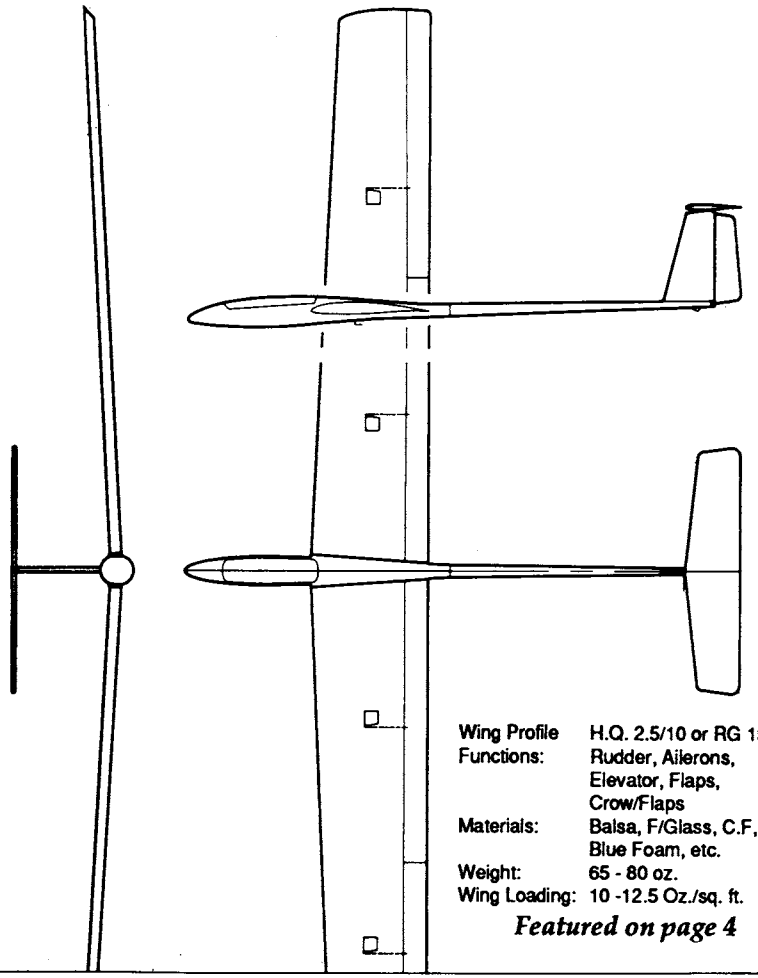
R/C Soaring DIGEST

Vol 6. No. 4 April 1989

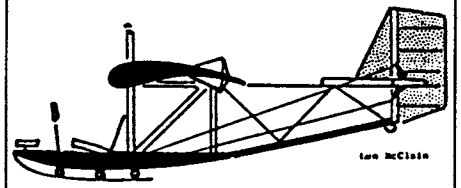
Conquest: Entry-Level F3B-type Sailplane

Designed by: Don Chaney



Wing Profile	H.Q. 2.5/10 or RG 15
Functions:	Rudder, Ailerons, Elevator, Flaps, Crow/Flaps
Materials:	Balsa, F/Glass, C.F, Blue Foam, etc.
Weight:	65 - 80 oz.
Wing Loading:	10 -12.5 Oz./sq. ft.

Featured on page 4



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

RC Soaring Digest
P.O. Box 1079
Payson, AZ 85547

Bulk Rate
Postage Paid
Permit # 17
Payson, AZ 85547

ADDRESS CORRECTION REQUESTED
FORWARDING POSTAGE GUARANTEED

High Start

Response to the "RCSD Challenge" has been gratifying to say the least. The original proposal called for June as the cut-off date for entries, and it looks as if that is a reasonable time period. Beginning July first, the judges will attempt to decide the sailplane, the set of rules to be adopted, and the task details for what is now commonly called "Sportsman F3B".

Already, you have seen some ideas discussed in the Gray Area, and this month there will be more. Several off-the-shelf designs have been selected as possible candidates, and several one-design sailplanes have been entered. More are on the way, and — with three months to go — there is a good chance that perhaps as many as four or five viable candidates will be in hand by the time judging begins.

There is much interest in modifying the rules and tasks "just enough" to allow for easier club participation; i.e., less overall workload per person, and fewer persons needed to run a contest than currently needed for full-F3B contests. In general, the tasks should be within the capability of a good pilot except perhaps for the speed run. Perhaps the speed run can be altered slightly to make it less intimidating to Sportsman F3B pilots. One idea might be to encourage speed runs, but reduce the danger of losing a sailplane or injuring someone. For example, sneak up on the run gradually by practicing techniques without going for overall speed the first few times out. There ought to be a "dry run" period before attempts at best times are attempted.

As this is being written, a group of Californians are holding a "Sportsman F3B" contest, and it will have task and rule modifications which could be what we are looking for. I will let you know as soon as things have been decided.

My goal is to have everything set by September so that a full winter building season will be available for Sportsman F3B pilots to ready their ship for competition early in 1990.

This is a very exciting prospect to a number of Thermal Duration fliers as well. Several dyed-in-the-wool T. D. pilots have written to tell me that they have become "bored" with the sameness of their contests and are looking for something new, different and interesting to challenge their already considerable skills.

Folks, that's what this is all about: something new and interesting to improve flying ability while having a lot of fun, and increasing overall enjoyment of this wonderful sport of ours.

Happy Soaring,
Jim Gray

The Demise of Wilshire Model Center
...by Jim Gray

Apparently, Wilshire Model Center has gone out of business after an unsuccessful attempt to keep it afloat. Unfortunately, for modelers who enjoy the imported varieties of sailplanes, sources of these machines have dwindled to just a few in the USA. Beemer R/C West is one and Hobby Lobby International is another, and there may be more I don't know about. Here is an opportunity for an enterprising individual or group to fill a need—on the west coast in particular. If I may be permitted an observation based upon years of experience in another hobby field, it is not sufficient just to "love soaring and sailplanes". First, you must be a businessman or businesswoman whose first interest must be in establishing and maintaining proper business principles. Any interest in soaring and sailplanes must be secondary. Too often, we have seen people who think it would be wonderful to make our hobby into a business go down the tubes. You've got to be a business person first, last and always.

RCSD Challenge: Sportsman F3B

...by Jim Gray

As I mentioned before, RCSD has received dozens of comments about the proposed "Sportsman F3B" class and the RCSD Challenge. Here are a few of them for your interest.

♣ ♣ ♣

Byron Blakeslee (Model Aviation Soaring Columnist) says:"...I'll do a similar plug in my June column...this program has a chance of really being popular...depends on how the local clubs embrace the idea, and whether they decide to sponsor Sportsman F3B events. I'd suggest we aim for minimal/flexible rules so the guys can spend maximum time flying and minimum time hassling.

"...I think the Sagitta 900 is a nice comfortable size plane...what would you think of increasing the maximum proposed ballasted weight to 80 oz.? Maximum dry weight could be 70 oz.

" Don Chancey sent me a copy of his letter to you regarding his Challenge entry, Bounty Hunter/Conquest. This would seem to be a perfect design for Sportsman F3B. It's a modern, proven design, and Bob Sealy makes nice fiberglass fuselages for it. A complete kit should come in about $150. It should also be great for Thermal Duration and even Slope Flying. Truly, a multi-purpose ship. I'd like to build and fly one myself!

"I agree that the 2-meter Cup rules would be fine. Also agree that we should stick to the 'real' rules as much as possible...I'd suggest club-supplied winches and organizers option of 'working time'...zero or one re-launch could be used...CD would need to measure wing area of each entry in the morning and weigh the winning sailplane of each flight...or, the planes could be weighed in the morning with full ballast, and the pilots have a gentlemen's agreement not to use more than that...ok for most club contests, and would speed things up.

"Jim, you and I and Don Edberg should keep really close on this program. Maybe with enough 'push' something will get going that will be of permanent value to Soaring in the 'ol U.S. of A.!

