were getting closer and closer when the tail wheel swivelled, allowing the clip to drag on my template. Oh no, the frustration of it all!

Seriously though, I have found the FeatherCut Machine from Tekoa to be an excellent product. The only flaw in an otherwise perfect method of cutting cores is found in the mounting system of the tail wheel. The rubber block which holds the tailwheel is not as precise as it needs to be for production use. This article will explain my simple fix for the inadvertent swivelling of the tail wheel.

My first step was to drill a 3/32" hole through the Folding Bow channel. This goes through the small rubber block that is supposed to hold the tail wheel in position. I took a piece of 3/32" brass tube and cut it to the height of the channel. This creates an axle for the tailwheel wire to mount in. I removed the wheel from the standard piece of 1/16" music wire supplied and slid it into the brass tube. Measure then cut this wire to allow for a piece of 2/56 all-thread to fit into the top 1/4" of the brass tube. I enlarged the hole from 1/16" to 3/64", tapping afterward to fit the all-thread. My last step was to put a #2 washer on the bottom of the brass tube for a stop. (See the accompanying drawing for details.)

Solder the music wire, washer, and all-thread to the brass tube. Re-install the wheel using the pieces of tubing supplied and slide the assembly into the hole in the channel. Place a #2 washer on top and tighten down with a self-locking 2/56 nut.

When you use the machine now, you can tighten the nut down locking the tail wheel assembly in place. You may change the positioning any time during the process to allow the wheel to track at the proper angle when cutting cores. Hopefully this quick fix will help you in solving the *"Case of the Swiveling Tail Wheel"* on your FeatherCut. ■



on the Wing

B²

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

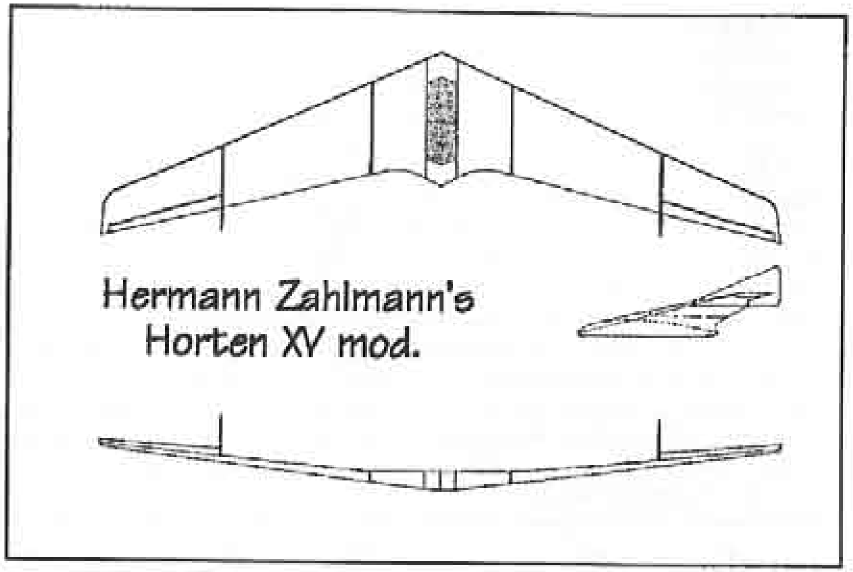
Hermann Zahlmann's Horten XV Mod.

It is always of great interest to examine a model in light of the designer's stated goals, and Mr. Zahlmann had a number of goals in mind when he designed his Horten XV mod. He wanted a good looking, inexpensive, easily transported tailless sailplane. It had to be stable in flight, controllable and quick (but not frantic), and suitable for both thermal and slope flying. A simple RC installation and easy field assembly were also desirable characteristics.

The result is a 2.4 meter span swept 'wing of wood construction with fabric covering which fulfills all of Mr. Zahlmann's objectives. The Horten XV mod. disassembles into three easily handled pieces which conveniently fit into the trunk of a medium sized car. The center section is large enough for the insertion of ballast, and the servos are mounted in the wings with direct connections to the elevons. While not an ideal thermaling sailplane, as it is a bit too fast, it has competed successfully with conventional tailed designs. Launches using a high-start made of 30 meters of rubber and 150 meters of line result in flight times of three to five minutes.

Mr. Zahlmann incorporated several novel construction methods in the building of this model:

- The center section is built inverted, with the upper surface on the building board. Jig blocks hold the leading and trailing edge and prevent the wing from rocking. When completed, the top of the center section is flat and the lower surface provides a small amount of dihedral.
- The airfoil section used at the center line has some reflex, and the cuspidate tail is formed so the trailing edge is a straight line when viewed from the rear.
- Other than the center line section, all



Hermann Zahlmann's Horten XV mod.

ribs utilize the Clark Y section. Stability is provided by inverting the panels outboard of the fins and incorporating an appropriate amount of washout. A rather ingenious construction method accomplishes this. The outer panels of the wing are built in the usual way, with the flat bottom of the ribs placed directly on the building board, but the spars are assembled with the wing rod tubes very carefully placed. When completed, the outer wing tips are sawed free and exchanged. The right panel is thus inverted and placed on the left wing, and the left panel is inverted and placed on the right wing. The correct amount of washout, about eight degrees, is automatically achieved when the panels are inverted and attached to the main wing with the wing rods in place.

The fins serve as fences, separating the two wing panels. This is a good way of handling the junction where there is a drastic change in contour, and the efficiency of both the lifting surface and the stabilizing surface is greatly improved. Holes in the fins allow the wing rods to pass through, and the fins are then held in place by pressure from the two wing panels.

The Horten XV mod. has fulfilled all of Mr. Zahlmann's stated design goals and offers several innovative construction methods. ■

"Do You Speak Model Airplane"

Written by Dave Thornburg

...Reviewed by Bob Steele
Fort Wayne, Indiana

I know we don't usually do book reviews in this newsletter, but here's one I had to let you know about. Despite the unusual title, this is a marvelous book about "the story of aeromodeling in America". It chooses as its starting point the flight of Charles Lindbergh, solo, across the Atlantic. And indeed, this was the beginning of mass modeling among the youth of the U.S.A. He goes on to describe how thousands of modelers (I and others like me) became "lifers". Those of us who will continue to cut and glue balsa, draw plans for the dream ship on napkins, flip every prop we can get near, and several times a day look at the sky and speculate on the model flying conditions. If this sounds so very familiar, you may be a "lifer", also! Thornburg does spend one chapter going back in time to the very earliest modelers, those men who were trying to solve the mystery of manned flight. He covers modeling before and after World War I and describes the hobby as it was during the 20's before the Lindbergh miracle. The rest of the book, to those of us who were born toooo long after this flight, is my history and the history of every other "lifer", and it may also be yours.

Modeling in the 30's is well covered; the progression from rubber to gas power, the move from indoor to outdoor ships, it's all there for you to read and remember. The pre-war Nationals and the birth of the AMA fill lots of pages. The advent of U-control and its popularization by Jim Walker, the resulting differences in modeling which this brought about. Then WW2. No more engines, no more rubber, no more balsa, and no more Nats! After this traumatic period which saw many of the "lifers" go into the service and come home eager again to build anything that would fly, we read about the glorious but all too brief rebirth of modeling: free-flight, gliders, quarter Comet kits, engines of all types and sizes. The Nats were resumed and the gathering of the clan took place, again. Forty-six, forty-seven, forty-eight... these were the high-water years, those years when everything seemed rosy. But it was not to last. The "junior problem" began early... and kept growing, and growing. For some reason, the young kids weren't modeling like their older brothers or their fathers. Why? How about television, or plastic models, or television, or slot-cars, or television, or maybe video games? But through it all, the "lifers" stayed with it, and some of the older fellows joined us. Thank God! These people kept the hobby going through the tough years. Dave Thornburg discusses all this and lots more. He reviews the Navy Nats, one by one. He details the beginnings of Radio Control which is something we will surely remember. From this book you get the true story about the people who invented and built today's digital proportional sets, Americans all. Names like Doug Spreng, Jerry Pullen, Bob Elliot, and Phil Kraft are all here. You have to read the book to understand all this. Thornburg describes the ups and downs of our hobbies "life blood": the monthly model mags. These too are all here: *Flying Aces*, *Air Trails* in its many incarnations, *Flying Models*, *Model Builder*, *R/C Modeler*, and the grandpappy of them all: *Model Airplane News*. I still buy them and read them every month, and I'll bet you do, too.

This book is the story of modeling's first ninety years. If you are a "lifer" like me, you'll want to read this book! And, not just read it. You'll relive your modeling past just like I did. You, too, will remember your triumphs and your failures that your small (or perhaps large) contributions made to the hobby that is our life. ■

Understanding Sailplanes

...By Martin Simons

13 Loch Street, Stepney,
South Australia 5069

The Cross Country Sailplane
(Notes prepared for the MARCS Symposium, October 1992.)

MacCready flying

I shall not say much more about MacCready theory, because, so far, model cross country flying has not reached the stage where actual racing is important. It will become so, and should be anticipated. The sailplane pilot who is in a race must not linger in weak thermals but leave them as soon as possible in search of strong ones **(Figure 7)**. To use every last shred of lift wastes time if there is better to be found. Looking ahead down the track, the pilot must estimate the strength of **the next thermal to be used.** This is not the next thermal that might be flown into, because that might not be strong enough. The pilot says: "The next thermal I shall use must be up to such and such a strength. Anything less, I shall not accept but shall simply fly through without circling. The only exception is if I make a bad mistake and get so low that I have to use any lift I can find."

The object is, not to enter the next thermal as high as possible, but to get to the top of the **next** climb **in the least possible time,** so achieving the best average speed. Between thermals, calculations show that the speed to fly must be faster again than the speed for least height loss.

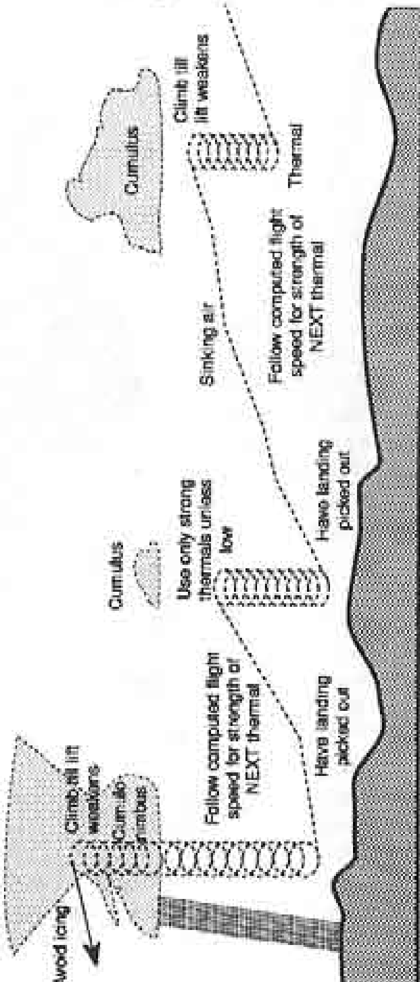


Figure 7. The MacCready style of cross country flying

Information needed: Rate of climb in present thermal (average).
Estimated average strength of next thermal (experience on the day/hour/minute).
Airspeed now and airspeed required for maximum average speed (through the air).
Altitude now and estimated altitude at next thermal.
Suitable landing areas.
Course, wind strength and direction and distance to fly to reach goal (turning point or race finish).
Final glide computer.

Instruments needed: Total energy variometer with speed to fly ring (MacCready ring).
Altimeter.
Air speed indicator.
Compass.
Gyro instruments if blind flying allowed (turn and slip indicator minimum, art. horizon better).
Oxygen breathing if likely to go above 10000 ft.
Maps and plan position indicator if available.

Dolphin soaring

Dolphin soaring grew directly from MacCready theory **(Figure 8).** Granting that not all thermals are worth circling in because of the time wasted in weak lift, good use can still be made of such rising air by flying through it slowly, without circling. Height can be gained without much loss of time. With the greatly improved performance of modern sailplanes, in recent years it has been found possible to fly at very high average speeds

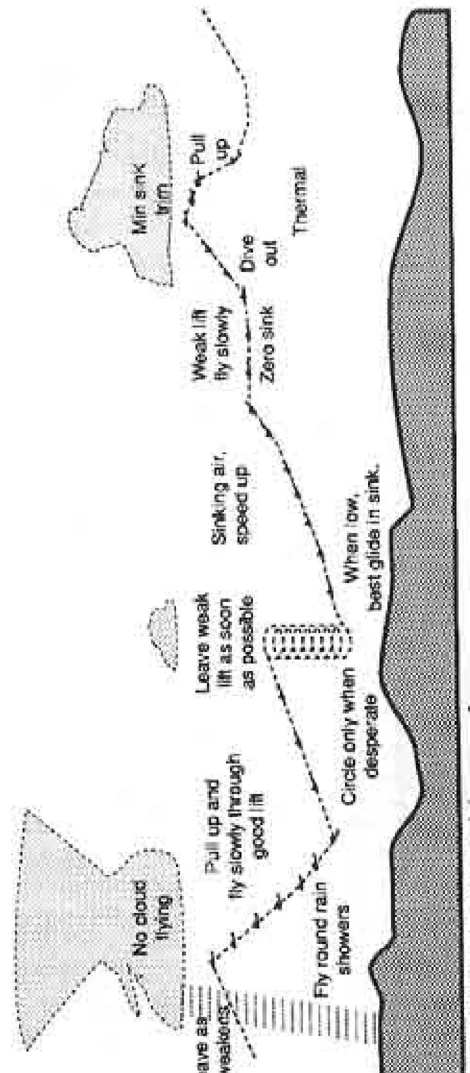


Figure 8. Dolphin soaring

Information needed: Rate of climb or sink now.
Airspeed now and airspeed required for maximum average speed (through the air).
Altitude now and estimated altitude in future.
Location of lift and pattern of thermals.
Suitable landing areas.
Course, wind strength and direction and distance to fly to reach goal (turning point or race finish).
Final glide information.

Instruments needed: Total energy variometers (several) with nav computer and averager.
Altimeter.
Air speed indicator.
Compasses (several).
Oxygen breathing if likely to go above 10000 ft.
Maps and plan position indicator.
Final glide computer (included in speed to fly computer).

for long distances, through weak and even strong thermals, without circling. Crossing the sinking air still requires very high airspeeds. When lift is found the pilot pulls up, gaining hundreds of feet in the manoeuvre, then levels out to fly slowly through the lift, gaining height all the time, until on running out of it on the other side, the speed is rapidly regained in a dive and the flight continues. Only if conditions become difficult or if an exceptionally strong thermal is encountered, does the modern racing pilot circle to gain height. the passage of the sailplane through the air resembles the plunging and surfacing of a dolphin, hence the name.

Models already do some dolphin soaring, as much by luck as by judgment. With good electronic instruments, we shall do a lot more. Our chief problem will be to keep up, on the ground, with our sailplanes **(Figure 9).** ■

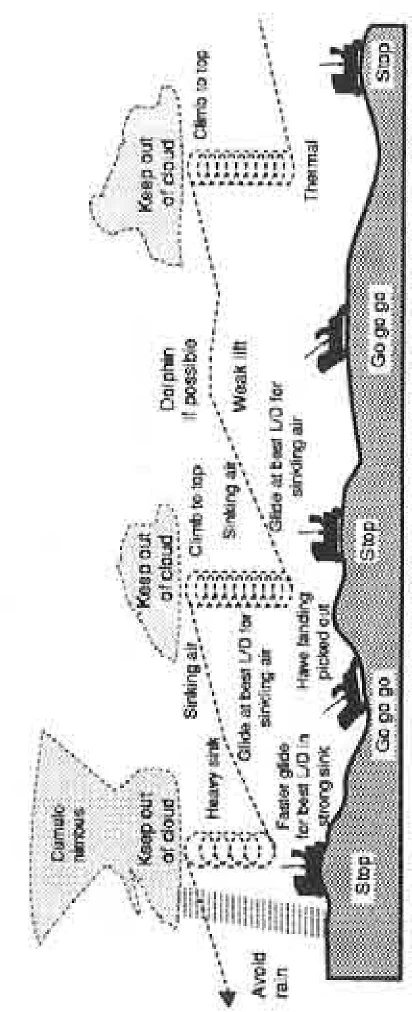


Figure 9. Cross country flying with model sailplanes: Use a large, strong sailplane!

Information needed: Climbing or sinking.
Altitude now.
Prospects of lift ahead.
Speed to fly through sink.
Suitable landing areas.
Wind speed and direction.
Hours of daylight remaining.
Battery charge information.

Instruments needed in glider, transmitting to pilot:
Total energy variometer (compensates for airseed variations).
Altimeter.
Airspeed Indicator.
Plan position indicator.
Battery sensor.
Artificial pilot?

Pre-planning:
Weather forecast, lapse rates, winds, whole day.
Map out proposed route - road, tracks, rough country. (Aerial photographs? Airports?)
Food, fuel and camping prospects.

Ground equipment:
Following vehicle (pick up truck or 'ute' with good seat for pilot and helper).
Reliable driver and navigator.
Communication pilot to driver.
Binoculars.
Reserves of everything - fuel, food, drink etc.
Electronic gear to receive and convey information from glider (Pilot has earphone, info in audible form.

Don't throw away that old plane yet!

...by George Siposs
Costa Mesa, California

I saw an ad in our club bulletin for a 2-meter Gnome with a Falcon style wing, flaps and ailerons. It intrigued me and the price was right so I bought it. Its builder-owner said that it was a "dog in the air", wouldn't turn, etc. I decided to modify it slightly.

It had a standard Gnome fuselage which required no rework at all. The wing was built up and totally sheeted, with a modern planform and slight polyhedral and small upturned tips, very strong, very well built. But I saw a couple of things that I would have done differently so I decided to test my theories.

The leading edge was blunt and misshapen, so I sawed it off on a table saw and epoxied-shaped-sanded a new leading edge in. The leading edge is where most of the wing's work is done and I felt very strongly that it had to be re-shaped. The entry radius determines a lot of flying characteristics (such as speed), so I spent considerable time on it to make it the same as the standard 2M Gnome. I used a cardboard template on the outside of the wing.

The wing also had ailerons and long flaps with plastic hinges and four servos. I don't like the weight and inertia resulting from four servos in a 2-meter wing, so I took a deep breath and only used one servo for the right flap and connected it with a U-shaped wire to the left flap. So now both flaps work in unison and one servo is eliminated; it is now on my left stick. I made a shallow groove (with a hacksaw blade) in the center of the wing to allow room for the center of the "U".

I mounted another servo in place of the left flap servo. This one moves its arm span-wise and I connected it to the ailerons via .047" dia. steel wire pushrods and bellcranks (which are located where the outboard aileron servos used to be). Steel wire is stiffer than plastic pushrods and requires no sheath. I retrofitted the pushrods into the wing by first peeling off the Monocote (the bottom of the wing past the spar is not sheeted) and feeding the wire through the ribs, piercing the balsa ribs carefully. They provide enough support so that the wire does not buckle when in the push mode. The holes don't have to be tight, slightly oversize is OK. They must be in-line to prevent binding! By displacing the bellcranks about 15 degrees, I obtained enough aileron differential (i.e., up aileron deflects more than down aileron). The aileron servo is now electrically connected (wires are soldered) to the rudder servo so the turning action is coordinated, yet I only use one stick.

