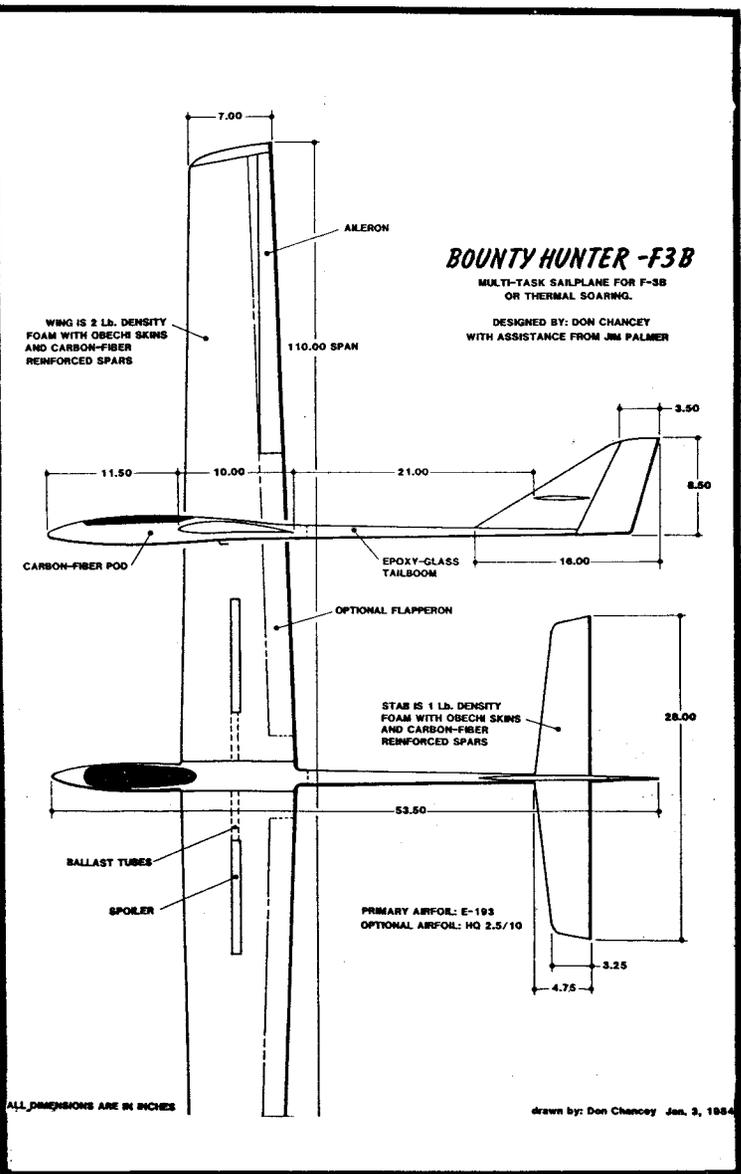


# Soaring RC Digest

VOL. 1 NO. 8

AUGUST 1984



## FLYSWAPPER

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\$10	\$9	\$8	\$7	\$6	1/8
\$20	\$18	\$16	\$14	\$12	1/4
\$40	\$36	\$32	\$28	\$24	1/2
\$80	\$72	\$64	\$56	\$48	1

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POSTMASTER: ADDRESS CORRECTION REQUESTED

## HI START

Although most of us are 'Sunday Fliers' (thanks to Ken Willard for this nice term) there is an undeniable attraction to exciting sailplanes and activities...and F3b is where the excitement lies for many soaring pilots around the world. As you read this, the finals will be less than a month away - in California - where the U.S. FAI F3b Team for 1985 will be selected. The team of three pilots will go to Australia in April next year to prove their mettle against the best the world has to offer - and, once again, the fever runs high.

Therefore, it's not inappropriate this month to feature still another F3b design on our cover. This one is by Don Chancey, and is called BOUNTY HUNTER.

Randy Kent and Johnson Knowles of Dallas and Garland, Texas, respectively, sent me the info about this new sailplane - which I am pleased to be able to present to you this month. Actually, it is a multi-task sailplane which Don designed to get into F3b competition. A few pre-production kits were made, consisting of fuselages and wing cores...with each builder to finish his own ship as he desired.