Thanks, Byron; super letter! Now, what do the other readers think and say? Here's some comments from Earl Levin's letter sent to Byron: "...At our general meeting I was able to corner Rich Spicer (member USA F3B Team)...he agrees that a true 'one-design' model will never happen...each builder would individualize it and want his own design. I talked to George Paige of our group, and he said to forget the one-design concept; history shows that it does not work...every time you try to force one-design on a group, the intended event dies.

"Sportsman F3B Requirements: Built-up foam wing with balsa, ply or obechi sheeting allowed; Light glass (3/4 oz. max.) for finishing only on wings; Carbon fiber spars and re-enforcing allowed; No trailing edge control allowed (no camber changing or reflexing); Flaps or spoilers and ailerons allowed - either mechanical or electronic mixing; wingspan limited to 100"; Single airfoil only, stock Eppler 205 or similar; Root chord of 10" required, tip chord left up to builder's discretion; Maximum wing loading under 14 oz./sq.ft., fully ballasted.

"When I asked George if tasks or events themselves should be changed, he said no, and the following conditions should apply: Club winches allowed, and in a fixed position; Standard F3B rules apply; Standard winch line rules apply; Working time allowed, with one (1) re-launch permitted; Except for speed task, scoring could be man-on-man in flight groups of 4; Use some type of pilot classification, i.e. fledgling for beginners, sportsman for intermediates, and expert for top fliers. Class advancement depends on wins (usually 2), automatically places flier in next higher class.

"Just for fun, I weighed my nearly-finished QUASOAR F3B version with the following actuals: Span, 112"; Chord, 8-9/16"; Total area, 856 Sq. In.;Weight, approximately 67 oz.; Loading (empty), 11.3 oz./sq.ft.; Loading (ballasted with 2 lbs. lead in wings) 16.7 oz./sq.ft."

Super comments, guys, and I agree with some but not all. For example, history need not repeat itself; the "right" one-design CAN work. In the full-size 1-26 class it has worked, and in the Olympic Class full-size sailplane, it worked...and will again. Let's not rule out the idea too soon. I disagree about no trailing edge reflex, but could be persuaded differently. I am not sure the 100" wingspan limit is desirable, either. Yes to a single airfoil, but let's use the best and most modern there is...not an Eppler 205 necessarily. As to proposed rules and tasks, I don't have any real disagreement with these proposals. The final details can easily be resolved. The "F3B QUASOAR" could be a contender...let's have a look at ALL entries in the RCSD Challenge. Now, on to more letters. Here's what Bob Sealy had to say: "I thought you might be interested in our latest design, the PULSAR. It is available, factory-direct for $129. A photograph is also enclosed."

Bob, I've been waiting for your input. Maybe the PULSAR (or the LASER???) could be a contender for the RCSD Challenge? Think about it!

The PULSAR is a Standard-class version of the ULTIMA, and it allows the choice of a flat wing with ailerons or a polyhedral wing; it allows choice of spoilers or flaps. Spec's are: Span 99"; Area, 870 sq. in.; Airfoil, Selig 3021; Hand-layed epoxy fiberglass fuselage 51" long; Dry weight, 54 oz.; Wing loading, 8.9 oz./sq.ft.; optional ailerons and flaps. The wing is two-piece, plug-in type with foam core and balsa sheeting. The PULSAR has a removable nose cone. How about this as a basic contender, folks, with builder-allowable changes like glass wing skins, etc.? The LASER is a stretched version of the PULSAR featuring a 124" wingspan, an area of 1110 Sq. In., a flying weight of 62 oz., and a loading of 8 oz./sq.ft. Would this be better, or something in-between? Think about it.

Mark Triebes writes: "Just a note to let you know how my "Challenger" is coming along. The first prototype is up and flying...built as a pure Thermal Duration ship to test the design capabilities as well as my new 'fliperon' control system. The wing is a three-piece design with the outer panels pivoting to control roll and spoiler/flap action. Span: 100"; Weight: 40 oz.; Loading: 7.2 oz./sq.ft.; Area: 800 sq. in.; Airfoil: Selig 4061; Built-up fuselage with carbon-fiber reinforcement; foam core wing with balsa sheeting; carbon-fiber spars and wing rods. In dead air with no ballast it will float with the best, but with an increase in wind and ballast, its performance gets better...extremely clean design and penetrates well.

"I am just beginning work on the plug for the glass fuselage, and the necessary design alterations to bring it to F3B standards. The second prototype will have a standard control system (aileron, elevator, flaps, rudder) and a somewhat beefier wing. I'll get a couple of photos of the first prototype off to you in a week or so." **(We're waiting, Mark!...JHG)**

Bob Welwood has this to say: "...I see the benefit of such a class as twofold: an opportunity for the average guy to get a good taste of multi-tasking for a relatively modest investment, and out of these ranks will emerge the guys who are more serious and would likely move up to International-caliber F3B. In the meantime, there are sufficient numbers of people in the Sportsman Class to provide a reasonable quantity and quality of skill-building and challenging contests...more like Europe, I guess. I also agree that a standard airframe is a good way to help prevent the whole thing from getting out of hand **(Exactly the reason for a one-design, Bob...JHG)**, but good luck *...continued on page 4*

on picking that universally-acceptable design! I do agree with your criteria, though. Just think how well that one-design will come to be analyzed, tested, and refined with all that potential input and involvement!"

Great letter of encouragement, Bob. I foresee the accepted entry winner as having potential for going into World-Class competition: both pilot and sailplane!

♣ ♣ ♣ *On The Cover* ♣ ♣ ♣

Don Chancey has had so many good things to say, that it is hard for me to find room enough to fit them all into this issue, so I will touch on the major points here, and comment further in May.

"I hesitate to use the name 'Challenger' out of respect for Otto Heithecker's 'Challenger'. There are probably some still flying.

"My CONQUEST is a modified version of the BOUNTY HUNTER ... which came about from flying the (German) DOHLE for two years in A.M.A. Thermal Duration competition, in which it racked up a record of 25 first places, two second places, and a fourth place — out of 28 contests. The only problem was consistent precision landing. BOUNTY HUNTER was designed at a much lighter wing loading. Overall flight characteristics remained almost identical, except that landings were much, much easier.

"As designed, the B.H. uses a solid spruce spar that tapers in both directions toward the tip. The spar is inexpensive and easily fabricated, and when coupled with a layer of Carbon Fiber over it and the foam core before sheeting, is very, very strong. My favorite is a C/F joiner rod with a tapered C/F tubular spar. This set up is faster to build and lighter - but also more expensive. The current design (CONQUEST) uses a pod/boom type of fuselage that makes it extremely versatile for different sizes. I have both 100" and 2-meter versions, and two ships have been built at 108" span. All have flown extremely well, and all have performed just as I had hoped in every possible way. If this design were to be chosen, a prospective manufacturer could possibly mold the entire tailboom and fin assembly in one piece. It would be very appealing to a manufacturer because several kits all based around the single "design" could be sold: i.e., entry-level F3B, Standard Class A.M.A., and two-meter.

"The Bounty Hunter is a proven design, and perhaps close to 20 have been built in the last 3 - 4 years, and many are still flying. I have personally won the Texas State Champs in '87 and '88, and a B.H. was also second in the State Champs in '87.

"CONQUEST is a slightly modified version of the Bounty Hunter and a name that could be used for any and all versions of the design. A kit could be produced in a builder-type package for close to the $150 limit, using readily-available materials and standard techniques familiar to most builders. As a bonus, the same glider could be produced using the most up-to-date materials and techniques — and offered as a 'complete' package in an almost ready to fly configuration.

"My current B.H. weighs 59 oz., but flies best at 68 oz. At that weight, a more durable and dependable glider can be built.

"I would like to see a max. wing loading of 12 oz./sq.ft., and believe it would have a tremendous effect in several areas: keep the speeds down to where more pilots can operate without destroying as many gliders. With the limited winch power now available, the lower wing loading will help with the all-important launch. I think we will have to allow standard club winches...the idea being to attract as many fliers with as few hassles or requirements as possible; i.e., make it as easy as possible for a club to run a contest.