The plane goes up on the winch like a rocket, turns on a dime, has a wide speed range and lands very slowly. It would make a pretty fair slope soarer because it can turn on a dime.

The effort was well worth the couple of evenings I spent on it and it proved my point in a most satisfactory way. If you have a "dog", you might want to experiment with it. You may be surprised! ■

Throwin' Up or Hand-Launch Topics

...by Scott Smith
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Introduction

Happy New Year! Hand-launch is getting off to an early start in Southern California with contests this month by the Inland Soaring Society and the Torrey Pines Gulls. Hopefully a few war stories will come out of these.

Sorry, but I'm deviating from the velcro flight trimming I promised for this month. I'm not finished with it yet.

An Aspiring Star

Mark Weiland of The Sailplane Works in Aurora, CO has sent me one of his first production units of the Aria, a premium hand-launch kit. I haven't started building it yet, but it looks impressive. The fuselage is to fall in love with; it is a glass, carbon-fiber, kevlar hybrid that is finished, lightweight, and beautiful. The instructions and drawings are complete, well-written, attractive to the eye, and filled with helpful hints that would apply to other building projects as well. The packaging will survive any encounter with any carrier.

I have only two questions: how it will fly after I've built it, and how in blazes Mark can market this for $99. You might consider buying one now before Mark realizes this and raises the price.

A Hint...

Joe Rodriquez of Inland Soaring Society passes along a strategy to save weight on foam wings; don't film cover the wings. Instead, coat the wings with Model Research Lab's Sanding Sealer and Glider Polish. He recommends two or three coats applied as follows: use a sponge to apply a light coat along the grain of the balsa or obeche sheeting. This laquer-based sealer attacks foam, so you want a light first coat to avoid puddling. Then apply one or two more coats. Saves up to two ounces.

...and a Kink

How to avoid a kink, that is. Your sailplane's weight should match your arm; it should not be too light as well as not be too heavy. I first flew my Climmax in a contest with no covering at all (how many of you have finished your plane at 2:00 in the morning before a contest?). It only weighed 11 oz. I could throw it very high (for me), but the next morning my arm was so sore it kind of scared me and I didn't throw again for 6 weeks.

I covered my plane in time for the next contest and brought its weight up to 13.5 oz. I've had no arm problems since.

Alternative Launching Methods

Kenneth Griffith wrote to ask about alternative launching methods for older fliers.

A year ago I was preoccupied with alternative launching methods; I even sponsored hand-tow contests that I wrote about in this journal.

Since then, I'm not as enthusiastic about launch-assist, because hand launch is not as hard as people who haven't done it think it is. I've talked with Joe Wurts and Darryl Perkins, two flyers you've probably heard of. Both of them are formidable hand-launch competitors; it is awesome to see how high both of them throw. The interesting thing is that both of them swear that launching is primarily technique, not strength or speed.

A year ago, I didn't believe them. I couldn't throw worth sh... you know what. But now I throw about average, and I'm 44 years old. I'm embarrassed to throw a baseball; but I can throw a hand-launch and catch thermals. Once more, I know my technique is lousy; I don't practice enough. But again, I can throw enough to catch a thermal, even search around a bit for one.

So what's the point, you must be thinking? The point is: once you throw a handlaunch airplane and it catches a thermal and "specks out", there is no more thrill than that. And everything after that is simply "Zen"; it grabs you and you keep doing it even though you're old and/or fat and/or look terrible in shorts and/or well, it doesn't matter. And competition is simply an opportunity to see how you stack up against your peers. And when your peers are just as old/fat/ugly in shorts as you are, then it's fun. Yeah, the young guys usually win, but it's because they're not married and they don't have kids and they don't have a house to pay off; hence they PRACTICE and they can PRACTICE A LOT. That's why they win; not because they're young. And, yeah, some of them are so good it takes your breath away.

But you see your 48-year old buddy nail four out of five 2-minute flights in the fearsome 3rd round, and it gives you hope that someday you can do as well. I had my first sequence of 2-minute flights this last summer; and I was almost as thrilled as the first time I caught a thermal from a hand-launch. There are 60-year olds that show up consistently at contests and do as well or better than I.

Remember, too, the airplane designs today are leagues better than just 3 years ago. Radio equipment, including servos and batteries, can be configured well under 4 oz and purchased complete for $180. If you don't cover but simply use sanding sealer, another 2 oz can be saved. These make it much easier to achieve a total weight of 14 oz. or less, which I didn't think I'd ever make a year ago.

Which brings my rambling to the point I'm really trying to make. Hand-launch is NOT about leveling the field so that everyone can compete on an even basis. Lord knows, I believed exactly that not long ago, and hand-launch seemed like a lot of work.

No, hand-launch is the primal thrill of throwing a glider and making it soar to the heavens. A contest is really about men getting together to give affirmation and to celebrate that each can indeed do this. You don't believe me? Go to a hand-launch contest and listen to the shouts of encouragement. Join in the whoops of joy when a newcomer "specks out" for the first time and has suddenly achieved his "rite of passage".

Hand-launch is about old men finding out they are not so old after all.

But...

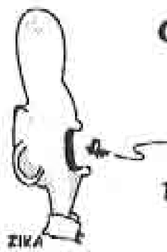
But, what if you're really old, or crippled, or have no arms, or no legs, or can't throw well at all? What then?

Next Month

(sigh) Alternative launching methods.

■

Curt Nehring
Southern California



On The Air With Cornfed

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"Flying Dog"

Well, another month has come and gone and here I am back in your face with a story that will be hard to beat.

First, I would like to lay the ground work by addressing the picture. From left to right is Mr. Rusty Rood, his daughter is in front. (Rusty is how this story came about, so I won't describe him at this time.)

Now the next one is Robert Lawson. Robert is a Psychologist. I wonder about him. One day we were out flying. I was laid out in my lawn chair and Robert pulled his chair up behind mine and started asking questions about my childhood. That seemed okay with me. I was answering him. Then, I answered a question with a question and waited for an answer. No answer... I turned around only to find Robert walking off with his hands in the air shaking his head. You don't suppose he was psychoanalyzing me, do you?

Next in the photo is Walt Frickie. Now, Walt has been involved with models forever. One man told me that Walt invented balsa wood...

To Walt's right is Cliff Williams. Cliff rebuilds transmissions as a trade. One day I'll tell you about the time he rigged up a transmission to a winch and peeled the skins off the plane.

Next is "Colonel" Asher Carmichael, best model builder this side of the Mississippi. After seeing his planes, it makes me want to fly my trash at night. As I understand it, Great Granddad Carmichael was a Colonel in the war and left numerous relics, photos, and stories that have grown more colorful with each generation. Perhaps that is why the flying field seems to cause "Colonel" Carmichael to go into some kind of fantasy about being a big shot pilot in World War I.

Next to the "Colonel" is Dr. Jim Johnson. He flies the Duck 100". They tell me he is one of its designers.

Last of all is Charlie Waller. His flying has been off a bit lately...

The plane in the picture is a scale SB 10 that belongs to Rusty. His flying skills, by the way, are second to none.

Well, as you can tell, I fly with a colorful group of folks.

Now, for the yarn...

There we were, setting up for the day, when up drove Cliff. Now, Cliff has one of them little yapping, big eared dogs about three pounds soaking wet. And, like all dogs, they seem to find someone they don't like, and Cliff's dog just flat out did not like Rusty. He always rapped on the window and provoked the dog every time he walked by the car. Well, the day was going fine. Rusty had flown about everything he had brought. I had just landed from one of those long, neck-aching flights of about 1.45 seconds. I turned everything off and noticed all the guys standing up to the winch. Rusty was doing a roll off launch. Man, it was pretty! He topped off at what looked like about 600 feet. That lucky dog popped right into a hat sucker. He was flat checking out. The Big 10 looked like a gnat up there. This plane has a 16 foot wing span, so who knows how high it was. Everybody was standing around looking up. They looked like hog callers at a hog calling contest. I hollered out, "Let me fly, Rusty." He said, "Are you crazy? Are you out of your mind?" I replied, "I don't know. Ask Robert..." Nobody, but nobody, flies the Big 10. Well, I didn't ask, again.

I looked over at Cliff. "How about a cold drink?" "Sounds good," he replied.

"Let me get 'um out of the car." I guess I broke Rusty's concentration. When I looked back to the heavens it looked as if it was time to start planning a landing pattern. That's when a perfectly good day began to turn pretty sour.

You can't blame Cliff. I guess if I hadn't asked for a cold drink, all would have gone well, but when Cliff opened the car door, Fluffy, his dog, bolted out of the car and made a bee line for Rusty. Barking and growling, he ran right over to him and latched onto the bottom of his pants leg. That dog was locked on like a snapping turtle. Rusty could not shake him.. You should have seen Rusty's eyes. He would look at the dog, then the plane, then back at the dog again. We all knew that it was time to land Big 10, but with Fluffy about to trip Rusty, no one knew what to do. Cliff was yelling at Fluffy, the "Colonel" was running in a circle hollering, "We're all being attacked!" Robert jumped up and just flat out slapped the "Colonel". Then... silence came over the field.

What to do?! A light must have come on in Rusty's head. Seeing he was an All-American football player in high school, he just stepped forward with his free leg and locked it. Then, he just boot kicked poor ol' Fluffy into flight! I guess he went up to about 35 feet. As the dog crested, it looked like he stopped in mid-air. Fluffy's big ears opened as if to slow himself down, and it did! He could not have timed it any better. That dog must have hit the biggest thermal of the day! Fluffy rose and rose 'til he was slap out of sight. As for Cliff, he posted pictures of Fluffy on telephone poles and ran ads in the paper. He never found Fluffy. Poor Cliff...

Oh yeah, Rusty and the rest of us were in utter amazement when this happened. Rusty just quit flying his plane. Big 10 crashed. Yep, tore it up. It looked like a pile of trash. It was not pretty, at all.

All we could do was console Rusty and Cliff. Charlie was in the background mumbling, "I wish that was the only problem I had."

What a day it was!

Well, by now ya'll know that I blew a little smoke at you, and that isn't really how Rusty lost his plane. I feel bad. I'll try to tell the truth. Rusty was flying the plane when someone turned on their radio on his channel. All I'm really trying to do is drive a point home about flying at the field with your friends. Please make sure that everyone knows your frequency. Before you fly, holler out your number and listen for a reply. Too many times you or a friend may lose a plane because of this problem.

By the way, since I'm telling the truth now, Cliff's dog's name is not Fluffy! It is L.D. (Little Dog). That dog is anything but little! He is so fat he can't even jump. Yeah, even Rusty would have had a hard time launching L.D.

Signing Off,
Cornfed

P.S. Don't forget: Love your dog, and say your prayers.

ATTENTION: Ed Slegers of New Jersey. I'm sorry about not including the check in the envelope. Will you cut the stamp off and return it? Then I'll be able to put the check in the mail to you. Ain't no sense in wasting another stamp, again! ■

FLIGHT PERFORMANCE QUESTIONS ANSWERS

The Effect of Model Size on Flight Performance

...A Question by Alan Mayhew,
Australia
...An Answer by Lee Murray
Appleton, Wisconsin

(In the September issue of *RCSD*, page 28, Lee Murray wrote about "Comparison of Model Sailplane Flight Times by Class"; Part II on this subject was included in the October issue, page 37, "Sailplane Flight Times as a Function of Launch Methods, Wind Speed and Time of Year". Lee's first article generated a letter from Alan Mayhew, Australia, to Lee Murray, and Lee in turn responded. We would like to share Alan's question and Lee's response.)

A Question from Alan

I bet you don't get a lot of letters from Bali! As you can see, I'm in holiday in Bali but live in Australia. I have just read your article in *RCSD* magazine and your comparison of gliders was a timely one. Some friends of mine and I were contemplating this very topic.

We are keen on competition flying and are using the current construction techniques (vacuum bagging glass on blue foam, carbon fiber spars, etc.). I notice that the vast majority of unlimited gliders available on the US market (e.g., Thermal Eagle, Saturn) seem to be limited to around 115" span and 10 - 11 oz./in.^{2} unballasted (with the exception of Frank Weston's Magic).

My question is simple. Why is the trend to limit the span to 115"?

With current building methods it is quite possible to build to 140" and (have) the same wing loadings, and an unballasted weight of 85 oz. Even in light winds, as this weight launches on a winch, are excellent. From our experience, it's when you get up to 100 - 120 oz. that light wind launches become a problem.

If you would care to give me your thoughts, we would appreciate it. I guess the answers may become obvious at the World Soaring Jamboree next year.

Cheers from Down Under,
Alan Mayhew

Lee Murray's Response

Thanks for your kind comments on my *RCSD* article on the effect of model size on flight performance. I have received a call or two about it and now your letter from Bali which makes me feel as if my time was well spent in writing the article. The second article will discuss launch methods, weather conditions, and time of year effects. The second article was more interesting for me since the outcome was, in part, unknown and still leaves plenty of room for a challenge.

I have taken a few days to consider your question "Why do so many American unlimited class models end up at a 115 inch span?". I can think of a few factors which tend to limit the size but don't really indicate why the American "high performance" models aren't a little larger.

The larger XC ships that I have flown, fly very well but suffer from several factors I will mention since to some degree the factors would also apply to larger unlimited class high performance ships:

- SIZE vs WING LOADING & WEIGHT LIMITS The FAI limit for model weight is 5 Kg (176 oz.). My 173 inch span Constellation is up at that maximum weight but it actually is kind of light for X-Country work. Perhaps cutting off some wing would get the loading up to about 16 oz./ft^2 where I am told it flies best. Larger models require higher wing loadings for optimum performance. At 16 oz/sq ft the model with maximum weight and a 12" average chord would have a span of 132". (Still seems workable here.)

- WEIGHT vs WINCH POWER Another factor is that the mass of the model increases with the cube of the span. The launching requirements for energy, and launch line strength, increase quickly with size. Most F3B guys recognize that requirement and used bigger motors and bigger planes until limits were placed on the motors. Then it was back to smaller and lighter models.

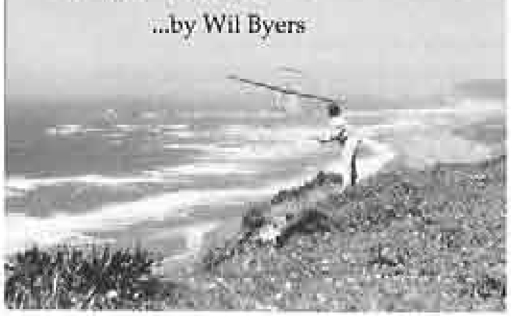
- DIFFICULTY in LAUNCHING After several crashes in trying to launch an XC model by myself, I now only try it with a second person running with the model until it has flight speed. Perhaps launching a larger model just doesn't feel as secure. I wouldn't consider launching a large XC model down wind. I would launch my smaller models down wind knowing that the winch speed will get the model to flying speed quickly, especially if I stretch the line a little.

- EFFICIENCY in CONTROL Turning radius increases with the wingspan. The inboard wing air speed decreases in tight turns so you can't turn as tightly with the larger models. The momentum is also greater making the model slower to respond to corrections. I have seen two XC models damaged with pitch instability problems close to the ground.

- SPOT LANDING PRECISION Landing accuracy is the last factor that I will speculate on. With the Constellation, I can't seem to control the rate of sink close to the ground like I can a smaller model. I can drop the flaps to about 50 degrees but the model wants to float when it's next to the ground.

All in all you can see that I don't have a good answer about why Americans don't fly 130" span models. I have been surprised at how well the heavier unlimited class models such as the Synergy and Legend fly compared to standard class models and conventional unlimited models. Lots of progress has been made in wing section design and with wing platform optimization in the last ten years. Perhaps it's only a matter of time before modelers start testing larger wingspans. I suppose that I should play with PC-Soar to see if there is some performance optimum in span. I didn't seem to find it in the range of models I flew. Perhaps the answer is simple - How about cost? Does the cost of the model increase with the cube of the span? If so the larger models might cost significantly more. ■

...by Wil Byers



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Scale Check-Ride

A painless transition to scale glider flying

...by Bill Liscomb
Carlsbad, California

The first time a modeler flies his new quarter-scale ship is usually a moment of truth. Do the piloting skills of the builder/flier match the investment of time and money in the new aircraft? I have seen one or two relatively inexperienced pilots try their hands at these large and fast birds with predictable results. I have also seen serious pilots get a handle on scale ships with less than a years' experience flying R/C. What really matters here is the quality of experience, not the quantity of experience. I recommend that a pilot be proficient flying fast, clean aileron/rudder/elevator models. I have helped quite a few pilots transition to scale, and in this article I will cover most of the points given in the field regarding take-off, flying and landing. Mentally rehearse all phases of your flight before actually flying. Large, scale gliders are fast and cover a lot of ground quickly and you will need to stay ahead of it mentally. What I present here is not the only way, but what has worked for me over the years. I encourage you to try something new or different if what I present here doesn't seem appropriate for your situation. Potentially, large gliders can cause serious injury, and caution must be exercised by the pilot at all times, especially when the model is in close proximity to people or their property. Please be careful and responsible. Safe flying is no accident.

Launching

Slope

The luckiest of all future scale pilots fly their models on slopes. I feel this type of launch is far less traumatic for a first flight than a launch on a winch. First, double-check control throws and directions, CG the model and eye-ball all surfaces for unwanted warps. Launching a big glider on a slope is basically a stall recovery maneuver. The glider needs to be pointing directly into the wind and the nose about 5 degrees below level. Nose too high and tip-stall is next, too low and a very short flight.

The first variation of launching is to have the launcher back up about thirty feet from the edge of the slope and run flat out with the model toward the edge. At the last moment the runner throws the model and puts on the brakes to avoid a messy demise. I always fear for both model and launcher during this type of launch. Especially if it is me launching on a large, sheer cliff. I have almost lost my plane and myself running full-tilt with both hands full of toy airplane and controls at Torrey Pines.

Plan B is to stand calmly at the edge of the cliff and point the model into the wind. This keeps the wings level. Next, feel the lift change as the angle of attack varies from zero degrees. Lower the nose several degrees from level and give the model a firm but smooth push down and away. Too hard a push can cause the wings to move away from the fuse if the wings are held on with wing blades, and has been known to cause batteries and ballast to relocate themselves at this critical time. Again, think of the launch as a stall recovery. At launch, the glider needs a relatively low angle of attack and some inertia. The model should be trimmed for best L/D speed and will take anywhere from 20-100 feet of horizontal distance to get up to speed, depending on the strength of the wind and the weight of the model. An eight-pound model in 15 mph of wind will literally jump out of your hand, and a fifteen pound model in 8 mph of wind will cover about 50-75 feet or more before it comes back up to eye-level. The first method might be preferable is on a shallow slope with little or no wind, or a short bungee could also work.

Watching people launch both ways at Torrey Pines, it is hard to see any difference in the glider's airspeed at the moment it leaves the launcher's hand. With a neck-strap or a transmitter tray, the brave pilot can launch his own ship. Be sure, if you are getting help, that your helper is a competent R/C pilot, and has been carefully instructed in what to do!