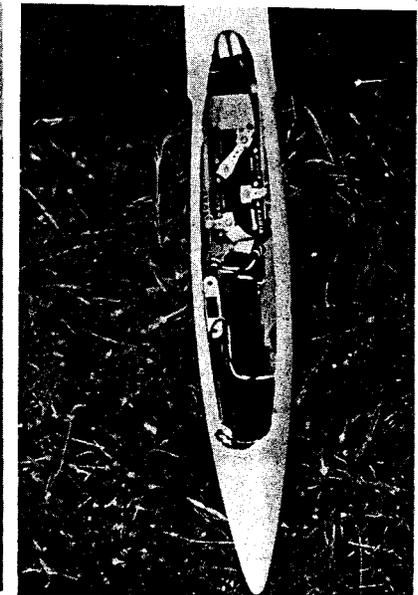
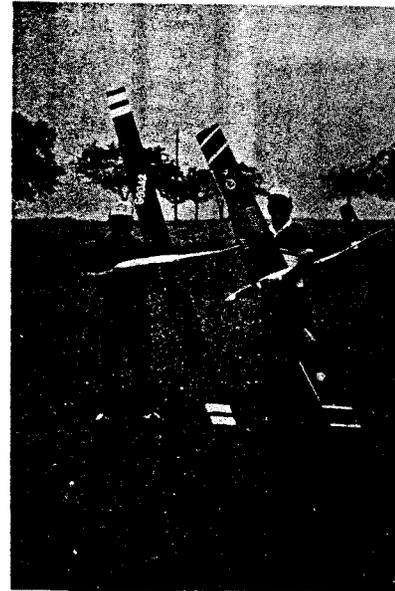
Both Randy and Johnson have built their own versions, and Randy's has Obechi-covered foam wings, with a graphite re-inforced spar of 1/2" x 3/16" spruce from the root out to about 36", and then 1/2" x 3/16" balsa the rest of the way to the tip. The carry-through/joiner rod is 3/8" spring steel.

Don has made some carbon fiber/Kevlar fuselages which are very tough, stiff and durable - much more so, says Johnson, than similar fuselages of fiberglass.

Aileron servos in Randy's version are located in the wings. The total weight is up around 5 pounds, which gives a wing loading close to 12 ounces per square foot - unballasted. The airfoil can be the pilot/builder's choice, and both Eppler E-193 and Quabeck 'foils have been used with success.

The cover three-view has most of the necessary info and specs, but more will be forthcoming soon...as I have asked the fellows down Texas way to send it in to me for publication. Spoilers are used for glide path control, and ailerons are differentially operated, with a 3:1 differential; the up-going surface travelling about three times as far at the trailing edge as the down-going surface. This feature reduces adverse yaw, making less rudder necessary for co-ordinated turns.

Happy soaring,  
Jim Gray



JOINING ALUMINUM TUBING FOR PUSHRODS... Lee Murray

In my new ASW17 I needed light, stiff pushrods to couple the servo arms to the rudder and elevators. The balsa supplied for this purpose was too 'bendy' and subject to breakage. To solve this problem I used pieces of K&S aluminum tubing as shown...and added only 1/2 oz. over the originals.

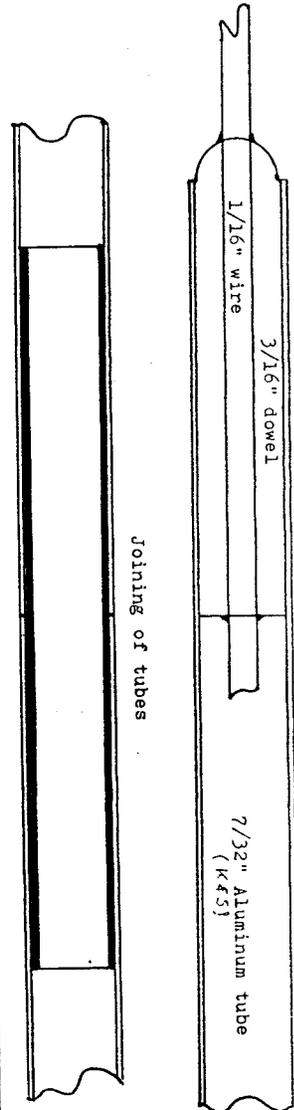
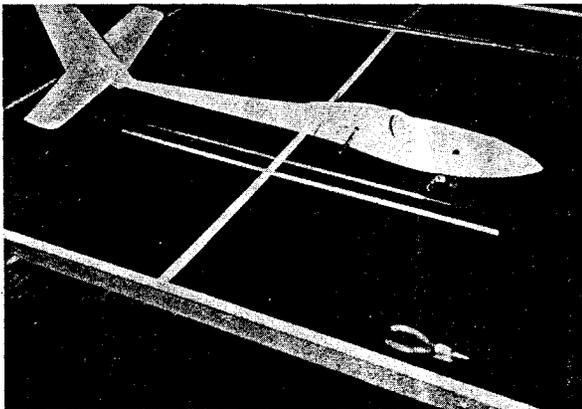
STEPS