"It might be nice to run a Regional/National type contest somewhat like the NSS contests are run each year. I WOULD BE WILLING TO HELP SET IT UP AND COORDINATE IT. One idea might be to have as many regionals as clubs want to run in a given time period. The results would be sent in **(postal type contest...JHG)** and National winners for the new event/class awarded.

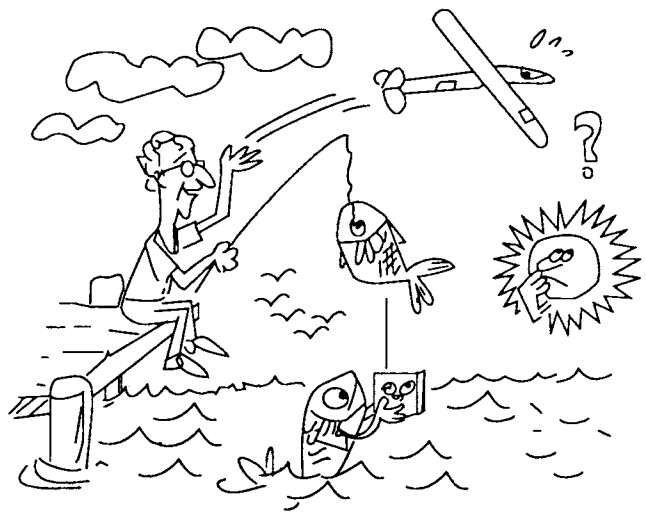
"To encourage Sportsman fliers, and create/build new interest, it ought to be set up so that if a pilot had placed in the top (to be decided) % of the F3B Team Trials in the last (to be decided) years, he should NOT be allowed to fly in this new event.

"Another possibility depending upon the interest generated would be to have series of monthly or bi-monthly or tri-monthly or ?-monthly contests run the same way as described above. At the end of the year all the results could be sent in and tabulated. If as many as five contests in a year's time were run, then a pilot could have his best 3 out of 5 results scored, allowing for improvement and the possibility of missing a contest or two. Remember, we are trying to build consistency and generate long-term interest.

"I will be available to keep a data base on the contest and/or fliers.

"I don't see anything wrong with existing F3B tasks except for the logistics of running them. Perhaps something could be worked out whereby a duration task could be run one month, and a speed/distance task the next. WE NEED TO COME UP WITH SOMETHING TO MAKE IT EASY FOR CLUBS TO RUN THESE CONTESTS, AND FOR FLIERS TO PARTICIPATE. We must use contest-supplied winches and equipment so as to be fair to everyone and not discourage people by telling them they must have a 'team' of 3-6 people to be competitive."

Don, we all welcome and appreciate your contributions to the sport, and -once again- I'd like to ask you to carry out your kind offer to set-up and co-ordinate the contests, as well as the data base. Your CONQUEST design has all the ingredients of a great entry into the RCSD Challenge, and I agree that the name Challenger ought to be left in the hands of Otto. So be it. I'm anxious to see other entries, and most anxious to see what the judges will choose.



FLYING FISH OR FISHING FLYER?

My good friend and occasional correspondent, Julio Fairlie Silva, of Lima, Peru (South America) is a retired newspaper cartoonist whose son is a soaring pilot as well as a purser on the Peruvian Airline. Julio, Sr., presents us with this fisherman's-eye view of RC soaring. Thanks, Julio.

On The Wing
...by B^2

We found the following quotation in the Minutes of the second meeting of TWITT (The Wing Is The Thing), published in TWITT Newsletter #2, July, 1986:

"Harald Buettner then demonstrated a mechanism, which he had designed and mocked-up, which he proposed as a replacement for conventional trailing edge control surfaces. The demonstrator was a short section of a fiber-reinforced-plastic wing in which the upper and lower skins were not bonded at the trailing edge. This left them free to flex and to slide against each other from the rear spar to the t.e., producing a smooth change in camber over that region. A torque tube anchored to the rear spar drives a belt bonded at its ends to the upper and lower skins to flex them under the pilot's control."

No doubt about it, our interest was piqued! Our letter to Harald Buettner requesting permission to share his idea with the modeling world received a quick and positive response, and we decided to build our own mock-up to determine if the system could be used with small chord, minimum thickness wings. The result of our exercise, although crude, demonstrated that such a system could be easily installed in a five inch chord Eppler 214 wing section! Control surface movement is not only effectively achieved, but the process is both beautiful and fascinating to watch.

The major considerations to be taken into account during construction are: (1) the control surface, when completed, will not be supported by the foam core, (2) flexibility, and hence control surface movement and freedom from distortion, is dependent on the weight of glass cloth used and the rigidity of the trailing edge, (3) the belts must make a complete revolution around the torque tube in each direction from their attachment point, the belts connecting the flexible surfaces to the torque tube must cross so that the lower rim of the torque tube is tied to the upper surface and the upper rim is tied to the lower surface, and belts must come off the torque tube at a 90° angle, (4) the trailing edge will be only as sharp as the combined thicknesses of the finished skins, and (5) insufficient care during construction will, of course, result in an airfoil and control surface which do not perform well, if at all.

Our method of constructing Harald's control system adds several steps and additional parts to the building of a foam core wing: the skins must be premolded to the shape of the airfoil surface as they are not supported by the foam core after the wing is complete; the torque tube, belts, and sufficient bearings (plywood with brass inserts) must be installed; the premolded skins must be attached to the foam core, a two stage procedure; and some sort of trailing edge strengthener must be incorporated, both to stiffen the trailing edge and to provide a hold down for the belts.

We highly recommend that you construct a working mock-up prior to attempting to incorporate the system in a flying model. Some of the construction is tricky (as we found out), and it's better to have negative experiences on a small scale.

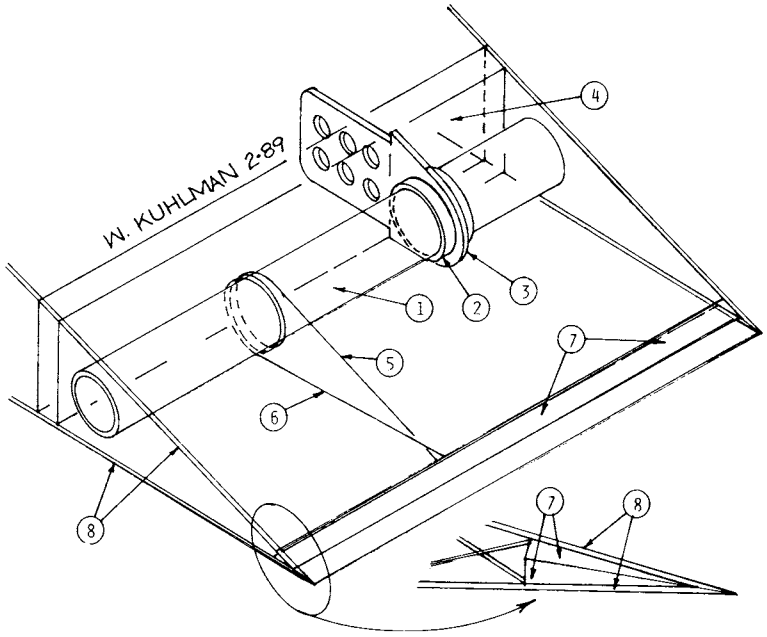
Experimentation, particularly with the weight of glass cloth used, will undoubtedly be necessary. We used a single layer of two ounce cloth for our five inch chord mock-up and found that we could have used a heavier weight cloth to benefit.

There are probably some improvements/adaptations that can be made to the basic system. On a tapered wing, for example, the torque tube's diameter can be changed along the length of the aileron; this would provide more or less control movement at various locations along the span of the aileron. With some experience and/or imagination and some mechanical ability it is possible to design the system to incorporate tapered and swept control surfaces, along with variation of movement across the span.