Winch

The flying characteristics of scale models are very similar to their full-scale counterparts, and I find that my full-scale training applies to the models. In winch launching, there are three phases; 1) take-off and acceleration, 2) rotation and climb, 3) round-off and release. Due to the weight of these models, a rise-off-ground take-off is recommended. I have seen people hand-launch 1/4 scale ships and all goes well until the model leaves the launchers hand. The model goes about three feet forward, then drops its tail and mushes along nose-high for a few feet before really flying. **I almost can't watch.** A ROG take-off will certainly cost a few feet of altitude at release, but the model is in less jeopardy for phase one. Make sure the winch you are going to use can easily snap the wings off smaller, lesser models. I use a Rohm winch, and it has easily pulled up 1/3 scale gliders. Follow the instructions for placement of the tow hook on the glider. If the glider came with German instruction or none at all, a good place to start with hook placement is half-way between the wing joiner and the leading edge of the wing on the bottom of the fuselage. The distance the hook is below the wing (and also below the center of mass) will cause the glider to pitch up more than you are used to on a glider with a skinny fuselage, so don't put the tow hook too far aft. If your glider sports a retractable gear, this advice presents a problem. The gear is right where you want to put the hook. Two solutions. First, install a tow hook about half-way up each side of the fuse or under the wing and use a bridle. This works OK, but the bridle and two hooks seem like and invitation to that dreaded optimist, Murphy. It's also easy to lose or forget a bridle. Second fix; drill and tap a hole in the mounting foot of the retract, at least half a tow ring diameter outboard of the open gear door, and lock-nut the hook from inside. The hook is off center, and will initially yaw the glider slightly until flying speed is reached. I usually point the nose of the glider about five degrees towards the side the hook is on and most people are surprised to see the glider has this setup after they have seen it launch. I usually retract the gear on the way up to keep the doors clear, but it is not necessary to do so.

Tall grass and weeds are the death of big gliders in flatland flying. These models fly like their full-size counterparts so why not use a runway? I dream about taking off and landing on sod farms. With a retract a street or other smooth, paved surface is perfect, traffic permitting. Before we put the tow-ring on the hook, there are two more things to consider. We can either have someone level the wings with no tension on the winch line, or our helper can hold the front of the vertical fin (hopefully from behind) while the brave pilot stomps the winch gas and intrepid helper lets go after sufficient line tension is achieved. Each way has its' benefits and problems.

Let me tell you about two launches I

have had. The first was one of my first ROG scale launches. Another member of the local glider club was holding the fin and leveling the wings of the glider. My plan was to have him let go when he felt about 5-10 lbs of tension, then I would keep the winch full-on until the ship was safely 75 feet in the air. I mashed the foot-switch and waited. To my surprise, the winch was slowing down and the glider was still being restrained. The winch stalled and I took my foot off the switch. I was sure that my helper knew he miss-judged his release tension and wouldn't let go until we relieved line tension and started again. As I lifted my head to look at the turn-around, a streak of white rocketed away from my helper. Surprised, I hit the switch but it was too late. The line-stretch took the model about 75 feet in the air, and the winch could not catch up with the glider. The glider came off the tow hook. So, there was the glider, dead in the water, nose straight up less than fifty feet above the pavement. I flipped off my elevator dual-rate and cleared the asphalt with two feet to spare. One of the guys there knew CPR and I was OK again in no time. So that was the worst-case-scenario for that technique. This style is helpful if you don't have a runway, or if there is wing-tip level grass, crosswind or any combination of things. Some pilots prefer to launch this way exclusively.

The other way to do it is to start with no line tension at all. If there is any wind the wings can be leveled with the ailerons. A soda can or a helper can also level the wings for you. Just be very explicit in instructing your helper to merely level the wings, not to hold or otherwise restrain the craft. That's another story. I launch my models this way to avoid a communication-based disaster ("I thought you said *that* much tension!"). But it also did in an old favorite ship. I was flying in the mountain meadows at an altitude of over five-thousand feet. I'm used to flying at sea-level, and after making the appropriate nose-down trim correction, my friend and I launched several times using the tension method. The grass was about 6-10 inches high, and the runway was a plastic tarp twelve-feet long. I wanted some video tape, and my friend was to shoot tape while I did a solo, no tension launch. Just as I hit the winch throttle, the wind shifted from the model's nose to quartering off its' right. It was too late to do anything but watch as the left wing tip never left the ground and the rest of the glider pivoted around said tip. It landed upside down, right wing tip first. Big models leave a pretty good debris field when they go in at a shallow angle. The point here is to evaluate your field, glider, friends, conditions and decide which style suits you best.

The first phase in the winch launch is the take-off and acceleration. With wings level and a some down elevator, firmly squash the go-pedal with your favorite foot. The object is to let the model take-off. Keep the angle-of-attack low and build up a healthy amount of speed. Do not climb out steeply from the start. The moment arm of the tow hook, beneath the center of mass, will try to pop the nose up if you let the model fly itself at this point. Keep the climb shallow until the model is about fifty to seventy-five feet in the air. Do not pulse the winch until the glider is at least at this point.

To enter the climb phase of the launch, relax the down elevator and let the glider climb. I usually let the wings tell me how much winch to use by watching to see if they flex. A little is OK, and I have launched successfully without any flex. Please do not use the winch to break the wings now. With a forward hook location some up elevator may be needed. Too fast is better than too slow. After you have done several launches, and are at the point where you have remembered to breathe while launching, you can start to get a feel for the hook placement.

The third phase is the round off and release. Most scale ships are not stressed to take aggressive zoom launches. I usually stop the winch and let the glider fly off the hook at this time. Gentle zooms are OK, but watch the flex of the wings. Full-scale ships don't do zoomie winch launches. On the winch I use #18 braided nylon line and a stout F3B type hook on the glider with a lock nut on the inside of the fuselage.

Flying

Now that we have survived the launch, we are faced with another dilemma. How do we actually fly this thing so that we look good (very important) and get the most performance from it? Speeds to fly are the answer, just like in full scale gliders. Many people are initially startled at the tip-stalling tendencies of these big birds. Washout is not the answer to the dreaded tip stall, airspeed management is. One of my 1/4 scale gliders has a 24 oz. wing loading and looses 100 feet for every turn in a spin. My first clue that the glider has fully stalled in a turn is that it is inverted! The solution-I don't stall it. Most scale ships are much more docile than a racer, and the stall can be anticipated as the ship becomes familiar. These gliders have a higher wing loading and are very clean. With their high-aspect-ratio wings, they accelerate or slow with small changes in angle-of-attack. Subtle changes can result in a stall or a high-pitched whistle that can be heard on the ground caused by lots of airspeed.

On the first flight do not be scared of the model. Wring it out and get a feel for it. Loop, spin, stall and roll it. At least open and close the spoilers to see if and how much they affect the glider at different speeds. Do the same with the flaps, but not at high speeds. Dive the glider with the trim in different positions to see how it accelerates and recovers from dives.

The speeds we want to trim to are; 1.) minimum sink and 2.)best glide (max L/D). In a aerobatic slope ship, we want neutral or near-neutral pitch trim. In a large ship, an aft cg-neutral trim condition makes thermaling or flying between thermals more of a challenge. It is harder to keep the glider at the desired speed. In some scale gliders spin recovery could be non-existent with the CG too far aft. I personally prefer my planes to be slightly nose heavy, because the speed of the glider can be perceived as slower than trim speed if it is diving, and faster than trim speed if it is ballooning. The speeds-to-fly for the glider are set in the following manner after the cg and incidence are dialed in. These are pretty general, and will vary with different amounts of elevator sensitivity and throw, etc. Gradually slow the model down and feed in up trim slowly, and fly it as slow as you can, on the edge of a stall. I add four or five clicks of down trim from this position and the glider is at minimum sink speed. Some models with thin airfoils and/or high loading will fly better slightly faster. About six more clicks of down trim results in best glide speed, which should be about 5-7 mph faster than min. sink speed. I adjust the linkages or software so that the best glide occurs with the trim in the middle, and that's where the trim is for launch and landing. Additional down trim is for high-speed and aerobatics. Most newcomers to scale gliders tend to fly them way too fast. Practice slow flight until you are accustomed the models' feel in this end of the envelope. If I don't experience several incipient stalls when thermaling, I know I'm flying too fast, and my sink rate will suffer accordingly. Models that are trimmed at sea level are tail heavy at higher altitudes, so add weight to the nose and down trim as required.

Thermaling is where I turn off the coupling. Some pilots are content to leave it on all the time while flying scale ships. In the cockpit of a full-scale glass ship, the first thing the pilot does when a thermal is sensed is to straighten out the leg corresponding to the direction of the desired turn. The ailerons are always more powerful than the rudder, and the rudder is given a head start. This is not as important in the model, probably because we can't see the yaw string point the wrong way and the tail feathers are bigger. When we closely watch a scale model thermal with the rudder and ailerons coupled, we can see that it is in a slip. The inner wing tip is leading the race and the nose is pointed outside of the circle the craft is scribing in the air. Here is what is happening. As the glider banks, the outer wing is going faster than the inner wing and generates more lift. Overbanking occurs, and to keep the bank angle constant, the pilot applies aileron opposite to the direction of turn. The rudder, coupled to the aileron, is also deflected against the turn and yaws the nose away from the intended flight path. This happens to models as the span approaches the three meter ballpark.

It is now time for the left thumb to become educated. To co-ordinate the turn properly once the desired bank angle is established, the ailerons must be high-sided, or in a left turn, a tiny amount of right aileron is needed to keep the wings from overbanking and maintain a constant bank angle. The left thumb must apply rudder into (left) the turn to keep the nose pointed the direction the airframe is traveling. It is a constantly varying dance of the two sticks, as things like turbulence and airspeed will upset the delicate balance the pilot has achieved. Once you have mastered the technique of cross-controlling, you will never fly thermals coupled again. When first learning how to do this, make sure not to let the wrong thumb take the lead when landing! Flying at high speeds, or in a straight line over some distance, it is easier to fly with the controls coupled.

Most scale gliders use relatively thick airfoils with a healthy dose of camber, such as the Quabeck 3/14, which has three percent camber and is fourteen percent thick. This is a lot of camber and thickness compared to a F3B airfoil. When thermaling a model with a similar airfoil and flaps, the only benefit from using them in the positive mode is a smaller diameter turning radius. This is offset by more drag (the Cd rises faster than the Cl in this situation) and a higher sink rate. Along with this goes increased adverse yaw. Flaps are great reflexed for high speed flying. When used for landing, flaps greatly reduce the touchdown speeds and required space. A German manufacturer once bragged that he could stall any winch by launching with the flaps down. I do not use the flaps when launching. One full-scale repair facility I talked with said most of the ships they repair are the Standard Class un-flapped ships, because without flaps their landing speeds are much higher.

Landing

Now is the time to be way ahead of the plane mentally. At both ridge and winch flying sites, I am mentally ready for the landing procedure when the model is 250-300' above ground level. I decide before I fly if I am going to use a left or right hand pattern. This is often decided for me by things such as trees, buildings, or other obstructions and hazards.

I've already walked my body to the landing area and like to have a second set of eyes to help me spot traffic. I prefer to land the model like a real aircraft with a downwind leg, base leg and final. Before entering downwind, I trim the model to best L/D speed and add an extra click of downtrim if it is very windy. The extra speed will help the model punch through any turbulence, wind gradient or pesky hand launch gliders in the pattern. Be careful not to get the model going too fast in the pattern. Too much speed is not necessary and will make your job more difficult. If the glider is too low at any time, simply clean it up and you are already at the best speed to fly to cover ground. I usually enter the downwind leg at a 45 degree angle and mentally label a prominent landmark as the IP (initial point). When I hit the IP at about one hundred feet the checklist is as follows:

- T traffic - hopefully none, be alert and use a spotter
- W wind - direction and velocity
- A airspeed - best L/D and add for wind. Flaps down and re-trim now
- R runway - is it clear?
- G gear down and locked
- S spoilers - check for proper operation

I usually stand at the upwind end of the runway with my spotter's head on a swivel. If something isn't right at the IP, I have the altitude and speed to go back to the ridge or the house thermal. When it's not soarable, this is where I dream about the retractable power unit. As the model enters the downwind leg, I like to have it slightly upwind of me, at approximately 100' agl, 50-75' off the centerline of the runway so I can make gentle turns in the pattern. If the model doesn't have flaps I use about one-third to half spoilers throughout the pattern. I can increase or decrease the rate of decent this way. At the beginning of the downwind leg the model is about 30 degrees up from what I perceive as eye level. As the model flies the downwind leg, this angle will decrease slightly. I let the model pass the desired touchdown point and continue on for another 75-100 feet downwind before turning onto the base leg. Keep the bank angle around 30 degrees. With too much altitude or in dead air the pattern is enlarged. With less altitude or lots of wind the pattern is smaller. Anticipate lining up with the runway and turn final. The glide path control adjustments should be subtle and smooth. When the model turns final I add a little down elevator and bring the model over the threshold (end of runway). The most common problem I see at this point is pilots are used to pulling the nose up at this point and slowing the glider down. With a scale ship, a stall and spin entry are imminent with this method. Keep the speed up and level off one foot (12") or less above the ground. You can add full spoilers at this point and let the glider settle back to earth and touchdown smoothly. Some models will pitch down when the spoilers are opened and balloon up when they are closed. Other models have very little pitch change with spoiler operation. Learn how your glider reacts to spoiler operation before entering the pattern. Keep it flying until touchdown. Fly it onto the ground, smoothly. You can stop it in mid-air but it won't taxi very well. The ideal landing is tail wheel touching a fraction of a second before the main. For the roll out, keep the glider on the runway using the rudder for directional control and keep the wings level with the ailerons (Remember the easy uncoupled thermaling lesson?).

Models with flaps land a little differently. With the flaps and ailerons in the crow mode, the spoilers can be used to fine tune the descent or make it steeper for short field landings. When programming the crow into the glider, get the flaps down as far as possible, but only reflex the ailerons three degrees to make sure you have plenty of roll control for the landing. Keep the nose DOWN to maintain airspeed with all that draggy stuff hanging off the glider. Speed will bleed off quickly if the nose comes up. Do not raise the flaps with the glider close to the ground. Without flaps, the glider flies faster and it will use altitude to generate airspeed, so I don't recommend raising the flaps once the glider is below fifty feet agl.

If you are using a retractable landing gear it does not need a wheel brake. A brake tends to bring the glider to a stop with the tail in the air. I do not use a wheel brake and can consistently stop the glider where I want it to. An exception would be a downhill, paved runway. Full-scale training teaches up-hill, downwind landing in this situation. A full-scale glider loses only a few points of L/D with the gear down, and I cannot perceive any difference in the performance of my models with gear up or gear down. If you get into a sticky situation in the landing pattern, don't worry about the draggy gear (**not!**), keep flying the glider. Deal with the gear later. Keep your priorities straight.

Scale gliders are beautiful and majestic. I believe that scale ships are among the highest performing R/C gliders in existence. They can be intimidating at first, but once fears are replaced by knowledge, the rewards are great. You can slope soar, winch, aerotow, fly cross-country, and even win thermal contests with scale ships. Plus they are simply beautiful to look at. I hope you will come to enjoy your scale ship as much as I have.

Many happy landings! ■

Infinity 600A & 660 Comparisons

...by Steve Savoie
Gorham, Maine

The Infinity 660 is finally here and I've just received a copy of its operating manual from one of the DownEast Soaring Club members. In fact, two club members purchased Infinity 660s at the recent WRAM show. The 660 has three basic aircraft types: Helo, Airplane and Sailplane. This article will compare the Sailplane program of the 660 to the generic program of the 600A. The radio shares the same comfortable case as the 600A and 1000. I'll try to remain non-bias in this article, even though I've owned a 600A since December 91.

Now let's clarify a few of these similarities. The Infinities can run trainer cords only to other Infinities. The elevon function is used for flying wing and delta wing servo mixing; the servo centering feature is used to center servos electronically instead of adjusting linkages. Data reset is used to clear the custom settings that are programmed into a particular plane so that a new plane can be entered, like a big eraser. Failsafe is a PCM function that will re-position control surface setting in case of loss/interference of the radio signal (e.g., slight up elevator and right rudder). Failsafe can also hold the last commands received by the receiver, if desired. End point adjustment electronically limits the end travel of the servo instead of adjusting linkages. Flaperon and Spoileron mixing lowers/raises both ailerons to control lift and braking effect while still affording banking control.

The 600A and 660 have many similarities such as:

Dual Rates	Switch Assignability	4 Plane Memory
Trainer Mode	Mode I or II	Data Reset
V Tail	Servo Ailerons	Elevon
PCM or FM	Servo Reversing	Failsafe [PCM]
Crow	Servo Centering	End Pt Adj
Flaperon	Camber Control	Spoileron
	Aileron Differential	
	[Mixers]	
Flap→Elevator	Aileron→Rudder	Flap→Aileron

The 660 has many features for helos and powered aircraft that are outside the scope of this article. When setting up the 660 one must first select the aircraft type: helo, airplane (powered), or glider. From that point, specialized menus prompt the operator for required information. The initial screen display (2 line) gives aircraft type, model name, total time counter, stopwatch, and voltage. The next six menus are brought up by pressing the edit button, one of six buttons to the right of the LCD display. The stopwatch timer can be activated by an assignable switch to count down and will sound one second beeps the last 10 seconds of the designated time. The same timer can also be used to count up if desired. Another timer is a duration timer that can be used to measure the total time the transmitter is on. It does not reset when the transmitter is turned on or off and must be manually reset, for example, after a charge.

The second menu contains settings for servo centering, elevator presets (2), dual rates (2), spoiler→elevator mix, and gear→elevator mix. A unique feature with the two elevator presets is that they can be adjusted (in flight) by rotating the two knobs on the face of the transmitter or preset with the knobs deactivated. The presets are selected through assignable switches. The spoiler→elevator mixer can also be used to mix flaps to elevator by assigning a negative mix. For example, if the elevator is programmed to 15% (up) for spoilers, just program the elevator for -15% down elevator for a plane with flaps instead of spoilers. The last mixer in this menu is the gear→elevator mixer which can be used to mix the elevator up or down with the deployment of landing gear, or upon activation of a motor controller for electrics. If neither is used, this mixer could be used as a third elevator preset since the transmitter doesn't know if a servo or controller is plugged into the receiver.

The next menu continues with more mixing. Spoiler→left aileron and spoiler→right aileron are used to establish crow or camber mixing when flaps are used. Mixing the ailerons in the same direction as flaps allows the entire trailing edge to be reflexed for speed or cambered down for additional lift. Reversing the mix ratio will drop the flaps and tip the ailerons up (crow). The next mix is aileron→rudder which slaves the rudder to the aileron, but still allows the rudder to be independently controlled by the left stick. This is followed by aileron differential which is the ratio of upward deflection of the ailerons to the downward deflection. The last function in this menu is trim memory and works to save the trim tab adjustments made during flight and then updates servo centering to all or selected servos. This then allows the trim tabs to be placed back in their centered position. This is a very useful time saving feature that all computer radios should have.