1. Join the 2 1/2 lengths of 7/32" aluminum tubing for each of the two rods with 3" segments of the next smaller size tubing. Use thick CA such as Goldberg Super Jet, or Loctite Super Bonder 420.
2. Cut four 3/32" wood dowels to 1" lengths and center-punch each dowel for concentric drilling to receive 1/16" threaded wires.
3. Drill a 1/16" hole in each dowel (use a drill press and vise if you have one).
4. Glue (CA) the correct lengths of 1/16" threaded wires into the dowels. Glue the wires and dowels onto the control-surface end of the rods.
5. Bend the curves in the wires as required to exit the fuselage and connect to the control horns.
6. Install the dowels and wires on the servo ends of the rods, temporarily holding them and marking them to proper length before gluing. Sand the dowel ends smooth, and round them.

The new rods are able to provide optimum stiffness when you put the short segment of tubing toward the bent end of the wire rod.

PHOTO

My ASW-17 fuselage showing servo and control rod made up according to this method. The balsa rod is shown for comparison.

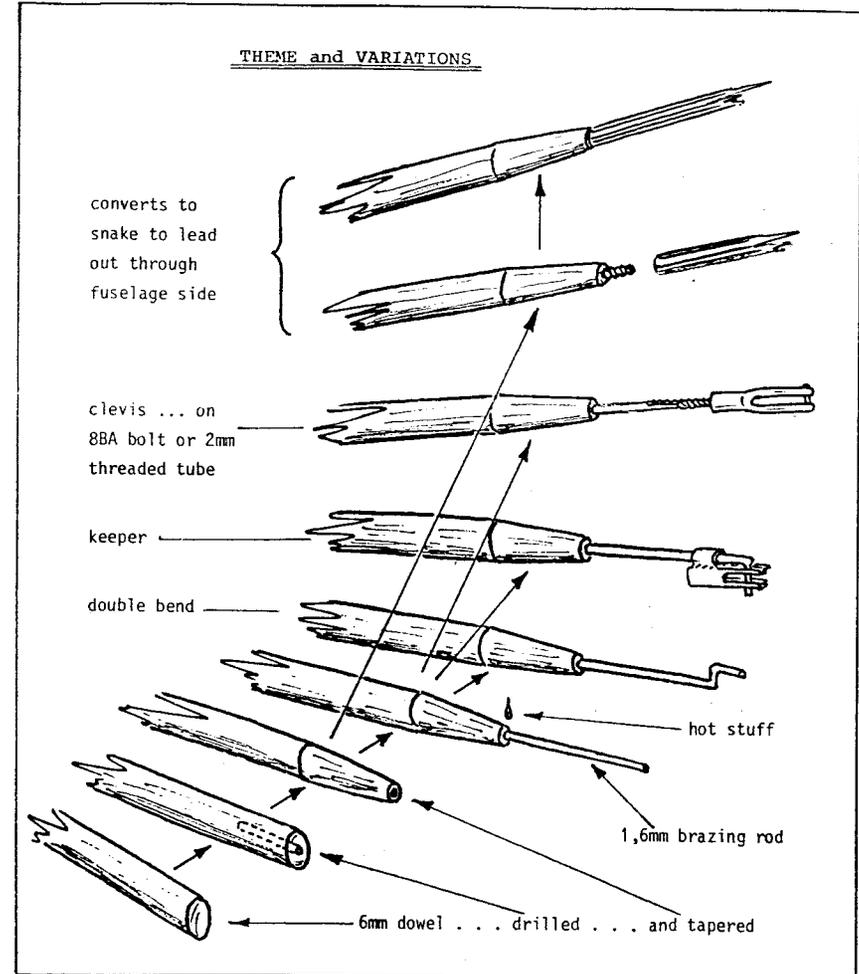


Projects and Hints :

An alternative to cables

Courtesy of John Lightfoot and the SOUTHEASTER, newsletter of the Southern Soaring Club, Capetown, South Africa. Thanks, John.