One item that sort of "bugged" us was the open ends of the control surface. A shallow plug of latex foam, the shape of the "neutral" section, would probably work well. Held in place with a very thin coating of bathtub sealer, this sort of plug should seal the end effectively and still retain a large amount of flexibility.

After considerable thought, we have come to the conclusion that the system probably cannot be retrofitted into an existing wing. The system relies upon a flexible skin of glass fiber and epoxy only; it will not work with a balsa substrate, Rohacell sandwich, etc. Aside from that, constructing a whole new wing would probably be easier than working out a retrofit.

Send a SASE for detailed step by step direction for the construction method we used. Included are several pages of instructions and sketches of various procedures used. We would be most grateful for any suggestions that RCSD readers may have in the way of streamlining the construction process.



1. *Torque Tube*
2. *Bearing for Torque Tube*
3. *Torque Tube and Bearing Mounting Bracket*
4. *Rear Spar/T.E. Cap*
5. *Belt to Lower Surface*
6. *Belt to Upper Surface*
7. *Plywood T.E. Strengthener and Belt Tie Down*
8. *Wing Skin of Fiberglass Cloth*

♣ ♣ ♣

Many thanks are due to Harald Buettner, not only for developing this control system, but for allowing us to share it with our fellow model builders. Harald can be reached at PRECOMTEC, P.O. Box 710635, Santee, CA 92072-0635.

TWITT'S newsletter, always filled with goodies, is available by subscription; contact TWITT (The Wing Is The Thing), P.O. Box 20430, El Cajon, CA 92021.

A big "thank you" is also due Jim, our supportive editor, who, upon receiving our mock-up in the mail immediately called us and expressed his enthusiasm and eagerness to print this article.

By
Bill & Bunny
Kuhlman
P.O. Box 975
Olalla, WA 98359
-0975

Electric Currents

Why an electric glider? Possibly because you've been wondering, "Should I try it?" You have to admit, it does present new challenges in soaring. You've got to admit it does have a lot of plusses, like not having to lay out lines and winches or being able to seek out higher lift or maybe try the exhilarating sport flying that F3E type flying gives you.

As a guest columnist for RCSD, writing about electric sailplanes/gliders I'm going to attempt to bring you, the soaring enthusiast, various aspects and information pertaining to electric gliders in soaring.

My background in electric soaring runs from installing a small leisure motor in an Olympic II some seven years ago to putting an Astro 60 Cobalt motor in the same Olympic II type "bird" and taking third in the 11th Astro Electric Championships Open Sailplane contest in 1985.

My interest in electrics led me to F3E type of flying which I found to be exhilarating and very challenging in the flying of these type of sailplanes and the satisfaction of pushing into the realm of experimentation.

Felix Vivas
1800 16th Street
H-310
Newport Beach, CA
92663
(714) 645 -3263

In the field of F3E FAI flying, I was the U.S. F3E team manager at the first World Championships held in Lommel, Belgium in August of 1986. At the recent Second World Championship in St. Louis (Cahokia, Illinois) I was a member of our U.S. team.

I will need and appreciate your inputs and questions, so feel free to write me or call to ask questions, information, or any help.

Southwest Regionals Sailplane Event 1989

The Southwest Regionals contest for 1989 featured a sailplane contest for the first time in several years. The Central Arizona Soaring League was asked, and agreed to host the event on behalf of the SW Regionals committee. The events chosen this year were a straight forward precision duration event with a graduated circle type landing, and for the second day a cumulative duration event (3 for 15 add 'em up) using the same landing option as the first event. Saturday, February 4th, dawned cool and clear. The morning competition began on schedule at 8:30 a.m. with the first of four 7 minute precision rounds. The task was quite a challenge in the early morning air and high scores were the exception. The scoring was handled by Mike Nikisher who not only wrote the program but also ran the computer. His software package should be of great use in the future and may even be marketable to other clubs. All you need is the hardware to run it on, a printer and a reliable generator for power. The contest ran smoothly for four rounds until the C.D. elected to take a lunch break of 1 hour. During this time the wind approached 20 MPH, but the decision to call the contest was brought about by the dust clouds which made visibility a real problem. Sunday was expected to be a carbon copy of Saturday. Four less flew on Sunday than Saturday. The event was run under difficult conditions of high and shifting winds, with the winches being moved about 150 degrees clockwise into the wind for the last round. Trophies were awarded to fifth place on both days and each registered contestant and each helper received a handsome enamel pin specially designed for the event. The host club did an excellent job of getting the logistics of the contest organized and, as the event C.D., I wish to thank them all for their efforts.

from the Central Arizona Soaring League Newsletter (CASL)

"Results" shown on bottom of page 15

Thoughts On Slope Racing ...by Mike Reed

Mike Reed
1775 Dumitru Way, #B
Corona, CA 91720

In slope racing, we demand more from our models than we do from any other form of soaring. Slope gliders have to be "clean" to retain aerodynamic efficiency; that is, the lift-to-drag ratio should be as high as possible. Structurally, slopers have to withstand high-"G" maneuvers, an occasional mid-air glance with another aircraft, and landing on unforgiving, rock-infested terrain.

It is not difficult to design a sailplane that is fast in straight-and-level flight, but slope racers must execute 180-degree turns at each end of the course.

For slope-racers, few design factors are as important as airfoil selection. If a 15%-thick, high-camber airfoil is used, for example, the sailplane will have too much lift and several ounces (pounds) of ballast will be needed to trim the sailplane for racing. Such an airfoil will be great when performing turns, but in the long, straight section of the course it will be too slow for real competition.

On the other hand, modelers who use too thin an airfoil on their sailplanes often drop out of competition for just the opposite reasons. For instance, a model with a 6%-thick airfoil and less camber will surely pass the 15%-thick, high-lift machine on the straights, even at identical wing loadings, but in a tight turn the 6%-thick airfoil model will have to use a higher angle of attack than the 15%-thick airfoil model to keep the turn tight and true. This causes more drag as the airflow separation moves forward toward the center of lift (high-speed stall). Frequently, a highly-loaded model with a thin, low-camber airfoil "mushes out" in a turn and sometimes "tip stalls"...usually spelling the end of the race for the pilot and his sailplane.

When a slope glider goes into a banked turn, the wing must generate more lift to counteract inertia. A bank of 60 degrees requires the wing to produce twice the effective lift,(two "G"s) and at a bank angle of 85 degrees, the model will experience approximately 9 "G"s load on its structure. In a turn, the angle of attack on a model with too thin an airfoil will be very high, thereby producing a large amount of drag, just to keep it in the turn. A sailplane with a thicker airfoil having greater camber will require a lower angle of attack to perform the same turn, and will suffer less drag and reduction of speed. When selecting an airfoil for your slope glider, keep this in mind.

Another factor in choosing an airfoil for slope racing is the TYPE of lift available at the slope where you fly. A sailplane designed to fly well at one slope may be a "dog" at another, and when a single sailplane is to be used for many different slopes, a happy medium between high lift and high speed will have to be maintained. If a 'plane is suited for only one slope, then its design can be optimized for lift conditions at that slope...meaning wind velocity and amount of lift produced.

A good place to start your design would be to select an airfoil of about 10% thickness for a 2-meter span (my favorite). Semi-symmetrical airfoils in this range (especially the laminar-flow profiles) can be loaded to about 13 oz./sq.ft. and still turn in a respectable radius.

The Thermal Navigator Undressed

...by Edward Granger

Ed Granger has been a friend and fellow glider pilot since the early '70's. He's a research physicist for Eastman Kodak in Rochester, NY, and flies with the Clarence Soaring Society as well as the Rochester Soaring Club.

♣ ♣ ♣

The Thermal Navigator offers a good solution to the thermal sensors that employ a crowded radio spectrum. My limited experience with the cross country event pointed out just how crowded the air ways can get when you have only 7 to 8 teams trying to climb out at the base. We found that we could not listen to our system until well separated from others on the same frequency.