The functions in this next menu are very straight forward and address the V tail option, model selection for selecting which plane to load into the program, servo end point adjustment, servo reversing, switch assignment, and gear/motor adjustments. Thirteen different functions can be custom assigned to the twelve transmitter switches by the operator and more than one function can be assigned to each switch. The gear/motor function is used to set the servo positions for gear up and gear down, or motor off/on settings when a separate motor controller is used.

This next menu functions are for alternate setup, timer set, aircraft type, data-copy and data-set. The alternate set-up function gives the pilot the ability to load another aircraft program into the transmitter by the flip of a switch while flying. This option can be used to experiment with different settings for mixes, trims and options. For example, if the alternate set-up has no aileron differential, the plane can be flown to a safe altitude on the original program; flip the switch to "alt" and the pilot can try out flying with no differential. One note, all other settings such as servo reversing, travel, servo options and mixers must be set within acceptable limits; just imagine if the elevator servo were reversed from one set-up to the other. The data copy function allows one set-up to be copied into another. This then allows for individual settings to be adjusted for experimentation with the alternate function previously described. The data reset on the other hand will clear all settings out of a plane set-up.

The functions within the next menu allow for modulation selection [PPM or PCM], aircraft name, failsafe designation and LCD display contrast. The failsafe function is used for PCM receivers and designates whether the receiver holds its last good radio input or shifts to pre-designated servo positions during a loss of radio signal or interference. The PCM receiver is slightly larger than the PPM [FM] receiver and requires a special three wire switch harness to the battery. The third wire maintains memory voltage to the receiver, even when switched off, to retain the failsafe settings. The last menu screen allows the operator to disable the audio beep which is heard whenever the programming buttons are depressed, and the last feature allows for the transmitter to be programmed for either Mode 1 or Mode 2.

The 660 has several features that the 600A does not have. These are the two timers, two line screen, voltage display, in flight adjustable elevator trim presets (2), a dedicated gear→elevator mixer, trim memory, alternate set up, data-copy and LCD display contrast adjustment. The most useful of these are the alternate set-up and trim memory. The trim memory is a nice time saving feature. The alternate set-up can be used for the same plane with two different set-ups, one set-up for camber changing (flap→aileron mixing) and the other for crow. The crow set-up would be selected just before landing. Remember, by design the 660 can not be programmed to camber changing and crow in the same set-up. (There is a way however to do this with the 600A through a switched mixer with only one set-up.) The crow configuration on both these transmitters lacks a threshold, meaning that as soon as you pull the flap stick, the ailerons begin to tip up. The Vision and other computer radios can be set to tip up the ailerons only once the flaps have reached a pre-designated position, for example 70°.

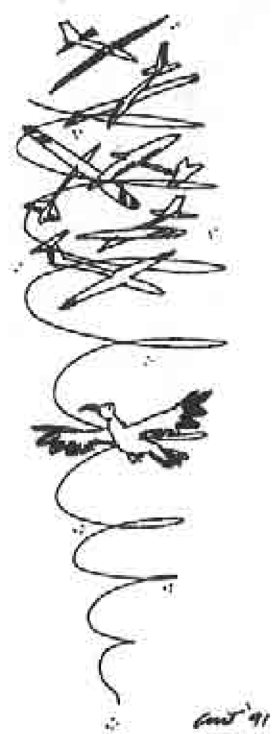
The 600A on the other hand has two completely assignable mixers with an array of options that offer a lot of creativity to the programmer (pilot). The radio also has two snap roll programs that can be manipulated to provide two elevator presets. The flaps can be given a preset launch position that by-passes the flap→elevator mixer for launches. (Why mix in down elevator for a launch.) One of the pre-programmed mixers for the 600A is an elevator→flap mixer that's switch assignable. Just flip the switch when you begin to circle in a thermal and entire trailing edge (flaps and ailerons) will lower via the mixer when up elevator is applied for a little added lift. The compensating mixer can even be configured for gear→elevator mixing just like the 660.

Other items lacking in the 660 glider set-up (helo and airplane have 1 comp. mixer) which the 600A has are a compensating mixer and a bi-directional mixer; both are completely assignable and the bi-directional can be configured as a compensating mixed. A compensating mixer has a master→slave relationship, such as when ailerons are mixing into the rudder, but when the rudder stick is given a command it does not affect the ailerons. The bi-directional mixer is always mixing two channels into each other, similar to a V tail mixer. The compensating mixer has several mix options that can select mixing for just one side, or the other side of neutral, or to drive the slave in the same direction whenever the master is taken off neutral. This can be used for small 2 channel slope ships by mixing up elevator anytime the plane is banked in either direction. The compensating mixer can also be assigned to a switch. On the previous example, the aileron→elevator mixer can be deactivated just prior to landing, or for acrobatics.

These mixers can be assigned to any of the six channels and can even be mixed onto themselves. To achieve crow and camber on the same set-up, all one needs to do is program the compensation mixer to reverse the direction the ailerons tip when the flap stick is pulled down. With the mixer off you get camber (flaps and ailerons both tip down); then flip the switch on landing approach and when the flap stick is pulled down the ailerons will tip up when the flaps drop, all on one set-up. The key to getting the most out of the 600A is your imagination through the use of the mixers. One last thing, elevator presets are possible with the 600A by hot gluing the snap roll switch (spring loaded) in the on position and selecting either snap roll prog1 (sw#7), or snap roll prog2 (sw#9), and assigning nothing to switch #8 (Switches 7, 8, and 9 are a combination 3 position rocker switch). Then set prog1 for up elevator (say 3%) and prog2 for down elevator (say -4%). That's it, just leave the ailerons and rudder set for 0%. During snap roll both sticks are always active. Don't try this with the 660 on the airplane set-up because both sticks are dead during snap roll programs.

Well that's it. I can go on and on with different ways to exploit the 600A through its generic set-up, versatile mixers, and options. By the way, pre December 1991 600A's should be fitted with the sailplane modification that allows the flap stick to directly feed into the flap and aux channels to free up one mixer. This is done free of charge by Airtronics. (You pay only shipping.) So, if you fly powered airplanes or a helo, and want the bells and whistles like trim memory, timers, and programming that is just a bit more user friendly than the 660A, then buy the 660.

But if you fly only gliders, I would go with the 600A for its versatile mixers. Just look back a few paragraphs and read some of the things you can do with these mixers, flap preset, crow or camber on a switch without using two plane set-ups, and there are more; just use your imagination, the possibilities are infinite. ■



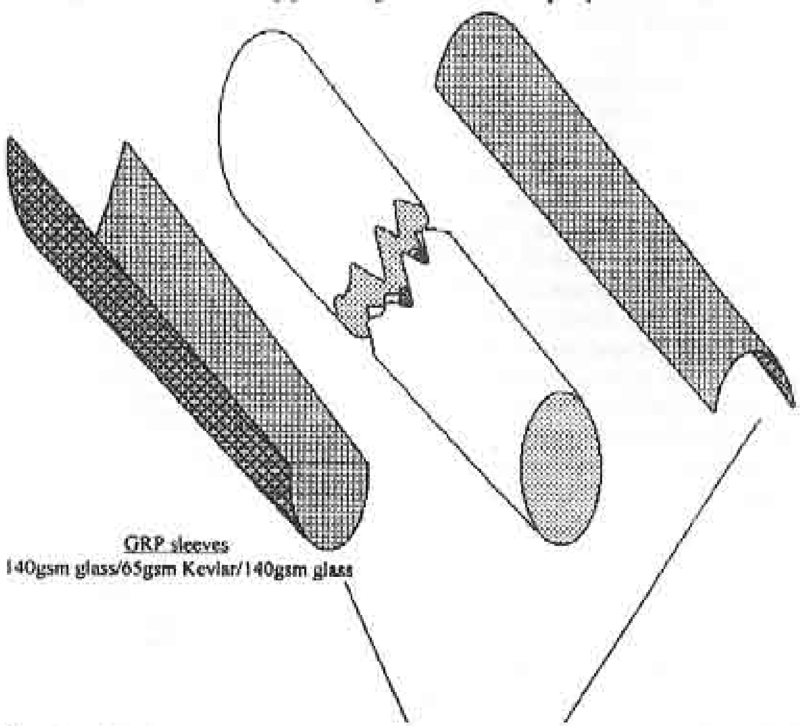
Fixing Fiberglass Fuzzes

...by Graham Woods
Hertfordshire, England

The approach wasn't right, so I decided to go round once again for another approach and landing; a touch down, and the model moved toward the edge of the west face. Suddenly, for no apparent reason, up went one wing and it smacked down hard. Luckily, it hit wings level, but the fuzz was almost snapped in half. The wing fillets became dislodged yet again, and the tailplane dowels got bent. Other than that, the Concept escaped pretty lightly. But how to mend the fuzz? I thought I'd try using the fuselage itself as a mandrel.

- Chez moi, dans l'atelier, I parted the front and rear halves of the fuselage and removed the rudder cables. I fashioned a piece of foam to wedge inside the two parts of the fuzz and glued the two halves back together as best I could with a 5 minute epoxy.

Join both Fuzz halves with 5 minute epoxy, wrap with polythene, create two pieces of GRP using plies of glass cloth and epoxy resin.



When hardened, remove the pieces of GRP and cut them to fit ***inside*** the broken fuselage starting from thickest part of fuzz. This ensures that pieces fit snugly. Glue in place with a mixture of slow epoxy and thixotropic agent. Fill, sand, and paint to finish. It goes without saying that all surfaces should be roughened and smooth for the best possible fit and adhesive bond.

- The next step was to wrap a polythene sandwich bag around the break and find some odd pieces of glass cloth. I've got all sorts of pieces of fabric offcuts and chose to use two layers of 140 gsm glass and one ply of 65 gsm Kevlar® for the reinforcement, although any glass cloth would have done.
- Now, it was just a matter of cutting the cloth pieces to size and slapping it on with epoxy resin (carefully using a heat gun to *thin* the resin). With one half done, another plastic bag was used to prevent the second set of plies from gluing to it. Same again. Slap it on; wet it out.
- Next day, when I peeled it all off, I had two pieces of GRP that fitted nicely around the outside of the fuzz. I cut the fuselage in half with the band saw, removed the foam, and cut the fitted pieces of soft, newly molded GRP ***inside*** the fuzz. When I had a reasonable fit *(for the inside of the fuzz is not as smooth as the outside)*, I mixed some Araldite 1927 epoxy with thixotropic silica (Cab-O-Sil) to stiffen it and stop it from running, and I joined the two halves of the fuzz back together binding them in place with masking tape.
- Plastic padding, sanding and a layer of two-pack paint made it as good as new. Well, almost. All I need to do now is make a couple of heavy landings to test my repair! ■

Creating a Computer Simulation of The Winch Launch for RC Sailplanes

...by John Hazel
Kalamazoo, Michigan

Today, many computer simulations are available for analysis of RC gliders in level flight. The programs combined with wind tunnel data have contributed greatly to our understanding of flight performance and unfortunately have also occasionally led us in erroneous directions in terms of design and construction. I am sure though that we have much higher performing gliders today than we would have had without computer analysis. The following is a report on some of the results I have obtained from creating a computer simulation of a glider being towed by a typical contest winch. As noted I have verified these results when possible first hand. I feel that the trends in performance shown by this simulation are valid but do not claim that some specific configuration shown by the model as being optimum actually is the optimum in practice. Many variables are involved in a towline launch and changing any one has effect on the results be it on the computer or at the flying field. That being said, let's look at the simulation and some results.

The forces on an RC sailplane being towed up by a winch can be represented by the vector diagram given in figure #1. If we make a few assumptions, translating the vector diagram into a mathematical model is fairly straightforward. Before we do this though let's look at these

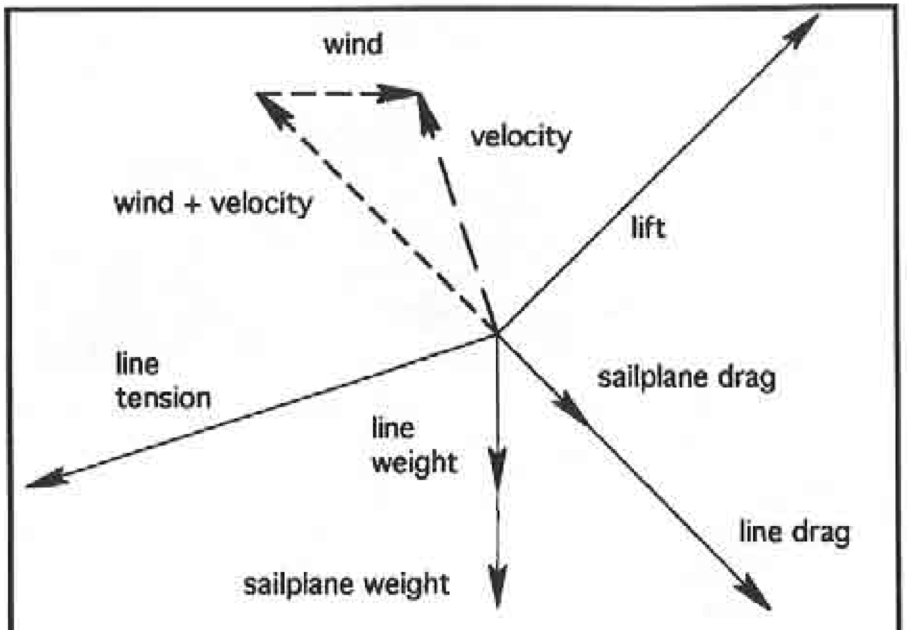


Figure 1 Force and Velocity Vectors

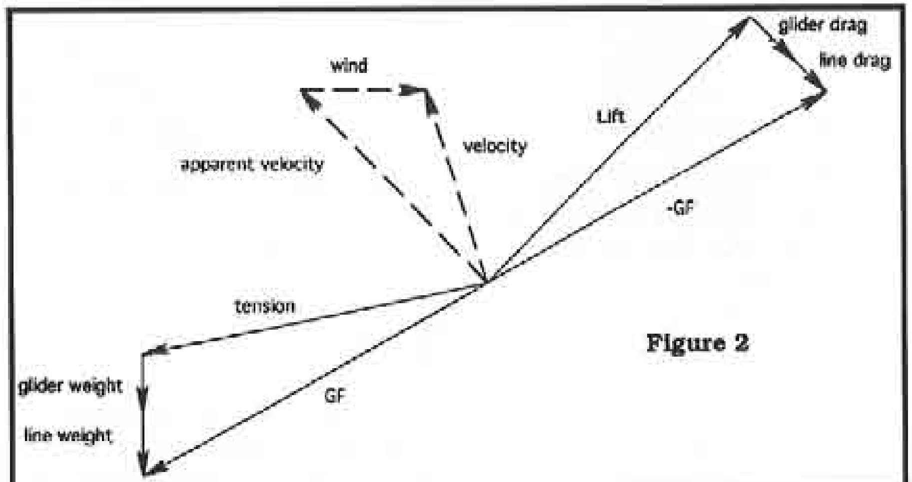


Figure 2

necessary assumptions and discuss the effect they may have on how well the actual launch is simulated. The first assumption in this model is that the sailplane has already accelerated from the release and is in a relatively steady climb. The mathematically important part of this assumption is that with a steady climb the sum of all the vector forces in figure #1 is equal to zero. This does not mean that the sailplane is not moving. It does mean that the forces are nearly balanced and the force of acceleration is small enough to be ignored. The acceleration forces involved during the climbing portion of the launch are less than one percent of the lift and line tension and therefore are indeed relatively insignificant. During the rotation to climb at the beginning of the launch and the zoom at the end of the launch the acceleration is much greater so our assumption makes the current simulation invalid for these parts of the launch.

The second mathematically important assumption was to assume that the drag force caused by the towline was in the same direction as the drag of the sailplane. In practice there would be slight differences in these directions which would have tremendous effect on the difficulty of calculation and negligible effect on the results.

Reynolds number effects were not taken into account for this simulation and a generic airfoil with flaps down was modeled here. This gives a small bias toward higher aspect ratio wings. The coefficient of lift was set at 1.4 for all simulations and parasitic drag for the airfoil was set at .03. These values are based on data from Soartech 8 published by H. A. Stokely.

For the following explanation refer to the redrawn vector diagram in figure #2. The actual simulation was constructed as follows. Forces not dependent on the velocity of the sailplane (line weight, sailplane weight, line tension) were placed in one group and velocity dependent forces (lift, line drag, sailplane drag) were grouped in another. From the three velocity independent vectors a single resultant was calculated (GF). The result of the velocity dependent forces then were set equal to but opposite in direction (GF). Using accepted formulas for aerodynamic forces and trigonometry the actual magnitude and direction of the lift was obtained and from that the direction and velocity of flight. A few more steps lead to the ratio of altitude gained per foot of line take-up. The final type written formula fills a complete letter size page. This was done using a mathematics program called Maple which is available through Brooks/Cole Publishing Company.

Let's look at some results and see how to interpret them. Figure #3 is a graph of launch efficiency of a 900 square inch wingspan standard class ship with a wing loading of 10 oz. per square foot. It illustrates the effect of line tension on launch

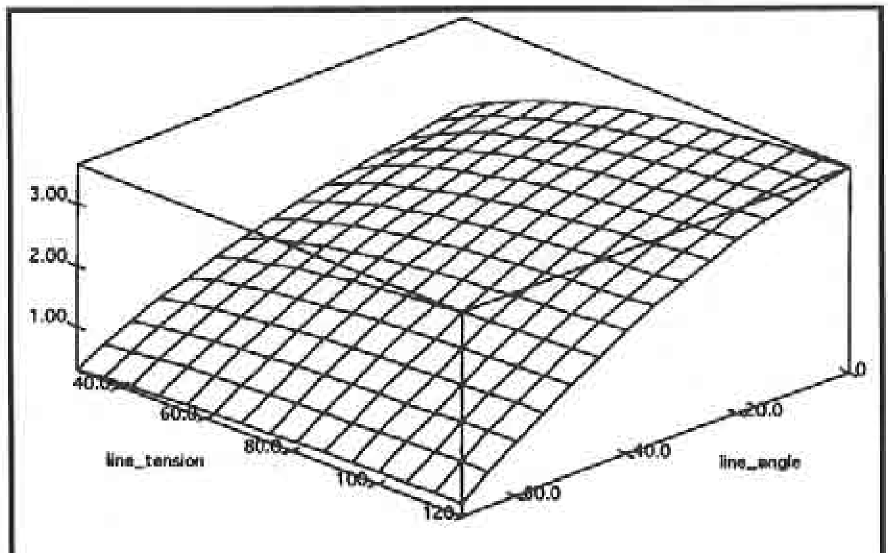


Figure #3 (no wind)

performance. Notice that one edge of the plot is labeled "line_tension." The line tension is in pounds of force applied to the glider and ranges from 30 to 120. The other edge of the plot is labeled "line_angle". This is the angle made between the ground and a line drawn from the turnaround to the sailplane. Most results from this simulation indicate that the sailplane reaches it maximum height at a line angle of about 70 degrees where there is no further gain in altitude for each foot of line take-up. This plot illustrates a no wind launch. Notice that in this situation more tension is better from the beginning (line_angle = 0) to the end (line_angle = 70) of the launch. This effect can be understood if the ratio of weight to lift and tension is considered. At high tension the weight becomes much less significant. Also notice that as tension increases the benefit of adding more tension reduces. I have personally verified its result with a strong 750 square inch two meter sailplane. The predicted result was not immediate. My first attempt resulted in what seemed to be a stalled wing being dragged down by the winch. Then after adding some down trim The launch was again to a lower height than usual. The winch was pulling the plane easily so the conclusion was that the line tension indicated by the simulation was not being achieved. The solution was to re-trim to the usual state and then allow a little more acceleration during the beginning of the launch. Indications of increased line tension were breaking 220# braided line or loading of the winch to the point where all it would do is make quacking sounds. The launch height was noticeably higher with a side benefit of increased zoom height due to the energy stored in the line stretch.