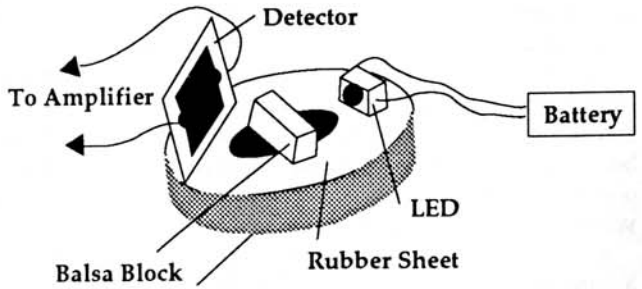
I have tested the Thermal Navigator and have found it to be reliable and responsive. In a demonstration at my club meeting, a small vertical motion over just a few inches at a rate of about one half foot per second gave nearly the full right turn thermal indication. Lowering the model the same amount placed the rudder in a slight left turn. The response in the field is just as impressive.

The Thermal Navigator comes in a small box about the size of 6 channel receiver. The small size allows the system to be placed even in small two meter ships with a little planning.

The heart of this device is in an even smaller box inside the Thermal Navigator. I undressed the Thermal Navigator by removing the black light tight cover on the box. The contents of the small box are shown on the drawing that I have included. This is one very nice piece of micro miniaturization. The main working part of the Thermal Navigator is a small balsa stick glued to a rubber membrane. The rubber sheet has been glued on top of a metal washer that has been sealed on the bottom. The seal also glues the washer to the bottom of the little box. The action of this system is simple. As the plane rises, the air pressure drops a small amount and the rubber membrane bulges thereby raising the small balsa block. Simple so far HEH!

The drawing shows the other simple and clever part of this little box. On one side of the washer is a small LED which illuminates a detector (CD Sulfide, I think). The thickness of the small balsa stick has been chosen to allow only about half of the energy from the LED to fall on the detector.

As the air pressure changes, the amount of light passing by the balsa stick changes. As the model rises, the air pressure falls, the rubber membrane bulges and moves the stick higher. This reduces the amount of light reaching the detector. The greater the height, the more the signal will be reduced. A falling model will see increasing air pressure and resulting increase in the signal as the balsa stick allows more light to fall on the detector.



Metal Washer with Bottom Sealed

The final wonder of this device occurs in the electronics connected to the detector. The signal from the detector is amplified and is capacitively coupled to the decoding electronics. The size of

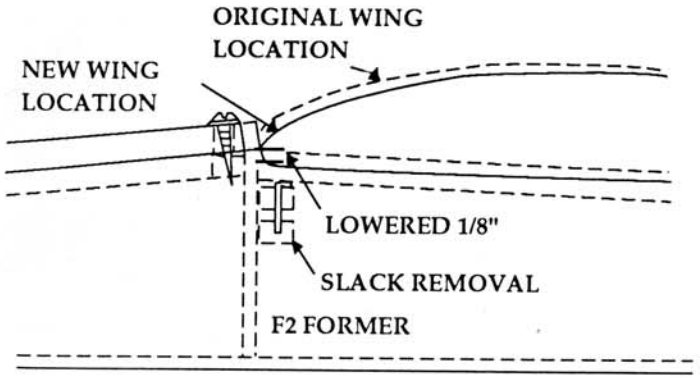
...continued on page 14

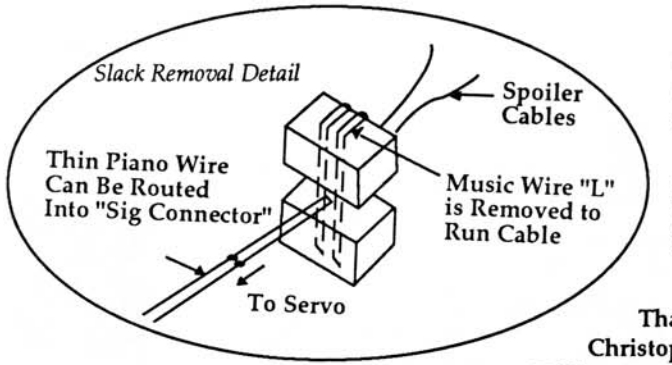
Wing Tips

...by Christopher D. English

Chris has sent in a couple of interesting items, and this will be his first. I'll run the next one next month.

♣ ♣ ♣





The OLYMPIC II seems to have a flaw built into the kit. Everyone I have spoken to said that the plane drags (its) tail and requires a c.g. well forward of the recommended location. I eliminated this problem by lowering the leading edge of the wing 1/8" by sanding the fuselage wing rest. It flies like a dream now, and I caught a light thermal for a four-minute flight on my first test.

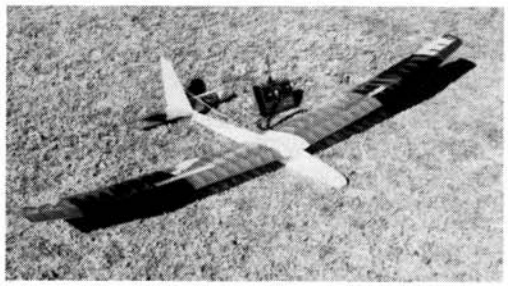
I've also enclosed a diagram for eliminating "slack" problems in a spoiler installation.

♣ ♣ ♣

Thanks for the information, Christopher. I'm sure a lot of OLY II fliers out there will be happy to hear about this "fix" of yours, and will use it to their own advantage. By the way, your OLY is a beauty (see photo). I wish our readers could see the yellow center section, red polyhedral and blue tips...all done in transparent film. The fuselage is white. JHG

News Flash!!!

ACE R/C of Higginsville, MO has purchased Off The Ground Models from Paul Carlson, and thereby acquired the PRODIGY, QUASOAR et al, which will be re-released by ACE. For the time table of availability, write Steve Kaluf, Sales Manager. P.S.: Watch for their new micro-processor-based transmitter about to be released, and compatible with all the present ACE receivers and servos.



The Aussie Odysey

G'Day Mate!

A belated Happy New Year to you! I hope Santa was good to you under the Christmas tree.

Australia was great!! I'm planning on going back ASAP.

The weather, people, scenery and "atmosphere" were great and wonderful. I recommend wholeheartedly to anyone thinking about going, to GO!

Their Nationals took place the first week of January and were held at RAAF Amberly, just outside of Brisbane; the home, incidentally, of two F-111 squadrons. I flew in Thermal Glider, 7-cell electric and the FF Night Scrambler.

Thermal Glider was a one-class event with 42 pilots entered. I took my PRODIGY and a new, as yet unflown, 2.5-meter SCOOTER. We flew six rounds, each round consisting of seven slots. Each slot was man-on-man with a target 8-minute flight within an 11-minute working time. Landings were 100 points on center with five points deducted for every meter away from center.

On the first day of flying I won one of my slots, but the lift was fluky for such a beaut day. The second day was windier, so I opted to use the SCOOTER as it was rigged for ballast. A timing error cost me one slot, but I took the last slot going away. I finished 13th — but so what, it was fun!

In the 7-cell contest I finished fourth with a cobalt 035 gear-drive O/D. The guys I went to see were the ones in front of me! Oh well, it's their turf.

I saw Bruce Abell at the field and he said G'Day to you. He gave me a "fiver" to buy you a "tinnie" or two. He's quite a guy.

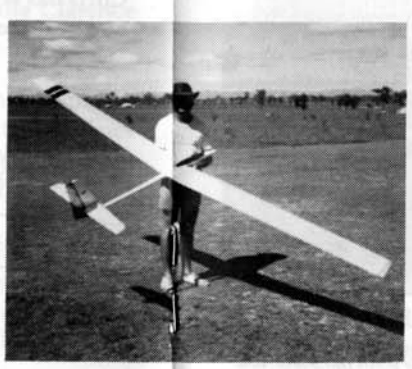
From the Nat's I went with Peter Pine to Ballina Down on the coast, then up to Armidale where Peter and his family live. Peter is owner of Moore Model Supplies and is/was on the '86 and '88 F3E team. His club is the host club for the annual Armidale Expo: a glider and electric contest held late in January each year.