For the case of launching in a ten mile per hour wind a drastic change in the character of the results occurs. Instead of a tight is always right, an optimal tension became apparent in the early part of the launch. (See figure #4) This can be understood by considering the wind as a source of launch energy. If the early part of the launch is done slowly the wind has more time to input energy into the sail-

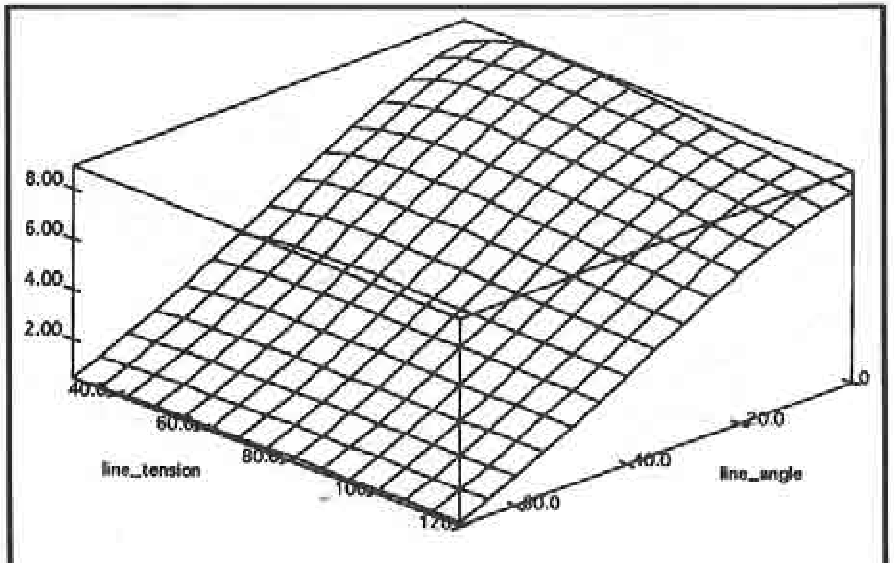


Figure #4 (10 mph wind)

plane and therefore less line needs to be taken in per foot of altitude gained. However towards the end of the launch more line tension is better becomes true again. During the early stage of the climb the wind's greatest contribution was to the lift vector. As the line angle becomes more vertical the sailplane must fly more directly into the wind which obviously increases drag which tends to negate the benefit of the increased lift. Fortunately we can take advantage of any extra line

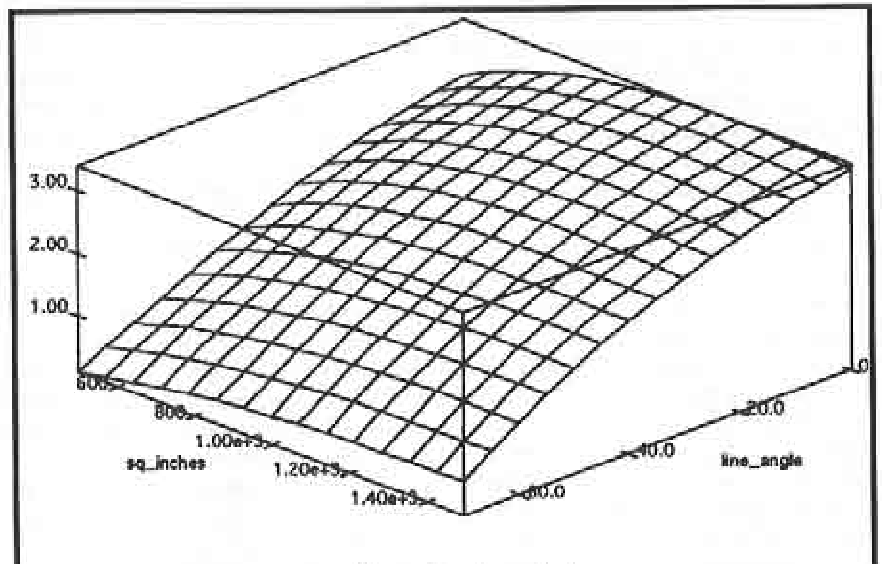


Figure #5 (no wind)

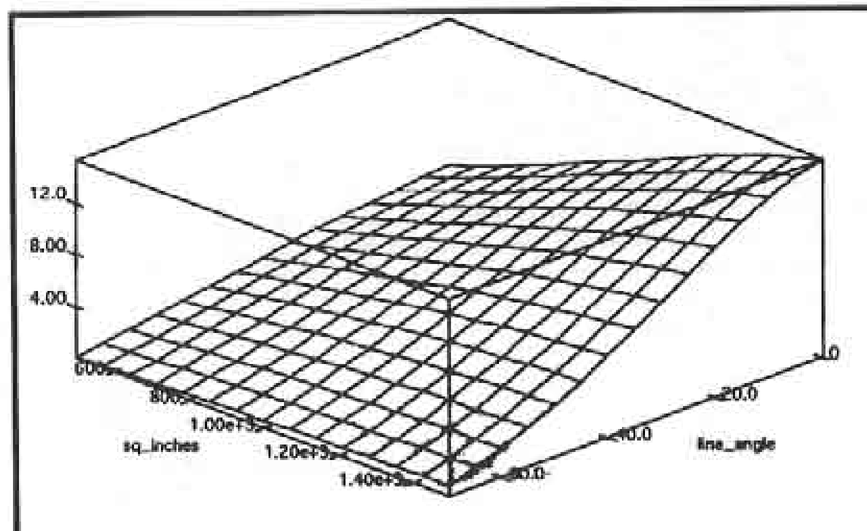


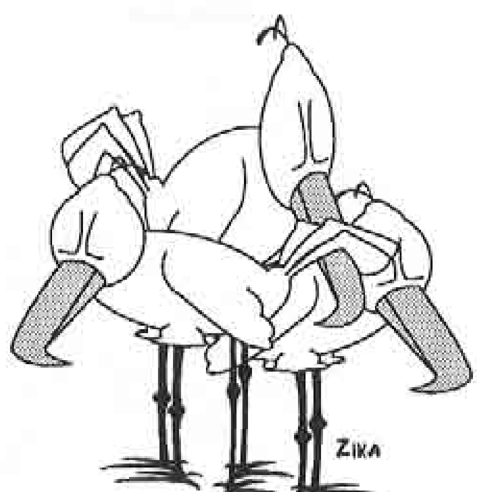
Figure #6 (10 mph wind)

tension during the zoom.

So far we have looked at how to launch a given sailplane. Let's turn to the design implications made by this simulation. Figures #5 and #6 show how wing area can effect launch performance. For this simulation line tension was fixed at 80 lb. and wing loading was 10 oz. ft. Remembering that this simulation does not take into account the beginning and end of the launch, we see that for a 100 inch span sailplane the best tow performance is given by a fat 1200 square inch wing area during the early part of a no wind launch. At the end of the launch we see that something over 1500 square inches would tow the best. In the 10 mph wind case we see bigger is better at least up to 1500 square inches. We can see this result applied in the design of kites. We must keep in mind here that too much wing area will hurt glide performance. Selecting the crossover point where the benefits of the increased launch height are lost through deficiencies in zooming and gliding is an extremely difficult task. Factors involved in making this selection would have to include such fuzzy factors as flying style; acuteness of vision; average thermal and sink size, strength, duration, occurrence, and physical separation; winch power and line strength. (The complete list is much longer than these few.) Remember though that this present analysis does not include corrections for Reynolds number effects so the performance of the lower wing area plane would be less than indicated here and they are also harder to see and not as strong as fat wing models. On the positive side of the lower wing area planes though is the greater zoom possible for a given amount of energy stored in the winch line.

In conclusion, we can claim from this simulation that if there is no wind the best launch is going to include maximum line tension for the entire launch. When the wind comes up the best strategy will be to use light line tension during the first art of the launch to gain altitude with very little line being pulled in and then as the glider begins to fly more directly into the wind more line tension will give the best results. On the designing for best launch, increasing the wing area of your design will no necessarily give better no wind launches but as soon as the wind picks up, sailplanes with larger wing area will be at a higher altitude just before zooming. When the increase in climb exceeds the decrease in zoom is up for debate and more complete simulation.

I would like to validate my modeling of the launch more fully and could use help in setting up instrumentation inside the sailplane that would record the orientation, acceleration, line tension, and airspeed during the 10-15 second launch period. With this information I could evaluate both performance gliders in use and as they are simulated on the computer. If you have any help or comments call me at 616-342-8122 between 6 and 9 EST, or write me at 1009 Westmoreland, Kalamazoo, MI 49006. Thanks. ■



Do Your Spoilers Let You Down?

...by Frank Deis
Pikes Peak Soaring Society
2680 Fairway Dr.
Colorado Springs, Colorado

I prefer spoilers over flaps for almost everything but camber changing. However, my current sailplanes have swept MAC lines and pitch down sharply when the spoilers deploy making them much less attractive. What follows describes some experimental results that indicate it may be possible to have the best of both worlds.

I am a big fan of spoilers for many different parts of the flight, especially for landings. I like them big, too: one to one and a quarter inches in cord and about thirty percent of the wing span. However, since about 1974 when I started using wing planforms with straight trailing edges and tapered leading edges (This produces a swept mean aerodynamic cord (MAC) line.), I have had serious handling problems with them. When I put the spoilers out, the sailplane dives so violently that I nearly lose control of it. When I got a Vision transmitter and could couple the elevator to the spoilers automatically (I use the flap stick for spoilers.), things got a little better. My unlimited ship needed ten to fifteen percent of full elevator throw to correct the pitch down at full spoilers, but it worked pretty well.

I recently built a SD7037 wing for my standard class sailplane and included large spoilers (twelve inches long by one and a quarter inches in cord), as usual. This sailplane requires thirty to forty percent of full elevator throw for compensation! The Vision transmitter applies the compensation in direct proportion to the percent spoiler deployment, but the pitch down effect is non-linear. If I put in enough compensation to get a reasonable decent angle with full spoilers, I get a pitch up effect at ten to thirty percent spoiler. If the compensation is set correctly at 30 percent spoilers, it is woefully inadequate at one hundred percent spoiler. Getting Airtronics to put a trigonometric compensator in my Vision seemed like a loser and giving up my big spoilers was not very attractive, either. I

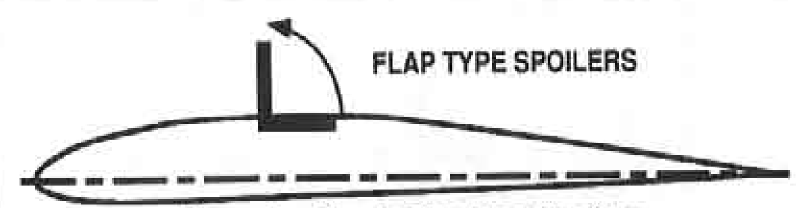


Figure 1 - Simple Flap Type Spoilers

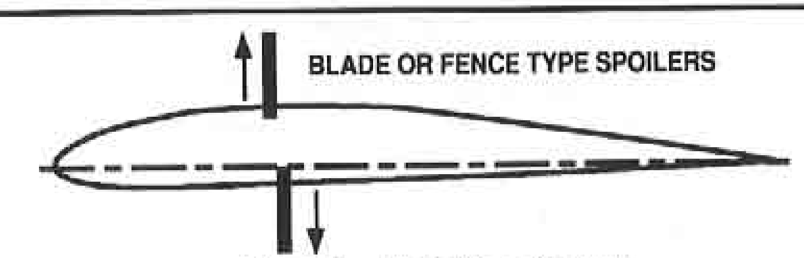


Figure 2 - Blade Type Spoilers

needed an alternative, but nothing I had ever seen would do the job.

I normally use simple flap type spoilers (Figure 1) like most pilots. Years ago I built a Cirrus using top and bottom blade type spoilers (Figure 2). From a handling qualities standpoint, they were great. They did not disturb the pitch attitude at all and adjusted the descent angle smoothly and predictably. The problem was that I broke the lower blade when I landed. So I ruled this option out. Milt Woodham, an old flying buddy, often uses the prefabricated vertical blade spoilers and comments that they do not cause a pitch down effect like his flap type spoilers did, but he does not know why. They are hard to install cleanly, sometimes jam when the wing flexed, damage easily and are hard to maintain; so, I ruled them out, also.

Thinking that perhaps understanding what causes the pitch down would give me an idea on what to do about it, I began to run through the two explanations I knew about.

The most commonly accepted cause for the pitch down is that the spoilers badly turbulate the air flowing over them and that this air then flows over the horizontal stabilizer. The turbulence is so violent that the horizontal stab can no longer develop the down force necessary to keep the sailplane in trim. The short term for this effect is "horizontal stabilizer blanking". I think this is not precisely correct, but it does convey a pretty clear picture of the general idea. There are two problems with this explanation. First, as many of you are painfully aware from the pitch trim controversy I ignited in a previous series of articles in *RCSD*, I trim my sailplanes so there is no down force on the horizontal stabilizer. Blanking might cause some pilot's sailplanes to pitch down, but not mine! The other problem is the observation that blade type spoilers do not cause a pitch down. Because they clearly cause the same kind of turbulence and down stream blanking as flap type spoilers, the blanking explanation does not fit the facts very well.

The other explanation is less widely discussed, but is my preferred explanation. At the risk of angering the "anti-center of pressure" community once again, here is how it goes.

Consider a wing consisting of two panels: a straight inner and a swept outer, as shown in figure 3. One can calculate the center of pressure for each one separately. Clearly the center of pressure for the outer panel is further aft than for the inner panel. The overall center of pressure for the wing can be located by computing a weighted average for the two panels. If the spoiler "spoils" the entire center panel, the center of pressure for the wing becomes the center of pressure of the outer panels alone. For planforms like the one in the figure, this means the center of pressure shifts aft when the spoilers are deployed. As a result of this aft shift, the sailplane thinks it suddenly got nose heavy. (Shifting the center of pressure aft is very similar to moving the center of gravity forward.) This easily accounts for the pitch down effect. Even better, I can pretty accurately guess how strong the pitch down will be by looking at the wing planform and how much of it is "spoiled". (You can build this same story in terms of the more rigorous mean aerodynamic centers (MACs) and pitching moment coefficients (C_m) terms, but it takes longer and is not as easy to visualize.) This still has a problem, however. This cannot be the full explanation because it does not account for the fact that blade spoilers cause much less pitch down than the flap type.

(This part is pretty flaky. I am not at all sure the physics are correct but it did lead to an interesting experiment. I welcome your explanations if you have a better one.) By comparing the two types of spoilers, I decided that the air might flow over them differently. If the flap type spoiler forced the air to flow smoothly upward it might cause a down force as shown in figure 4. On my sailplanes, this force (If it is really there.), would act well forward of the center of gravity, and therefore would cause the nose to pitch down. If the blade type simply turbulated the flow, it might produce no comparable force, or perhaps just a smaller one.

If this were correct, the problem is how to modify the flap type spoiler that has the simplicity, ruggedness and reliability I like, so that it does not produce the down force. A simple fix came to mind! Hinge the spoiler at its trailing edge (Figure 5), and open it at the leading edge! This would "trip" the airflow more like the blade spoiler does and yet, from a mechanical standpoint, is still the simple flap design. To make an already long story short, it worked. I reversed the spoiler hinges on the standard class sailplane, and the compensation needed in the Vision transmitter dropped from the 30 to 40 percent range to five percent! And, as a bonus, the linear compensation worked just fine!

The obvious problem with this is that the spoiler tends to be locked open by the air flow and one can calculate fairly large hinge moments (control force requirements) to get an open spoiler closed again.

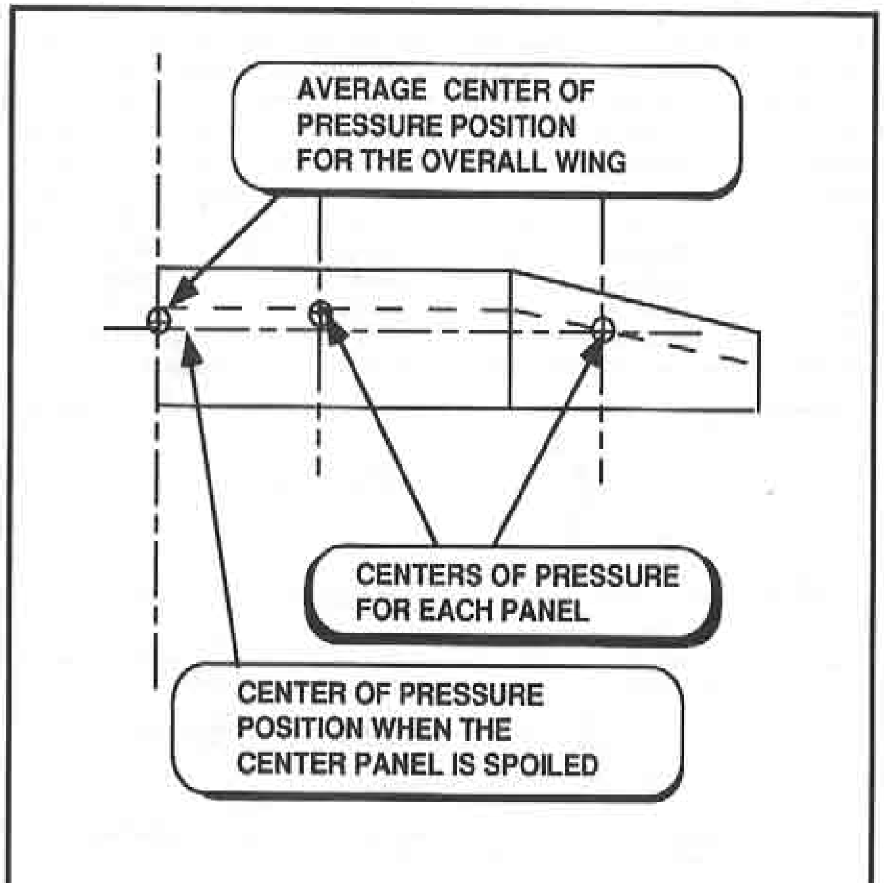


Figure 3 - Centers of Pressure for the Wing Panels and the Overall Wing

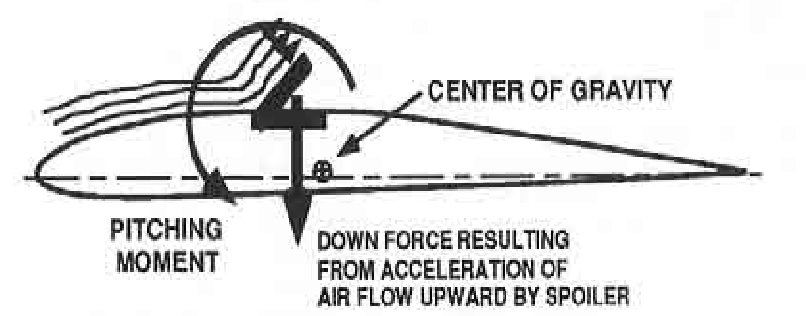


Figure 4 - Flap Type Spoilers May Produce an Additional Pitch Down Pitching Moment When Deployed

Figure 5 - Deis' Reverse Hinged Spoilers

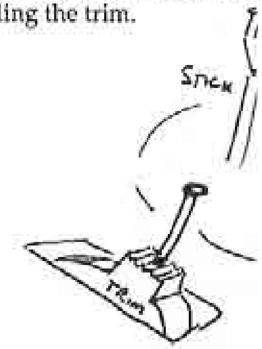
If you try this design, you must deal with this problem! I had no trouble because of the spoiler actuation system I use these days. I put a micro servo right in the spoiler bay beneath the spoiler itself. It directly drives the spoiler with a short (about three quarters of an inch long) linkage to a simple control horn. The servo wires terminate at a male plug buried in the wing root. When the wing is slipped on the wing carry through rod in the fuselage, the male plug automatically engages the matching female socket which in turn is connected to the receiver. This is really clean, simple and reliable and has none of the control force losses associated with long cable type actuation systems, for example. It has the bonus of being equally adaptable to push or pull applications. I had plenty of control force to close large spoilers on a fairly heavy sailplane (obeche over foam SD7037 wings with full spars and a fiberglass fuselage with a pound of ballast) at the end of a terminal velocity dive.

If you like spoilers as I do and have experienced an annoying pitch down tendency, give the reverse hinged spoiler a try. If you do, let me know how it works. If it works and you know why, write *RCSD* and clue the rest of us in. ■

Shop Hints

...by George Siposs
Costa Mesa, California

When I'm flying, I obviously don't look at the transmitter and thus have trouble locating the elevator trim. To remedy the situation, I drilled a 1/16" diameter hole in the serrated part and epoxied a nail into it so that it sticks out about 1/2". This works very well as I have no trouble finding the trim.



Many candies or small parts are packaged in containers or separators that are transparent plastic, vacuum formed. Don't throw them away. Cut them apart so that you have several small containers. They are very handy when you want to mix epoxy!

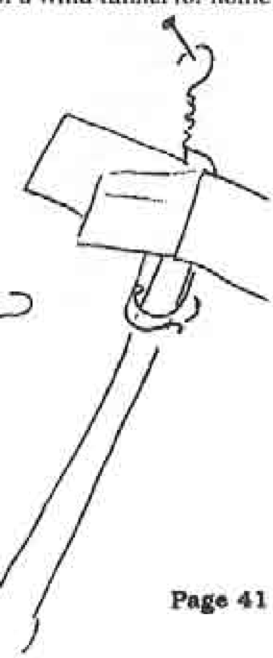
With a small shop and many gliders, it is difficult to find room for all the fuselages. Here is a good way to store them. Drive nails into the wall about 3 inches down from the ceiling and space the nails 15" apart. Now, bend the shape as shown here from ordinary coat hanger wire. It wraps around the fuselages just in front of the fin and enables you to hang the fuse on the nail. With little hooks at the end of the wire, you can stabilize the hanger with a rubber band so that when you hold the fuselage vertical, the wire does not fall away.

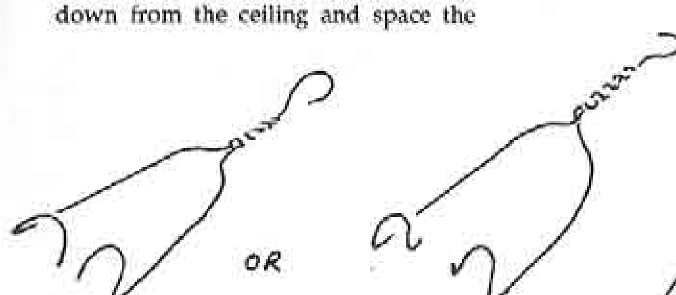
Subjects of Interest

One of the reasons I like to read *RCSD* is because it stimulates thinking about gliders. I like more theory and would like to read some articles written by aerodynamicists or very experienced designers on the following subjects.

1. How do the various parts of the airfoil affect performance? For instance, if the leading edge is raised, what effect does it have? How about a sharp leading edge vs. a blunt nose? We need to know this as we sand the leading edge to shape on a foam core wing. Most modelers have no idea that the leading edge is the most important part of the airfoil. How do you modify an airfoil on a plane by simple methods, such as reshaping by sanding the leading edge?

2. Does anyone have a simple but effective method for a wind tunnel for home





experiments? How do you make a smoke-emitting device with which one could test various parts of a plane in the wind (holding the plane in the hand), or with a fan blowing?

3. How does wing location affect lateral stability (shoulder wing vs. high wing, Aquila vs, conventional full-size gliders)?

4. What are the angles and effects of straight vs. dihedral vs. polyhedral wings? In repairing or modifying a plane, we can easily bend a wing rod to modify the performance. What should we aim for? Is more better? Why?

5. Should spoilers be deployed 45° or 90°? What size should they be?

6. Most tow-hooks are under or behind the CG these days. In older books, a 30 to 60 degree ahead of CG location was mentioned. What is the trend and the theory?

(If any of you would like to tackle any of these subjects or expand on another area that these subjects bring to mind, we will include your responses in *RCSD*. Ed) ■

Winch Line ...by Gordon Jones

Gordon Jones, 214 Sunflower Drive, Garland, Texas 75041; (214) 840-8116 After 5:00 P.M. CST

Installing Wing Rods

Installing wing rods has never been one of my favorite chores. Over the years I have learned how to do an acceptable job of getting them in and having the whole thing lined up. It takes measuring, measuring and more measuring to do it right. As with everything else the more care you take in doing it the better and easier it all comes out.

The first step is to measure properly with an accurate metal ruler. A good small metal ruler is available at most places that sell graphics supplies and even some of the larger hardware stores carry them as well. They are available in many scales so find one that you are comfortable reading and working with. You will also note that most of these rulers come with two different scales so you can try another as well.

Start the wing rod/carry through installation by inserting the wing rod in the wing panel and then slide the brass tube for the carry through over the wing rod (this is what most folks forget about). Carefully measure the distance from the brass tube to the forward point of the leading edge. Is best to mark the center of the leading edge on both wing panels so that you are measuring from the same location. Be as exact as possible in your assessment of the reading; then write the measurement down on a piece of paper being sure to indicate the wing panel you are measuring. Repeat this process for the other wing panel.

Next measure the distance from the brass tube to the top of the wing panel. Be sure that you measure at 90 degrees so that you obtain measurements from the same point on both wing panels. Again write down the measurements and the corresponding panel identifiers.

The distances for both forward and upper measurements should be the same or real close. If there is a big difference take another look and measure again. If there is something awry in construction you should know about it now and figure out how to make any corrections before you start drilling holes in the fuselage.

Using the measurements for one side of the fuselage, measure and mark the end points on the fuselage. Draw a line at 90 degrees falong both points on the fuselage with a fine tip pencil. These lines when completed should be at 90 degrees from one another. Keep the lines as narrow as possible this increases you accuracy. If you happen to have a drafting template with holes the next step is real easy. Line up the template for the intended hole size against the two lines and carefully mark the hole on the side of the fuselage. If you do not have a hole template use the brass tube in the same manner, lining it up with the two lines and mark around the brass tube. This will be a little oversize so remember this later.

Now measure the hole outlines on both sides of the fuselage, again measure the leading edge and top of each hole to be sure you have them lined up with the leading edge and top on the fuselage. Again, if there is a big difference in the hole locations find out what happened and correct prior to drilling the holes in the fuselage.

Locate and mark the center point of both circles on the side of the fuselage. Then take an X-acto knife and using it as a drill make an indentation in the fuselage for a pilot for the drill bits. Next take a small drill bit (1/16" works good) and drill a center hole on each side of the fuselage. Repeat the process using successively larger bits until you have a hole slightly smaller that the circle marked on the fuselage side. If you used the brass tube as a hole template you want to be very careful not to get the hole too large.

Use a Dremel tool or a file to enlarge the holes evenly until the brass tube fits snugly. If the brass tube is a long one and not previously cut for the size of the fuselage, measure and cut it now. Leave a little extra on the ends so that a little bit will stick out on the side of the fuselage on both sides.

Temporarily install the brass tube in the fuselage and then the wing rod in the brass tube. Install one wing panel on the wing rod and slide it down next to the fuselage. If the wing rod is straight the wing panel will fit flush against the side of the fuselage. If it does not then mark the side (front or back) that has the gap.

Observe the wing against the fuselage looking from the front and determine if the height of the wing matches the upper shoulder or top of the fuselage. Again determine which way the wing has to move to correct the offset. The wing should be real close if you have measured and drilled properly.

<u>CAREFULLY</u> file the side of the hole that requires correction in very small increments. Install both wing panels every time you finish a correction to be sure that you don't go overboard. A correction on one side will affect the other side as well as you are changing the angle of the rod.

Once you have finished making corrections, install the wing and block up the fuselage and wing panels on a flat surface. Carefully measure to be sure that the fuselage are aligned. Mix up a slurry of epoxy and microballoons and using a long scrap of balsa as an application tool smear the slurry around the brass tube inside the fuselage. Some folks like to CA the brass tube in place and remove the wing panels to do this and if you are careful it works quite well.

Once the epoxy has dried sand down the excess brass tube on the outside of the fuselage. Then measure a point approximately 3" to 3 1/2" toward the trailing edge of the fuselage for the alignments pins. Once you have both sides marked double check the measurements and then drill a hole large enough for the brass tube.. Install the brass tube in the fuselage and CA it in place. Using an extra piece of music wire the size of the alignment pin wire (it helps to sharpen this wire a bit) chuck it in the drill. Install one wing panel and align the trailing edge of the wing panel to the fuselage. While holding the wing panel in place slide the extended drill bit through the brass tube and drill a hole in the wing root rib. Repeat this process with the other wing panel and then check the alignment from both front and rear of the installed wing. If any alignment problems are encountered you can pop the alignemtn pin out and make the necessary adjustments there.

If you have any tips or ideas that are worth passing along please let us know. ■

Turbulation

...by Al Sugar
Carrollton, Texas

Part 1
Let's Slow the Heavy Bird Down

Over the years, I have seen applications of turbulators that simply do not make any sense. Take turbulator spars in the leading edge structure of a wing, or the pieces of tape of approximately 4 mils thick that have been applied to the upper surface to "promote turbulation" that would take a very sensitive readout to really analyze the effect at "normal" airspeed. Yes, forcing the turbulated airfoil to operate out of universe as done in speed runs may create a very small change in characteristics; however, my outlook on that evaluation is like dropping a Cadillac off the side of a mountain to prove it has good gas mileage. I see adding turbulation only as a means to obtain gain at soaring velocity (approximately 30mph) for particular designs, or to embellish stabilization damping of tail surfaces by giving them polarization (i.e., more emulated dimension when deflected in one direction over the other).

There is no free lunch with turbulation. If you have a machine where you turbulate the upper wing surface, and if you gain 20% more lift for 10% drag, you are the winner. You are a winner if you pick up 30% drag for 30% more lift, because your wing is emulating a larger volume; your machine can use thermal lift more efficiently, as long as it still has sufficient speed to go from thermal to thermal. My approach to wings are different than most, because of my power background. To me, they are a quantum value that have traditional approaches to their dimensions to gain efficiency; airfoil selection is used to handle the weight that my building skill limits me to. Compromising is necessary to prevent going off the deep end, like a two meter sailplane having an aspect ratio of 25:1, and a 25% thick under-cambered airfoil turbulated all to heck to make it fly at 25 oz. of weight!

In SOARTECH 8, the reference turbulators were typically 20 mils, which is just about minimum for the ones that I employ. This makes a lot of sense because they were devices used to tweak the test airfoil into higher performance, and not necessarily "repair" of a design shortcoming. The full-size Saber Jet of years ago was the airplane that first gave me an insight into how much turbulation is necessary to control a situation. The dual array of a dozen or more right angle turbulator plates, 2" wide and sticking up 1" above the upper surface, were placed at each wing tip to prevent tip stall; they really impressed me. Over the years, I have played with different approaches and techniques of turbulation, only to realize they are a great tool to enhance, repair, or finesse an airfoil at soaring velocity for the purpose of improving stay-up-man-ship. My turbulators as typically 1/8" wide and range in height from 20 to 95 mils. in thickness. I believe they are a product of airspeed and have very little relationship to wing chord. At the airspeed I feel comfortable with, 35 mil. turbs. is a starting point. I have learned that the location of attachment seems to have different effects (i.e., if installed in the first 1" of wing chord, they seem to hold back and soften stalls). When the turbs. are placed further back from 1 1/2" to 35% of the wing chord, they seem to improve lift as if the airfoil got thicker. When placed about 60% back, typical reaction was that the sailplane flew faster as if lift reduced; however, I did not do much experimenting in this area of tripping, because I believed, at the time, that adding weight would do the job better. I did learn that the locations of the turbulators are not critical (i.e., the front turb. had a range from 3% to 12%, the main turb. was from 15% to 40% of the wing chord). After reading some other reports, I believe that it would be interesting to do some research in tripping at 60% some of the misfit airfoils I use, especially in light of the possibility of the high drag bubble on the upper surface as described in SOARTECH 8. I would love to see what the flat plate would do with a .062" turb. at 10%, and a .093" turb. would do at 30%. (This is the array that I used on a Legionnaire which made it fly so slow that the rudder become ineffective. The big failure of this experiment was the high drag that occurred during launch, which was compounded by a poor multiple carry-thru system which held it back from getting decent height. Oh well, I'm really not that fond of slow blimpy "gas bags", anyway. It was a great experiment that gave me more knowledge.)

Finally, let me sum up the scheme of things by stating that the use of turbs. on the front section of the wing is like shifting the total speed range into a lower quantum. Also, some of the pre-conceived arguments my associates have stated about large increases of adverse pitch, as a result of turbulator employment, is simply not true. The mild increase in adverse pitch simply broadens the trim settings forcing the tailplane to need a couple of clicks more of up. This positive trim setting is simply in phase with the locked loop effect of airspeed regulation, so I simply do not look at it as a detriment. Basically, if you have a lead sled that you would like to float, turbulation may be "The Jeanie in the Bottle" for you.

Part 2
Invigoration & Tripping

Since my previous paper on Turbulation, Part 1, I simply had to do more research on invigoration (i.e., adding a turbulator at approximately 60% to work in harmony with the turbulators at the front of the wing). The acquisition of a Spirit 100 with flaps and ailerons really spiked that curiosity. The Spirit 100 with its light weight of 65 oz. seemed to fly very bright and crisp with my style of flying. (I must admit, it is the best machine I have ever flown.) In an attempt to analyze the design's attributes, the most glaring fact was the 1/8" gap between the wing and the flap. This apparent turbulation generator may be the reason for the high performance, so I had to experiment by adding Invigorator onto my turbulated wings to see if the performance would improve. My findings were that the performance indeed improved; however, it was not enough to really pursue all the complications of tuning this array. In a way, I felt like Walt Disney's Dumbo grasping a feather in his trunk, and flying. Then, *RCSD* came to the rescue with a great article on "Bursting the Bubble" by Graham Woods. If the RG-15 seemed to have the stagnant bubble at speeds in excess of what I fly at, imagine what my motley group of airfoils designed by "Quasymoto" are carrying. When I removed the front turbulator and left the Invigorator, I basically transformed its function into a tripper. Now, we have more of an answer on what to do with that nasty old bubble. The increase in "brightness" flying the tripper at 60% back from the leading edge with a thickness of .040" for the full span, is amazing. This experiment was then carried out on 5 different sailplanes, and all seemed to have its sizzle range improved as if the knee of the polar curve became closer to a straight line. The most graphic change occurred with the Spirit 76 that had seemed to be weak in roll and difficult to maintain at a uniform speed. With the tripper in place, the spirit flies like a 3/4 scale version of the 100" Spirit that I'm having a love affair over. So far to date, the low aspect ratio (9 - 13:1) poly machines seem to have the big jump in performance; however, I am beginning to believe the application of tripper and invigorators on high aspect ratio wings will be the wave of the future: appearing on F3B machines to really break them loose to improve speed and distance.

What happens to an RG-15 wing when a tripper of 40 mils. thick at 55% is added to its upper surface is probably what the majority of pilots want to know. Well, the setting up of my Ellipse in this manner has been a very pleasant experience for me. First surprise was an improvement in launch height that almost seemed to be more consistent. The second effect seemed to be an enhancement of the tip dihedral angle, which allowed me to incorporate a little more yaw via rudder/aileron mix ratio for a tighter speed spiral. Now, the Ellipse can be snap-spiraled comfortably; an exercise that was a little difficult for me because of the small stab size. And last, when I want the machine to move out, a small dive sets up the airspeed that seems to be easily maintained due to less sharpness in reaction to the down-stick. Yes, more weight would improve acceleration, however the added weight would not improve the regulation of the airspeed once attained. The payback of having the lighter, tighter and faster spiraling machine in lift's core, to me, seems to be a greater advantage. I am sure others would want to use the greater weight so as to slip through the air even faster than my limits.