From Armidale, Peter and Anne to me over to Tamworth to catch up with Wayne Hadkins and his family on the way back to Sydney. We stopped in Scone and saw the Cole Pay collection which consists of a Spit Mark VIII, CAAC CA-15 (Aussie-built P-51), Tiger Moth, and T-6...all of which are flying. He is presently restoring a P-40 and a Nakajima Ki-43 "Oscar"— extremely rare and planned for future exhibition. I've got a couple of slides of me sitting in the Spitfire - needless to say I've got a large grin on my face!

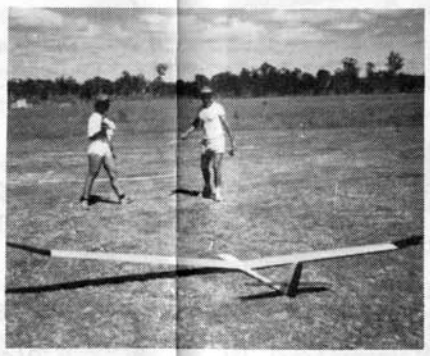
Wayne Hadkins was on the '86 F3E team when we met in Belgium. It turns out he is VERY good friends with Peter Abell (Bruce's son...JHG). Once back in Sydney, Peter and Nerida came over for tea. Wonderful couple; and to hear the stories about the '87 World Championships!

We all went up to the Blue Mountains to do some slope soaring, but guess what? No breeze! Peter is a botanist at the Royal Botanical Gardens in Sydney, so we turned the trip into a nature hike and new slope site search.

Photos by Mark Nankivil



Peter Goldsmith showing off his one-design: Balsa/Glass on foam, E205, 4.2 METERS! 1500 sq. in. @ 10 oz./sq. ft.! Ralph Learmont APOLLO glass fuselage.. "Digger" hat keeps hot Aussie sun out of eyes -- in January, believe it or not!



NICE TRY, BUT NOT CLOSE ENOUGH TO COUNT...Sleek Unlimited Class ship just misses the landing spot. Look at those clouds and those shorts...both indispensable in the hot Aussie weather.

On the Right: F3B machines of Vels and Stewart. Far ship has a John Herrin airfoil, and near ship uses an E-374. Three-meter span, fixed stab..."Tailplane" to "Aussie" pilots.

Quite interesting and a real blast! We did fly a bit at sundown, but the lift just wasn't there.

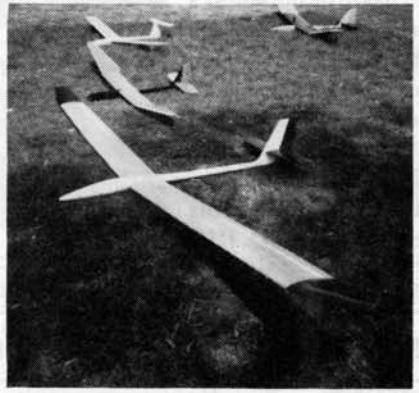
The rest of my time in Sydney was super, and included a 2-1/2-hour helicopter ride over the Sydney Harbor and a ride in the Skyship 600 blimp. Nice to know the right people!

Enjoy the decals and patches, and keep the photos. I'm heading down to Scottsdale in April or May to see my father, and I see on the map that Payson isn't too far away (75 miles...JHG), so I'll give you a warning and come up and see you! My dad's a co-pilot on DC-10's for United and has a Christen EAGLE. For his next project he's ordered a Lancair 320.

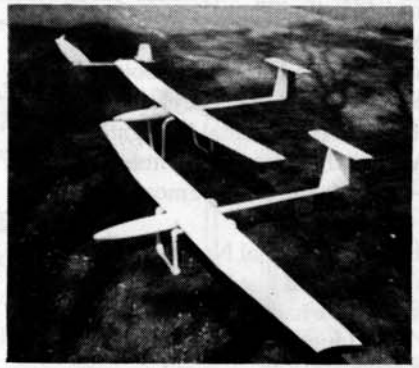
With a little luck I'll bring along my entry-level F3B to enter your Challenge. Take care, keep smiling, and make them wonder why! Hooroo Cobber! Good Health and Good lift.

(signed) Mark Nankivil, 1815 South Newstead, 1 South, Saint Louis, MO 63110.

Response: Mark, that is a fabulous letter, and I won't take the time to talk; I'll just print some of the photos with suitable captions. Thanks! JHG



Steve Weissner's "MERRY" -- another "Big 'UN" at 14 feet and 1500 squares. Modified Eppler 205 and a "cusped" trailing edge...the way an E205 should be built. Balsa over foam, extended tips and Learmont "APOLLO" fuse. All these machines compare with the best anywhere in the world. "Hooroo, Cobbers."



Mark Nankivil didn't pose much, but he flew a lot. Mark had so much fun flying in Australis, he wants to go back as soon as possible...and he recommends it to anyone from the U.S. who can possibly go.

What RCSD Readers Are Building & Flying

Builder Extraordinaire

Dear James,

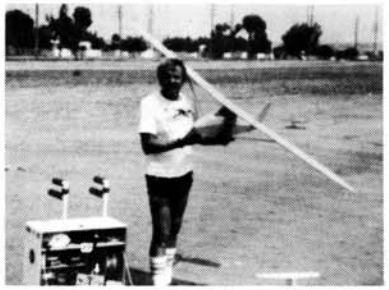
I started competition flying last March, and I think I'm doing okay. Since then, I made six gliders: a 2X2, OLYMPIC II, BOB CAT, SAGITTA 900, a scale-like GRUNAU BABY, and the MINI-NIMBUS.

This year will be very busy for me. I will give F3B a try and will keep going with local contests. I'll keep you posted.

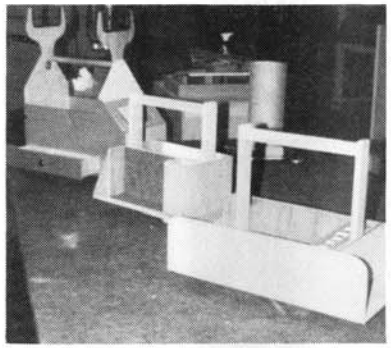
Field boxes are also in my future projects. They are selling very well in the L.A. area, and I'm planning on going bigger. Please send some info. about advertising in RC Soaring Digest.

Well, it's time to go. My SAGITTA, the one with flaps, is calling me from the closet. Yes, I build all my gliders in the closet, thanks to Betty...

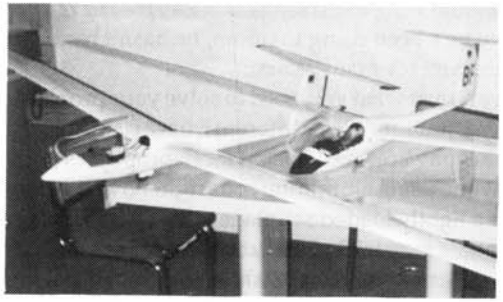
Best Regards, (signed) Hugo Sandroni, 302 Miraleste Dr., #12, San Pedro, CA 90732



Hugo Sandroni poses with his scale-like "GRUNAU BABY II"...and it flies beautifully, too.



Response: Readers, Hugo just has to be the world's most prolific builder of gliders! Most of them (see pix) take him 3 to 5 weeks each to finish, ready to fly! His scale models have complete cockpits...and look like the full-size machines, only smaller! I think his field boxes will be a great success with our readers, and if they are built like his models, you just have to have at least one! We featured his MINI-NIMBUS in the September '88 RCSD. JHG

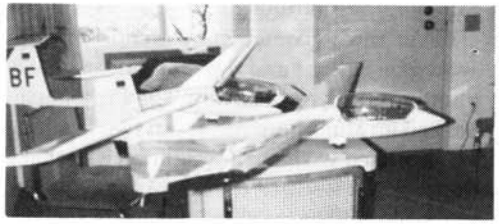


A PAIR OF BEAUTIES: MINI-NIMBUS SCALE MODELS with completely detailed cockpits. One has a working (!) AM-FM radio installed.

WHO'S that masked man? Shades keep the hot California sun out of Senor Sandroni's eyes. HOB 2X2

On the Left: Hugo's Field Boxes. He makes several different sizes: FOR SALE! (See letter in this issue.)

On the Right: IN CLOSE FORMATION -- A pair of MINI-NIMBI (?)...in close formation. Hugo says they took a L-O-O-N-G time to build -- quite unlike his 3-week specials!



The Thermal Navigator..continued from page 10

the capacitor has been chosen to, first, limit the response time of the Thermal Navigator (slow as you go and no jerks) and, second, simulates the air leak that is found in the large bottles that are used in those OTHER thermal sniffers. The electronics also offers a control input to turn the Thermal Navigator off on launch. I use the GEAR switch on my transmitter for a positive Navigator on/off—much better than the moveable AUX lever.

Adjustments are available on the Thermal Navigator for sensitivity. I found that this one worked just fine out of the mailing carton. As you can see, I have had a good time with the Thermal Navigator and have found it to be easy to use and a sensitive indicator of "green air".

Edward Granger

Classified Advertising

For Sale:

Two Olympic 99 sailplanes (stock) for 3 Channel Radio.....$175 complete, covered, ready to fly, less radios;

Two Olympic 99 Sailplanes (stretched to 120" span).....$225 complete, covered, ready to fly, less radios.

Elliott Boulous

The Institute of Silent Flight

P.O. Box 430, Morgantown, PA

Tel.: (215) 286-5129.

Results

Southwest Regionals

Saturday 7-Minute Precision

1.	ASHLEY OSBORNE	1884
2.	JOHN MANGINO	1694
3.	HENRY WURZBURG	1601
4.	KENNY KEAR	1577
5.	DON SCEGIEL	1549

Sunday Cumulative Duration

1.	GEORGE HOFFER	900
2.	ASHLEY OSBORNE	894
3.	HENRY WURZBURG	866
4.	VERN POEHLS	848
5.	J.J. MANGINO	749

Titanium

A new product of the market is the titanium wing rod. I know that Ray Juschkus has been using these rods. Ray tells me that since he's been using titanium, he hasn't bent a single rod, a malady which previously plagued him for many years.

Lets look into why a titanium rod may be just what you need to solve your problem, too. In order to get some perspective into why a titanium rod is different from a steel rod (or even an aluminum rod), let's talk about the physical and mechanical properties of these materials. Although I don't know of anyone using aluminum rods right now, it strikes me that this material might be just right for a lightly loaded sailplane which isn't winch or hi-start launched. Hand launched and electric powered planes come to mind.

There are three properties that are pertinent to our needs: the strength, the weight and the modulus of elasticity. The first two are self explanatory and the modulus of elasticity is the property that relates to a material's springiness, or stiffness. The density (weight/unit volume) and moduli of elasticity are essentially independent of the strength of all of the materials, so here's that stuff:

	Aluminum	Titanium	Steel
Density (lb./cubic inch)	0.10	0.16	0.29
Modulus (lb./square inch - millions)	10	16	30

The modulus has the same units as strength (lb./square inch - hereafter psi) and a typical number, the modulus for steel, is 30 million psi.

Given three geometrically identical rods, but of different materials, the aluminum one would be lightest and the titanium and steel would weigh about two and three times the aluminum rod, respectively. The variation in moduli can be visualized as follows: Suppose we had an aluminum rod about two feet long which is supported off the edge of our work bench. Then we hang a weight on it so that the end deflects about three inches. Since the titanium rod is stiffer, the same rod, made of titanium would deflect only 10/16th (the ratio of the moduli) as much as the aluminum, or about two inches. The steel rod, being about three times as stiff as the aluminum, would deflect only about one inch.

That's the background on stiffness, and the pertinent thing for Ray is that the titanium rod is about twice as flexible, or limber, as the steel rod. If we had a sailplane on the winch, the wing tips would deflect considerably more with a titanium rod, than with a steel rod. The result is the same as waving a flag, since your wings will deflect more than you may be used to and you will back off on the winch. You can see two benefits here, a signal when you might be over-stressing your wing and, of course, saving about half the weight of the rod over a steel rod.

However, that's not quite all of the story. It would seem that you could do it even better if you used aluminum. Unfortunately, the aluminum has a much lower yield strength than either the titanium or the steel. For our purposes, the yield strength of a material is that stress level at which a rod would remain permanently bent. In other words, you can stress a rod, of any material, to slightly less than it's yield strength as often as you like and it will return to its original, straight shape. However, once you exceed the yield strength, even once, the rod will remain bent. If you straighten the rod, then you can start all over, again.

The highest strength aluminum rod that you can obtain will have a yield strength of about 65,000 psi. My sources say that this material (titanium) is typically about 150,000 psi yield strength, or about 2.3 times stronger than aluminum. I had four steel rods hardness

Wing Rods
...by Paul Bell

tested to give the following results:

Sagitta 900 rod	165,000 psi yield
Sagitta 600 rod	170,000
Aquila rod	185,000
Goughnour rod for Sagitta 900	195,000

You can see that all of these (real data) exhibit yield stresses greater than the titanium. Therefore, if you want all out gut strength, without bending, the steel rod is still the best bet. But, for about a 20% loss of yield strength, you can get double the warning of an impending bent rod.

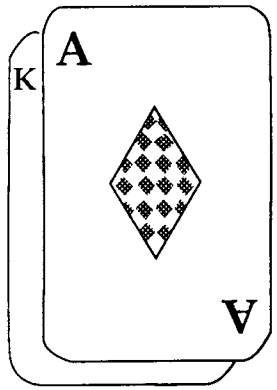
For you technical guys: the bending stiffness of a rod is proportional to its diameter raised to the fourth power:

stiffness = 0.049 X diameter^4 (moment of inertia)

and the bending strength is inversely proportional to the diameter cubed:

$$\text{stress} = \frac{\text{moment X } 10.2}{\text{diameter } ^{\wedge} \ 3}$$

from Millstone (NJ) Valley Silent Flyers



Lo-Tech Stuff
...by Brian Chan

Playing Card Tricks

1. Great for use as mixing pad for 5-15 minute epoxy. The cards are stiff enough, and disposable.

2. Use it as a spreader to spread epoxy, white glue...

3. Use it as a squeegee to push the water out from under the water-transfer decal. Actually, the older one works better because of the softer edges.

4. Use it as the cutting pad on top of building plans. When you cut balsa on top of the plan it will not be all cut up into pieces.

5. Use it to cut out a template. It is stiff enough to stay in the right shape. Use it to cut the template for setting the dihedral angle on the root rib.

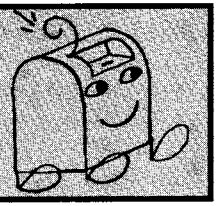
6. Cut it up into small triangle pieces. Use them as gussets for small wing ribs, open framed fuselage.

7. Use it as a heat shield when soldering pushrod over wing. Lay card between wing surface and pushrod.

8. When you are done with building project, use it to recover some of the costs (make sure you still have 52 cards or use a new stack)! Maybe!

Thanks to the SBSS SILENT FLYER newsletter, John Dvorak, editor, by way of the Modesto R/C Club THERMAL TOPICS newsletter. This good stuff gets around, doesn't it?

THE GRAY AREA



Dear Mr. Gray:

You have mentioned several times in the last year an interest in adding some electro-flight material to RC Soaring Digest. The big question is: what part of electric? Just electric-launched sailplanes (F3E and tamer versions thereof) or electric pattern and pylon racers, too?

Most electric fliers seem to cover the spectrum, being more fascinated with the propulsion system than in its application to a single type of RC aircraft.

The electro-flight community in general could use a good "mouth piece" for transfer of ideas and general information, but a stand-alone publication probably wouldn't have the necessary support for a publication such as RCSD.