Let me be the first to state that what I am doing is still very crude. Who knows, maybe someone who has access to a wind tunnel can set up tests to accurately determine tripper location, height, invigorator spacings and their height for an array that would fit onto the top of existing airfoils for both our model and full-size sailplanes; and also develop a computer program that would map these devices relative to the airspeeds the expert pilot requires. Wow, ain't high tech great! ■

Servo-Locks and the Hollow Core Wing

...by Mark Weiland
Aurora, Colorado

When I was asked by a friend to combine the electric Falcon fuselage to Mark Allen's F3B Eagle wings, I found myself needing a positive, precise, and removable way to install the servos in the wings. Being a hollow core, fiberglass wing, there are not the usual ways to attach the servos in the wings. We settled on a device that Robbe has developed called the Servo Lock. These devices have a short cylindrical tub that is epoxied in the wing and a cap piece which fairs the pushrod and servo arm into the wing. The servo itself is held by two plastic pieces that are attached to the servo lugs and then slid into a recess in the pre-installed tub. The cap is held on by three flat head screws. The whole device is simple, clean, and precise,

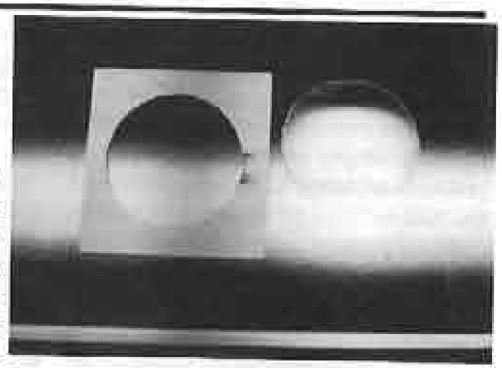


Photo 1

Photo 2

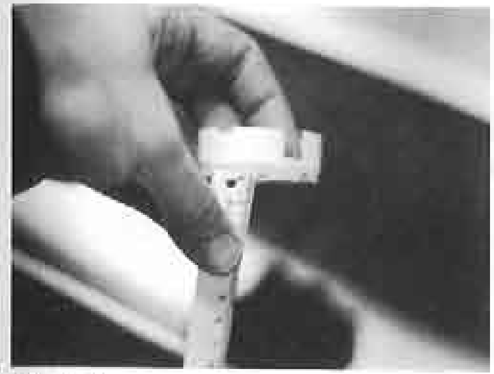


Photo 3

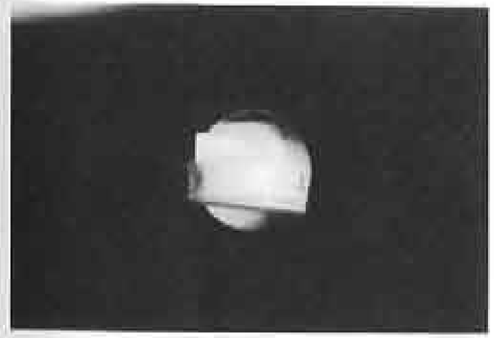


Photo 4

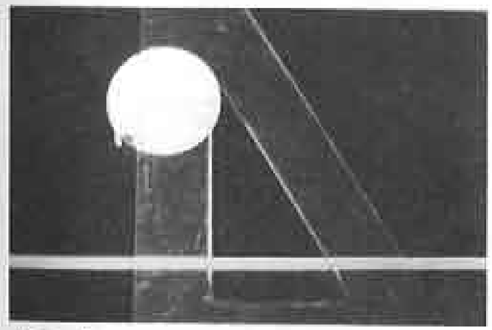


Photo 5

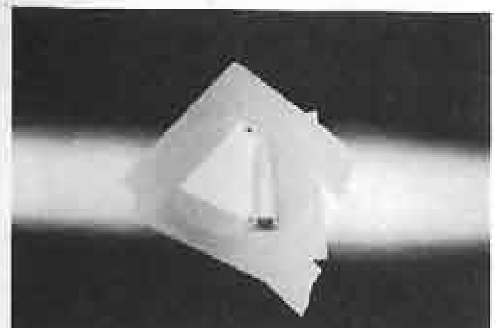


Photo 6

yet is not deep enough to use in a hollow core wing. The remainder of this article is devoted to the process of how I installed the servo locks in this type of wing.

The first step is to decide on the servo position and make a template out of 1/16th ply to mark and cut the holes with. (See photo 1.) After cutting the holes, you will need to attach the tub to a piece of 3/16th balsa (or whatever thickness needed to raise the tub up to the level of the wing skin), and shape to match the bottom of the tub. This assembly is placed into the hole and measured to match the fore and aft taper matching the top of the wing. (See photos 2 & 3.) Sand this angle on a disc sander checking to see when the assembly is flush with the bottom of the wing. (See photo 4.)

When you are satisfied with the angle, you will need to mask all of the openings in the tub, using scotch tape to prevent epoxy from entering inside. I then place a thin coat of Vaseline on the outside lip of the cap to prevent the epoxy from sticking to this part. Put both the tub and cap together and mix one ounce of epoxy per wing adding an equal part of micro balloons to the mixture. Pour 1/2 ounce of this mixture into each opening. You will need to work quickly to prevent the epoxy from spreading too far out on the top surface which doesn't add strength to the overall assembly. Place the servo-lock assembly into the wing and align with a triangle. (See photo 5.) Place low tack masking tape over the edges to keep the epoxy from leaking onto the bottom surface and seal down. (See photo 6.) When both Servo-Locks are installed, if using flap and aileron, turn the wing over and let set right side up until the epoxy has cured. This process will allow the epoxy to flow downward over the sides of the servo lock to the bottom surface, forming a fillet locking the assembly to the top and bottom of the wing.

Remove the masking tape and cap, and carefully trim the scotch tape from the openings. (See photos 7 & 8.) Using a piece of cable rod, pull your wires through the wing and hard wire the servos. I used a four pin Deans Connector installed in the root to provide a plug in when attaching the wings. When the wiring is completed, attach the small drums that hold the servo in the tub and the servo arm. (See photos 9 & 10.)

I made a clevis and rod to use when marking aileron and flap horn positions on their respective surfaces. Remember, if you are going to use a Z-bend, they will need to be offset 1/16th of an inch to allow for the bend, providing for a straight line of travel. I also use a large servo arm cut down to make my own "custom-made" horns which are epoxied into the surface. After the epoxy has set, I mark the control rod for length, make the Z-bend, cut, and deburr the rod. (See photos 11 - 14.) The final step deals with making sure the surfaces are centered, then attaching the servo-lock cover. (See photos 15 & 16.) Photos 17 & 18 show the entire wing bottom with the servo-locks installed. I have found these devices to be a simple solution to the problem of how to install servos in a clean, positive manner. The last two photos show the completed conversion of the Electric F3B Falcon. The experimentation with new ideas and the creation of an

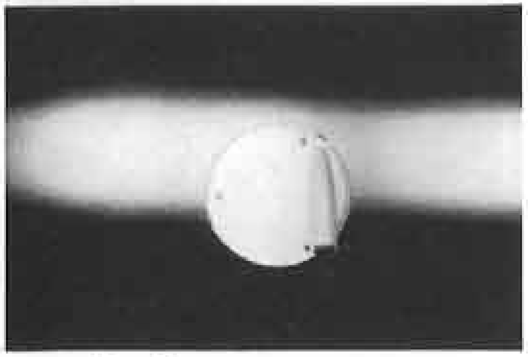


Photo 7

Photo 8

Photo 9

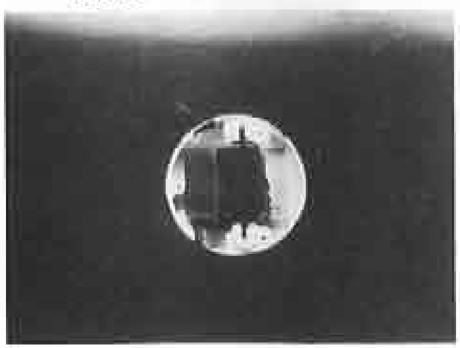


Photo 10

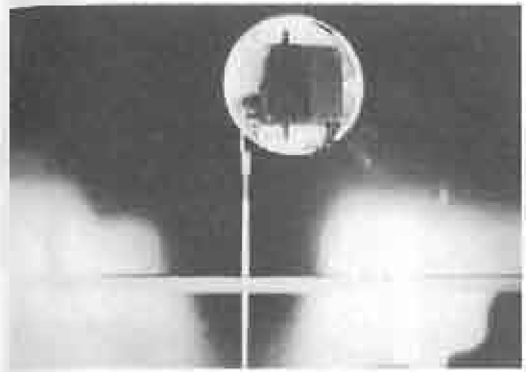


Photo 11

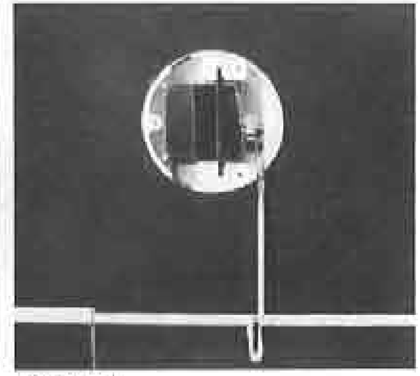


Photo 14

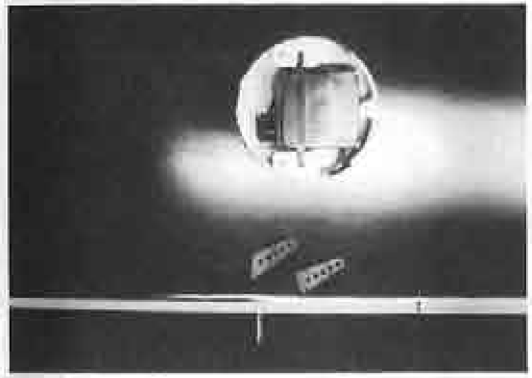


Photo 12

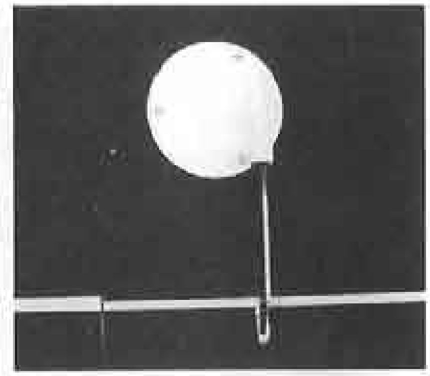


Photo 15

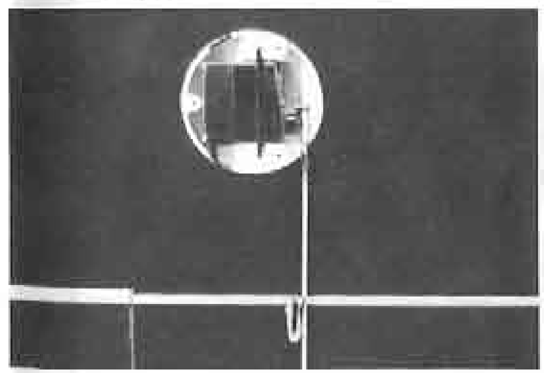


Photo 13

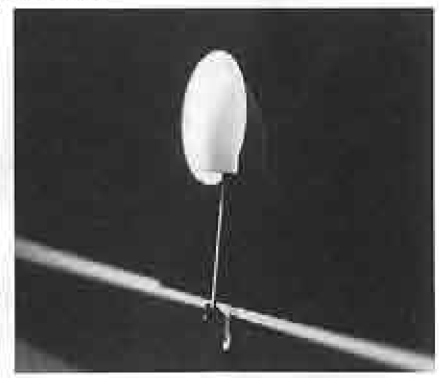


Photo 16

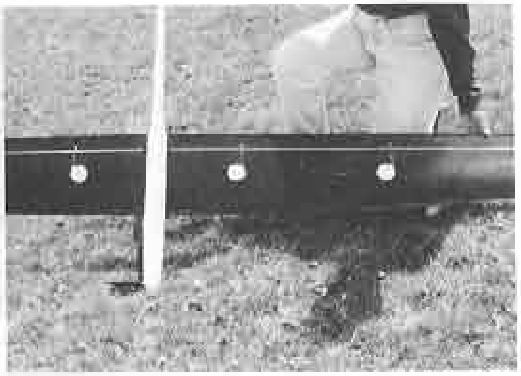


Photo 17

Photo 18

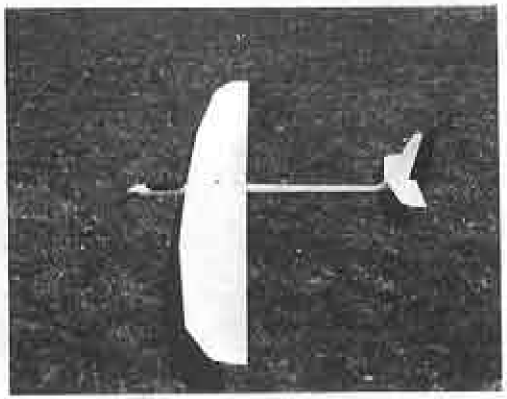


Photo 19

Photo 20

original model is what makes this hobby so captivating. If you have any questions regarding this process, feel free to give me a call at (303) 699-0467 from 6:00 to 9:30 Mountain Standard Time. ■

R/C Soaring Resources

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

Seminars & Workshops

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

California Composite Seminars - We want to help you build better! Bring your project and let us help you with it. Thirty five dollars for a six hour plus Composite Technician lesson includes lunch! Two people minimum, please. Great mountain flying all year round! Clubs? We travel, too! Please call (805) 822-7994 and ask for Scott Metze.

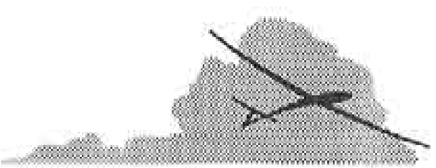
Reference Material

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



Contacts & Soaring Groups

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

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

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

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

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

Kansas - Wichita Area Soaring Association, Pat McCleave (Contact), 11621 Nantucket, Wichita, Kansas 67212 U.S.A., (316) 721-5647.

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

Maryland - Baltimore Area Soaring Society, Al DeRenzis (President), 5003 Wetheredsville Road, Baltimore, Maryland 21207 U.S.A., (410) 448-0808.

Nevada - Las Vegas Soaring Club, Steven Smith (President), 6978 Starwood Dr., Las Vegas, Nevada 89117 U.S.A., (702) 873-9591.

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

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

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

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

Special Interest Groups & Contacts

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, 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 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: $12 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

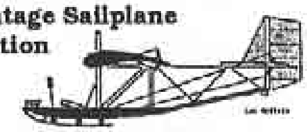
T.W.I.T.T.

(The Wing Is The Thing)

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

Send SASE for membership application and flyer: "What is T.W.I.T.T." or, send $2.50 for full information package including one back issue of our newsletter, postpaid. Full membership is $18.00 (US) or $22.00 (Foreign) per year and includes twelve issues of the newsletter. Back issues of newsletter are $.75 each, postpaid in USA.

The Vintage Sailplane Association



VSA is a very dedicated group of soaring enthusiasts who are keeping our gliding history and heritage alive by building, restoring and flying military and civilian gliders from the past, some more than fifty years old. Several vintage glider meets are held each year. Members include modellers, pilot veterans, aviation historians and other aviation enthusiasts from all continents of the world. VSA publishes the quarterly magazine BUNGEE CORD. Sample issue $1.-. Membership $10.- per year. For more information write: **Vintage Sailplane Association, Route 1, Box 239, Lovettsville, VA 22080.**

You are invited to join the

NATIONAL SOARING SOCIETY

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

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

NASSA News

Up and Soaring

...from Gregory Vasgerdsian
Concord, California

Greetings to all NASSA members! As a member of the board of directors I have some pertinent information to pass along. 1993 saw the formation of NASSA. At this time we can brag of a high quality membership of 91 scale modelers, and a successful NASSA scale rally last May in Richland, Washington, in which some 40 modelers took part, did lots of flying, and took home some great donated prizes. We also did a run of NASSA T-shirts which are still available. Not bad for a formative year, but 1994 should be much, much better!

First, let's get by this question of "What do I get for my dues". Well, you get to support scale. Your dues are intended to pay for the NASSA achievement program, to sponsor a yearly NASSA rally, to help sponsor local NASSA events, for special member only mailings, and to help finance items such as the NASSA T-Shirt when high interest is shown to have such an item. In North America we have only a handful of scale kit manufacturers, a few importers, and a few scale plan sources. Individually we hardly exist but as a club we increase our power to influence. Our goal is to promote scale so that we have more local scale events and more scale model kits to choose from. Last of all, when you join NASSA you are joining a network of scale R/C soarers, to make friends with, exchange ideas, learn from and to enjoy scale R/C soaring!

On the question of dues, all current members are good through December of 1994. The Board of Directors feels that not enough was accomplished in 1993 to ask members to pay dues for 1994, so if you joined in December of 1992 you essentially get a year free. The dues structure for 1994 will be pro-rated, if you join January to July it's $10.00, August to October is $5.00, and after that it's $10.00 which will apply to the next year.

IMPORTANT! All members, we need you to spend $0.29 on a stamp and send to us your AMA number so that we can complete the AMA club charter. Please do so as soon as possible.

Early January all members can expect a packet to include a Membership Roster, plus an article on Purchasing a Scale Kit (From December 93, *RCSD*), and a Scale Kit Specs List which gives some good details on available models. We can thank Wil Byers, Byron Blakeslee and Robin Lehman for most of this information. Thanks guys! You will also receive details on the NASSA Building and Flying Achievement Program, which begins January 1994.

NASSA will be supporting the 1994 World Soaring Jamboree and we expect to make a big showing of PSS, scale sailplanes, and scale gliders. At one scale fun fly back in 1989 in Washington some 200 scale models made a showing! I think we can easily match if not exceed that number! The Jamboree should be an excellent opportunity to bring your best, and show the non-scale flyers what it's all about!

Also, for those of you in the South, we are working to support the Mid South Championships in Tennessee next June. The idea is to have one major event every year, which will be in a different region each year. Also, to have smaller NASSA events put on during the year in as many different areas as possible. We want to see NASSA events across North America!

F3I? Did you know that France had put forth F3I (aero-tow soaring) as an FAI designated competition? This is not late breaking news but from what I have read in Silent Flight, I understand there is already talk of an F3I International contest in the UK next year, as well as events in Belgium and Italy. Aero-towing is an area of R/C soaring which has been on the increase here and I would think it only a short time before modelers in North America get serious about F3I. This would make a terrific NASSA event!

If you have a core group of enthusiastic scale modelers and would like to put on a NASSA scale event in your area please let us know. Remember there is no dictated format, just guidelines. Put on what turns you on, whether it's F3I, PSS, Scale Thermal Duration, Cross Country, or a Fun Fly. NASSA will help you promote your event with press releases, ads, trophies and other PR materials as is appropriate.

Make it scale in 94! ■

Special Events

Schedule of Special Events

Date	Event	Location	Contact
May 14-15	Masters of Soaring	Covina, CA	Pete Olsen (909) 597-2095
May 28-June 5	World Soaring Jamboree	Richland, WA	Wil Byers (509) 627-5224
June 23-26	Mid-South Soaring Championships	Memphis, TN	Bob Sowder (901) 757-5536
Oct. 1-2	CVRC Fall Soaring Festival	Visalia, CA	

Curt Nehring
Southern California

New Products

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*.

Klingberg Rocket Wing

...from Future Flight

Blast off on your next mission! The Klingberg Rocket Wing is the next quality kit offering from Future Flight. Based on the extremely popular 2 meter Klingberg Wing, this scaled down version has a 52" wing span and a wing area of 377 sq. in. With an "E" size motor, the takeoff weight is a mere 14.5 oz., so you can launch to over 600 feet. The Wing also features Autoyaw™ which makes the launches easy, even the first time out. After the launch, the well known superior aerodynamics of the wing will allow you to climb on the lightest lift or perform many aerobatic maneuvers. The motor is attached to the radio hatch cover only, so the Rocket Wing is very versatile. With a simple change of the cover, it can be launched with a high-start, flown on the slopes, or powered with a gas or electric motor. To join this exciting aspect of our hobby, contact Future Flight, 1256 Prescott Ave., Sunnyvale, CA 94089; (408) 735-8260. ■

AERO*COMP Software - Version 2.0

...from USR&D Corporation

Version 2.0 of AERO*COMP (R) is now available. AERO*COMP is software for performance characterization of electric-powered model aircraft. AERO*COMP is used to determine whether an electric airplane or sailplane will fly, and how to make it fly better. Also useful for gas/glow, ducted fan, and helicopters. AERO*COMP has been used to turn ordinary planes into award-winners, including winners at the 1992 U.S. Nationals and the 1993 Canadian Nationals. NASA now uses AERO*COMP to analyze experimental electric-powered aircraft.

Use AERO*COMP to determine how well your model will perform before you build it. Anticipate whether your aircraft will fly well, marginally, or not at all. Avoid damage to expensive motor and radio equipment by keeping marginal or non-flying aircraft on the ground. AERO*COMP helps you:

- Select a motor that is powerful enough to make your plane fly, and fly well
- Select the best propeller for your airplane
- Select the best gear ratio for your airplane
- Select batteries for competition electric planes
- Determine maximum weight for the performance you desire
- Select the best wing design, airfoil type, and fuselage design
- Maximize rate-of-climb, airspeed, or flight duration

Here's how it works: You maximize your airplane's performance by experimenting with its physical characteristics - you experiment in the computer, not on the workbench or at the flying field, so it takes only a few minutes. You can select the characteristics of many commonly used motors from easy-to-use "pulldown" menus - or you can enter values that you have measured in your workshop. On-line help screens explain how to make the measurements and how to use the program.

The numerical inputs to AERO*COMP describe the physical characteristics of the motor, propeller, battery pack, and aircraft. In Version 2.0, the MOTOR menu now provides data for more than one hundred electric motors of all sizes, ranging from "micro's" to the Astro Cobalt 90, Hecktoplett 355/40/6, and Aveox brushless motors. All motor data were measured at the USR&D laboratory. The PROP menu now permits you to input the number of blades, as well as prop diameter and pitch. A separate BATTERY menu now gives you control of the cell voltage, cell impedance, wiring resistance, and type of connection (series or parallel, as used on multi-motor aircraft), as well as number of cells and cell capacity. The AIRCRAFT menu now permits you to work with airfoil type, fuselage type, and landing gear data, as well as number of wings, wing dimensions, runway type (including paved, grass, water, and hand launched takeoffs), and weight. These improvements make the program applicable to all electric aircraft, including ducted fan models and competition models.

The numerical outputs indicate whether your aircraft will take off and how well it will perform once airborne. The outputs include takeoff RPM, motor current and voltage, motor input power, output power, and efficiency, optimum gear ratio; wing area, aspect ratio, wing loading, and Reynolds number at maximum airspeed; maximum thrust, takeoff distance and duration, takeoff speed, and thrust duration at takeoff speed; maximum airspeed, rate-of-climb, maximum altitude, and average climb angle; optimum angle of attack for glide, optimum glide ratio, and maximum glide time in still air; and other aerodynamic characteristics. The program provides this information by solving the mathematical equations of motor performance and the physics of flight.

Thanks to excellent feedback from our customers, we have also included a large number of other new features in AERO*COMP Version 2.0. The number of working files has been increased from twelve to thirty-six. Each file contains data describing one airplane. The program can now be operated in metric units as well as English units of measurement. The English system weight units have been changed from pounds to ounces. The help screen information has been updated and improved. You may now store data for up to 50 motors in an external file that you can edit yourself - this may be used to store data describing your own motors, to store data describing motors not referenced in the software, and to share motor data with other modelers.

AERO*COMP lets you quickly change any one input without requiring you to provide the other inputs all over again. You do not have to guess at the RPM and current corresponding to your particular motor and prop - AERO*COMP makes the calculations for you directly from the input data. Because AERO*COMP uses physical equations and accurate input data, the answers generally are accurate to within 5%.

To do a really professional design job, use your CAD program (like "AFEDIT", "CompuFoil", "Foiled Again", "ModelCAD", "Model Design Program", or other software) to design your model. Then use AERO*COMP to determine how well it will fly and how to make it fly better.

Remember, AERO*COMP is not a flight simulator or game. It is a serious computational tool, developed by professional scientists who are active R/C modelers. Staff members at USR&D hold advanced degrees in aeronautical engineering, electronics, physics, and geophysics. They helped design the first camera that went to the moon, they had a hand in the design of electronics for the Minuteman missile, they programmed guidance systems for the Safeguard missile project, and they helped design fighter and photo recon aircraft for Uncle Sam. They also have a combined total of more than 7500 hours as former USAF aircrew officers.

System requirements for AERO*COMP are: IBM or 100% compatible PC, XT, AT, and higher; DOS 2.0 or higher; 5.25" (360 Kb) or 3.5" (720 Kb) floppy disk drive; VGA, EGA, CGA, or monochrome; minimum 400 Kb RAM. Hard disk drive is recommended. Math coprocessor, mouse, and joystick are not required. AERO*COMP works within Windows. A User's Guide is provided. Delivery is normally from stock. Price $79 (U.S.) plus shipping ($3.00), plus NJ State Tax (6%) if applicable. (Add $1.00 per copy for international airmail postage.) Owners of Version 1 may upgrade to Version 2.0 for $39 (U.S.) plus shipping, plus NJ State Tax if applicable. (WARNING: AERO*COMP will not run on Macintosh computers, nor on any Macintosh computer equipped with a PC-emulator. Please do not purchase AERO*COMP for your "Mac".)

USR&D Corporation, P. O. Box 753, Hackettstown, NJ 07840-0753 U. S. A.; (908) 850-4131. ■

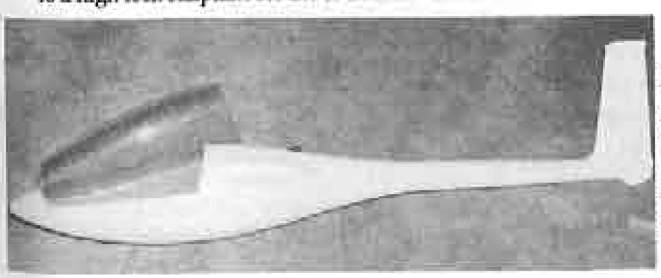
Pick 20, Scale Fuselage

...from ICARE Sailplanes

For the scale sailplane scratch builder, this is a nice project as it can be built with a different color than the classic white. The original sailplanes were available in white, green or creamy yellow, and were manufactured by Eiravion OY in the mid-seventies. The development of the Pick lead to a series of four versions named Pick - 20B, C, D, and E. The B version was the first composite sailplane using a carbon fiber spar; the C version was the 15 m economy version, equipped with airbrakes instead of flaps; the D version was the response to the German latest releases, improvement in molding techniques, new airfoil, flaps, airbrakes, and reinforced cockpit lead to a high tech sailplane for the 15 m class. The E version is the powered version, and carries a pylon mounted engine between the wings that flips back into the fuselage.

The scale fuselage in the semi-kit is fiberglass reinforced epoxy and is pre-colored white. Fairings for the Wortman/HQ airfoil are molded on, and it comes with a clear canopy and three view plan. Semi-kits containing wing and stab foam cores, obeche sheeting, and a quick building plan are available upon request.

For more information about our products, send $1.00 to ICARE Sailplanes, Etienne Dorig, 381 Joseph-Huet, Boucherville, PQ, J4B 2C5, Canada; (514) 449-9094 EST. ■



Specifications

Scale	1:5
Wing Span	118"
Length	54"
Weight	80 oz. approx.
Airfoil	Wortmann/HQ
Fuse. Price	105.00 + S&H
Semi-kit Price	$155.00 + S&H

Advertiser Index

Do You Need Help With Ad Copy?
One source for help with ad design & typesetting: Barry Kurath
105 N.E. 61st #12, Portland, OR 97213
(503) 236-4067

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DON'T YOU HAVE ENOUGH TROPHIES?? *** ATTN: CONTEST DIRECTORS!!! Award your winners w/shirts, caps, jackets, bags, individualized w/screen art (incl. place & class). Designed by fine artist and past Natl. Champion, Tom Jones. Golf shirts from $20.00, T's from $10.00. For more info. send S.A.S.E. to: **Zoomit Creations,** 3703 Penny Ln., Carrollton, TX 75007; (214) 394-0119.

MINI HI START KIT designed especially for 1-1/2 meter (hand launch). Thirty feet of 1/8 tubing stretches four times relaxed length for gentle launches. Two day glow colored tow lines, 120' and 150', use separately or together. $19.95 + $4.00 shipping. Sky Bench Aerotech, 58030 Cyrenus Lane, Washington, MI 48094; (313) 781-7018.

IRON ON CARBON FIBRE 3.7 Oz./yd^2, .007 - 2"x48"... $9.00, 12"x48"... $18.00, 1'x10'... $42.50. Iron on S-glass, 12"x48"... $10.00. Chopped carbon fibre... $2.95 bag. 100# test kevlar pull-pull system, 25' plus teflon-teflon sleeving... $7.00. 100% satisfaction guaranteed. Only $1.00 S&H. CA res. add 7.75% tax. Send LSASE for brochure & free samples to: California Carbon, P.O. Box 39, Jamul, CA 91935; (619) 669-6348.

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Multiplex DG 600 kit, NIB, 1/5 scale. New cost is $410, will sell for $350 or trade up for larger scale sailplane or kit or Super-V. Joe @ (408) 923-3045, days, N. California.

Futaba FP-7UAFS computer xmitter / FP-R128DF receiver. Both ch #20. Less than year old... $225.00 includes S&H. Roy Smith, P.O. Box 219, Kelseyville, CA 95451; (707) 279-9241.

Ready to fly: Airtronics LEGEND... $400.00; Agnew BANSHEE... $225.00; Airtronics ECLIPSE... $75.00. NIB kits: Mariah... $125.00; Dodgson CAMANO... $150.00; Dodgson ORBITER... $75.00; Dodgson TODI... $150.00; Dodgson MAESTRO III... $150.00. Ace DIGIPACE... $60.00. All prices include shipping. Jim Thomas (206) 488-2524, Washington.

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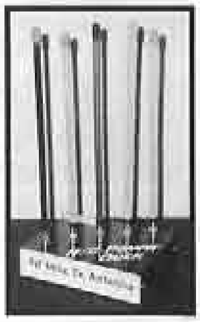

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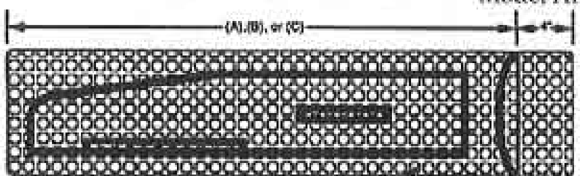

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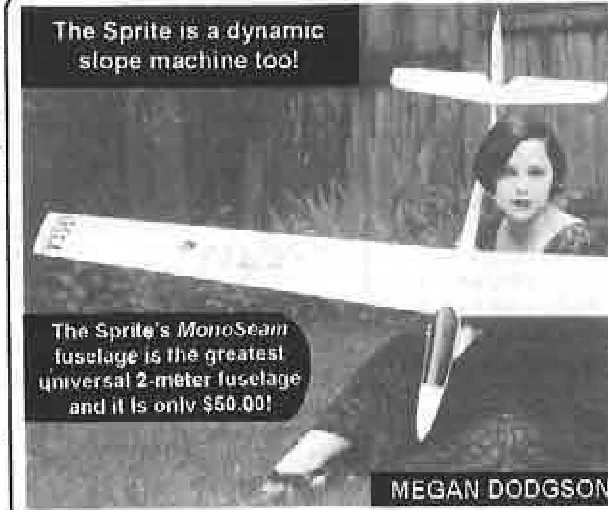

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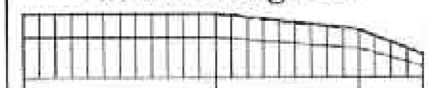

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LENGTH O.A.	33 inches
WING AREA	311 sq. inches
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WING LOADING	11.1 TO 12.5 oz / sq. ft.
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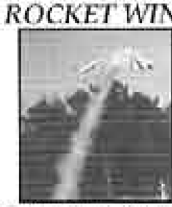

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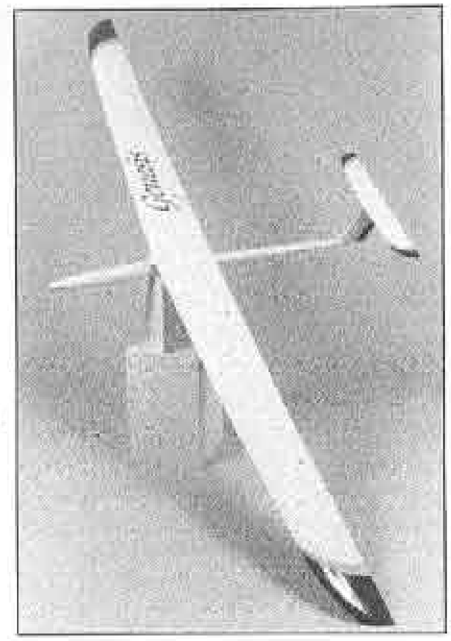

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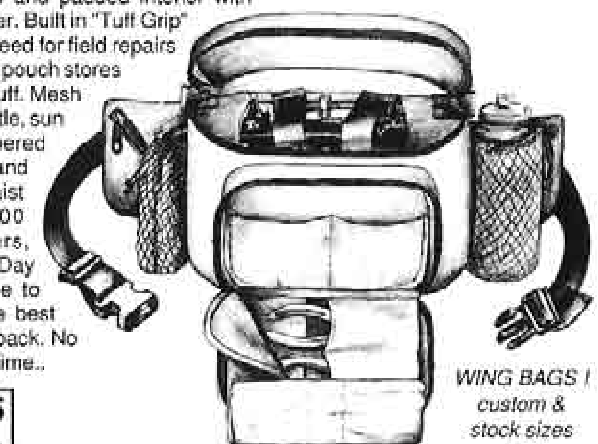

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4 CELL RECEIVER PACKS (Flat or Square)

		MATCHED PACKS			MATCHED PACKS			MATCHED PACKS
4N-50AAA	$ 8.95	12.95	4N-800AR	$12.95	16.95	4KR-1500SC	$13.95	17.95
4N-110AA	$ 7.95	11.95	4KR1000AE	$12.95	16.95	4KR-1800SCE	$18.00	22.00
4N-150N	$ 8.95	12.95	4KR1100AAE	$17.95	21.95	4N-1400SCR	$17.00	21.00
4N-200AAA	$ 8.95	12.95	4KR1200AE	$13.95	17.95	4N-1700SCRC	$19.95	23.95
4N-225AE	$12.95	16.95	4KR-1400AE	$16.95	20.95	4KR2000C	$20.00	24.00
4N-270AA	$ 7.95	11.95	4KR-1700AE	$19.95	23.95	4KR4400D	$34.00	38.00
4N-600AA	$ 8.95	12.95	4N-650SC	$13.95	17.95	4KR5000DEL	$42.00	46.00
4KR-800AAE	$11.95	15.95	4N-1000SCR	$15.95	19.95			
4KR-600AE	$10.95	14.95	4KR-1300SC	$11.95	15.95			

5 CELL RECEIVER PACKS
To order a 6 volt Battery Pack add the cost of a single cell to the 4 Cell Battery Pack.

CONNECTORS

FUTABA	J	$4.00	AIRTRONICS	$4.00
FUTABA	G	$4.00	JR/HITEC	$4.00

TRANSMITTER PACKS

			MATCHED PACKS				MATCHED PACKS
8N600AA	1 row of 8 AA	$15.95	19.95	8N600AA	2 sticks of 3, 1 stick of 2	$15.95	19.95
8KR800AAE		$20.00	24.00	8KR800AAE		$20.00	24.00
8N600AA	4 sticks of 2 square	$15.95	19.95	9N600AA	3 sticks of 3, 10.8 volt	$18.00	22.00
8KR800AAE		$20.00	24.00	9KR800AAE		$22.00	26.00

GELL CELLS

6 volt	1.2 AH	$12.00	12 volt	7.0 AH	$19.95

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DEALERS' INQUIRIES WELCOME

The Renegade is the new "Bad Boy" on the Slopes of California, winning everything in the new 60" span racing class. The RG-15 airfoil gives the Renegade a blistering speed range and the ability to carry a massive ballast load if needed. Its flaperon system cranks the plane through high-G pylon turns with little energy loss. Don't let Renegade's bad attitude scare you off because it is very stable at all speeds and has remarkable light lift and thermaling ability. This rugged plane gives you big plane speed at a small plane price.

Highly Prefabricated Requiring Little Assembly

- High Quality Molded Epoxy/Fiberglass/Kevlar Fuselage With Slip On Nose Cone - Installed Elevator Cable
- Vacuum-Bagged RG-15 Composite Wings Featuring Blue Foam Cores Skinned With Carbon Fiber And Glass
- Pre-cut And Hinged Ailerons
- Bolt-On Wing And Tail Surfaces - Optional Ballast Kit

Renegade sweeps 60" Class and gets SECOND Overall in Unlimited Class Slope Racing At '93 Torrey Pines Speed Week

The Contender is designed for those who desire the ultimate in speed and aerobatics, featuring three channel control with wingerons, elevator, and full flying rudder. Contender's long tail moment and stabilizer design give it hands-off stability even at extreme speeds. The airfoil and wing design allows for an incredible speed range with the ability to turn or climb sharply with unmatched energy retention. Wings are constructed with blue foam cores, Carbon Fiber, and plywood wing skins and spars. The fuselage is designed with a large ballast compartment over the C.G. where up to 20 ounces of ballast can be placed for high lift conditions or slope racing. At the standard flying weight of 50 ounces, the Contender is very fast and will fly great in winds averaging as low as 5-7 m.p.h.

SPECIFICATIONS

- High Speed 2 Meter Aerobatic Slope Plane
- Thornburg Modified S3016 Airfoil
- Wing Area 420 Sq. inches
- Flying Weight (unballasted) 50 ounces
- Wing Loading 17.0 to 24.0 oz. per sq. ft.
- Three Channel: Wingeron, Rudder, Elevator

FEATURES

- Machine Cut Balsa, Spruce, And Plywood
- Quality Blue Foam Cores And Carbon Fiber
- Wingeron Linkages And Control Cables
- Hardened Steel Wing Rod
- Complete Hardware Package
- Rolled Plans And Detailed Instructions

Climmax Takes 1st Place At 10th Riverside I.S.S. And Fall T.P.G. Hand Launch Contests

The Climmax is designed for Hand launch Thermal Competition and slope and thermal sport flying. The outstanding SD-7037 airfoil has been modified to prevent tip stalling and enhance upwind penetration in breezy conditions. Its clean aerodynamic profile allows for maximum altitude hand launches and it's high-aspect ratio flying rudder gives Climmax the ability to make tight, flat turns in small thermals. Climmax is also excellent for minimum-lift slope sites where only the lightest planes will stay aloft. An outstanding speed range and tight turning ability make Climmax a fun choice for light lift slope aerobatics such as snap rolls and loops.

SPECIFICATIONS

- Airfoil: SD-7037
- Wing Area: 400 sq. in. Wing Loading 5.0-6.0 oz. per sq.ft.
- Two Channel: Rudder, Elevator
- Flying Weight 14-16.5 oz.
- Machine Cut Balsa, Spruce, And Plywood
- Quality Feather Edge Foam Wing Cores
- Bolt-On Wing
- Full Size Rolled Plans. Detailed Instruction Book
- Standard or Micro Compatible

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