If you want to take on this area, you might try approaching some of the more common names in electro-flight to see if they'd like to put together a periodic (quarterly, tri-annually, bi-annually, etc.) article of the subject. Woody Blanchard and Bob Sliff come to mind, but there are others, too. I am all for it!

If you're interested, I put together some data comparing geared vs. direct-drive props for "05" (7-cell) electrics a few years back. Thrust vs. power consumed leaned very much to gear drives with props from certain manufacturers. The effect of Reynolds Number on props was very evident, as was the efficiency of a couple of kinds of props. The bench numbers of thrust (measured by a strain-gauge equipped bending beam) and current and RPM seemed to translate well to real flight. I should still be able to find the data and make it into an article if you could use it.

(signed) Norm Anderson, 10024 Century Drive, Ellicott City, MD 21043; Ph. (301) 750-1880

Response: Norm, I appreciate your comments and information. You will be happy to know that Felix Vivas has agreed to do an electric column for RCSD. I'd like to call it "Electric Currents". It won't be an every-month sort of thing, but will be an irregular feature, based on Felix' time and travel schedule. He has done several electric-flight contest articles for Model Builder, Model Aviation and others. Welcome aboard, Felix!

Regarding your offer to supply information, please do! It will be immensely helpful to RCSD readers. Thanks for your YEA vote for electric soaring. JHG

♣ ♣ ♣

Dear Jim,

Sorry for not writing regularly, but I've been busy retiring from the Air Force, redecorating, and generally getting used to Civilian Life.

I did make a video of all the B.A.R.C.S. (British Association of R/C Soarers) I attended in '88, and will send you a copy so you can see your old friends. It was shown at our Annual General Meeting in December, and again at the B.A.R.C.S. stand at the Annual Model Engineering Exhibit in January.

I "borrowed" some music, so it is basicly for private viewing (sound turned off at the Engineering Exhibition). Anyway, (I'll have it) hopefully in the mail soon.

(signed) Jack A. Sile, Box 2069, APO, NY 09755-5366

Response: Senior Master Sergeant Jack Sile and his wife have been stationed in England with the US Air Force for several years, and plan to retire and live there. Jack has been actively representing the U.S. by flying in British contests, and has become well known and well liked over there. Our good friend and sometime correspondent/contributor Tony Beckett has mentioned meeting Jack and flying with (against) him on several occasions. I'll be looking forward to seeing the video he has made. Sure wish I had a way of sharing it with readers. His address, for anyone who would care to write, is shown above. JHG

♣ ♣ ♣

Recently, I wrote to Flight Line Systems, and — in return — received an extremely interesting letter. This all came about because I have one of his sport winches (on loan to the Central Arizona Soaring League). Users have mentioned two occasional problems: backlash in the line, and retriever problems. Russ Keith, Mr. FLS himself, answered as follows:

Dear Jim,

I have been working on an electro-magnetic brake that can be added to winches already in the field...or retrofitted to winches sent back to me.

The winch operator can stop the spool by releasing the motor switch and depressing the brake switch, thereby activating a solenoid which pulls the brake pad against the outside end disk of the spool. The winch is stopped or slowed down regardless of rotational direction. The price for the complete brake kit is $55.00.

As to the tow line not working well with a retriever, the solution is to change the tow line to a braided variety. I offer #18 braided line on my FL202 model, or it can be purchased separately: $35 for 2,000 feet (Twisted nylon line is $20 for 2,000 feet.). In the future, I plan to offer winches with or without the brake, and with a choice of twisted or braided tow line. All winches sold without a brake will be pre-drilled to facilitate adding a brake later on.

I have done some work on a retriever with limited success, and plan to do more in this area.

Good Flying, (signed) Russ

Response: Russ, our readers will be delighted to hear about the new brake, and about your products. Although you are an advertiser, I am pleased to include some information here about your products and prices: FL101 w/twisted nylon line: $225; FL202 w/braided nylon line: $240; 14" hexagon nylon parachute (orange): $12; turn-a-round: $25. Note: winch requires $10 additional shipping and handling. Electro-magnetic brake: $55; FL101B w/brake: $280; FL202B w/brake: $295. Add $2.50 for COD. See ad this issue. JHG

♣ ♣ ♣

Two issues ago, RCSD presented Mike Reed's SLOPAR sailplane, and Mike has written to express some of his views.

Dear Jim,

...Thank you for printing the info. (on SLOPAR) in your magazine. I am looking forward to your next SCALE issue!

I'm also glad to see the return of "HI START", and along with all the other great info. in RCSD, I like the Gray Area, too!

A thought about electric sailplanes...I DON'T THINK they have a place in RCSD, even though they are sailplanes most of the time. They still have propellers. This might start a snowball effect, and we'll start seeing power-assisted slope gliders and Lord knows what. Keep RCSD 'pure'.

Thanks again, (signed) Mike Reed, 1775 Dumitru Way, #B, Corona, CA 91720

Response: Okay, Mike, I appreciate your input and thank you for it. Don't worry about our readers being "poisoned" by electric info. If they are already interested, they will like it — and if not, the presence (or absence) of a column on electric flight won't make much difference. We are going to need electric launches in the future, and if we want to put droppable "power pods"

...continued on page 20

on our ships instead of building in an electric motor, then that's okay, too. I used to be a "purist" myself, but after trying electric launching (and retrieve) I am getting more and more used to the idea. You needn't worry about a snowball effect, either, as it just won't happen because of articles in RCSD. If it is going to happen, it will anyway, with or without us! Thanks again for writing. JHG

♣ ♣ ♣

Dick Hallett (February letters) has a few more pointers for anyone who would like to "extend" their OLY II to the Unlimited Class size.

Dear Jim,

Build a 36" center section using the center W1A pattern and totally sheet it top and bottom. Use the identical joiner structure in the two ends as used in the original, putting in the maximum polyhedral at each end that the spar spacing will allow. Fill the space at the tubes with epoxy and web carefully the whole length of the spars.

Rather than use alignment pins I use a thin square of aluminum (1 1/2") bent into a triangle. In preparation for a first flight I always wrap the joint with 2" medical cloth tape. I then split the tape at the joint with a razor and leave the tape on to protect the wing. At the field, I place a triangle to clasp the trailing edge joint and then wrap the joint with the same tape but stripped to half width.

This is a small project compared to a new set of wings. Launches can be harder and higher. The higher aspect ratio allows a normal faster speed for penetration.

(signed) Dick Hallett, 65 Somerset Avenue, Pittsfield, ME 04967

Classified Advertising *For Sale:*

1: El Primo Grande, 100" span, Buzz Waltz design; Cost $65....sale $35
2. Conquistador, 118" span, Buzz Waltz design; Cost $80...sale $45
3. 400 Variant, 162" span, Bauer Modelle (Germany); Cost $475...Sale:$275
4. 300 Variant, 124" span, Bauer Modelle (Germany); Cost $350...Sale $175
5. 290 Variant (wings only) 116" span, Bauer Modelle (Germany) will fit the 300 or 400 Variant above; Cost $135...Sale $50
6. LS-6 Scale, 118" span, Graupner (Germany); Cost $335...Sale $225
7. Alpina, 13-foot span, Multiplex (Germany); Cost $380...Sale $250
8. Adante, 100" span, Airtronics (USA); Cost $125...Sale $75
9. White, braided winch line, 190-pound test, 900-foot roll: $9.50 each
10. New 12-volt winch with ratchet stop on machined aluminum drum, complete with line, looks good & works well: $225
11. New, beautifully-machined winch drum with stop ratchet installed; fits Ford long-shaft starter motor; Cost $135...Sale $75
12. Multiplex (Germany) double spoilers #2642; Cost $42...Sale $25
13. Multiplex (Germany) single spoilers #2641; Cost $30...Sale $15

I will package above items free of charge, customer to pay approximate cost of shipping via UPS.

Inquiries to 1-801-364-7761,
David Hansen,
1133 Richards Street,
Salt Lake City, Utah 84101.