Select straight, hardwood dowels from the hardware store. 6mm. (1/4") dia. are just right. For the fittings on the ends of the pushrods, use 1.6mm. brazing rod (1/16") 2mm. (5/64") brass tube, and bicycle spokes. The brass tube should be of the thick-walled variety so that it can take 8-BA thread which fits beautifully into the sockets of most plastic clevises. (This is finer than the 4-40 and corresponds to the 2-64 approximately). Bicycle spokes come in two sizes: 1.6 and 2 mm, and can be obtained from most bicycle junk shops. If you unscrew the nut from the spoke, the thread fits nicely into the plastic inner 'snake' and the socket of the clevis. Use phosphoric acid to make neat, strong solder joints. I keep mine in an old Hot Stuff bottle, and squeeze a drop on the metal just before soldering for extremely clean joints...even on steel spring wire and nichrome resistance wires. Wipe the flux/phosphate mess off with a dry cloth after the joint has set. Wires/spokes can be soldered to a short length of threaded tube to take a clevis; or, for a really neat look, both wire and tube can be filed half through and soldered flat-to-flat.



ACE OF CLUBS

Some time ago, I answered a letter from Marshall Searcy of Porterville, California in which he suggested that one of the topics he'd like to see covered in RCSD is soaring clubs: how they function, what they do, when organized and so forth. This seemed like a reasonable idea, so I challenged him to go ahead and tell me about his club...and suggested that maybe I'd publish it to see if anyone else liked the idea. I think I mentioned that if they (you) did not like it, I'd hear about it, and would be told in no uncertain terms that our time might be better spent elsewhere. So, here's a trial balloon in a manner of speaking. Take it, Marshall.

CENTRAL VALLEY RADIO CONTROL SOARING CLUB - AMA #120

Not all soaring clubs start out as soaring clubs. Such is the case of my club, CVRC.

"Originally, CVRC was called Central Valley R/C Club, a combination of power/gliders. After some conflict, two clubs were formed in 1969, one for power and one for gliders. Only the glider club survived the breakup, with a six-man club.

"The first, second and third president was Dell Henry formerly of free-flight fame. It is the effort of this one man that has made CVRC what it is today. If you have one leader and five workers you can grow, and grow we have. CVRC has 42 active members.

"In the beginning, CVRC was located in Exeter, California, and held meetings the third Monday of every month. Refreshments were beer and cookies. (cookies? ...ugh! JHG). To say the meetings were informal is a gross understatement. We still have our meetings the third Monday of every month, now in Visalia, California - without the beer. I must admit the meetings are more informative, but I still miss the beer!

"CVRC now has its own 15-acre flying site; much of it is permanent lawn. We host the annual Fall Soaring Festival, a two-day contest. It is now the single largest soaring contest held by any club, with 132 fliers attending our 11th annual meet last year. Two days of soaring, a huge raffle, trophies and a bar-b-que. We even had dancing girls last year. (How do I get there this year, Marshall? JHG)

"If you haven't attended a fun contest, try ours! We have an open challenge to any four-man team, and have won all but three of the contests in the last eleven years. Give us a try - you'll like us.

CVRC has two Level V LSF fliers, who are now flying the real thing. It is a club to be proud of, and we now have second-generation fliers with more to come. If you are in our area, give us a call. Better yet, see you October 6th and 7th in Visalia for our 12th Annual 'Fall Soaring Festival.'"

Well, Marshall, you have every right to be proud of your club and its hard-working officers and members. Many of us would really like to know how you managed that 15-acre site that you own. Thanks for the input...and we'll see what our readers say. (Cookies and beer?!)

AUF DEUTSCH

Rick Drury is back at it again with his lexicon of German words for our soaring vocabulary:

<u>GERMAN</u>	<u>ENGLISH</u>
Doppelsitzer	2-seater
Einsitzer	Single-seater
Spannweite	Wingspan
Profil	Airfoil type
Bremsklappen	Spoilers (there are other words in German that mean spoilers, but this one appears most frequently)
Bestes Gleiten or Gleitzahl	Best glide ratio (L/D)
Geringstes sinken	Minimum sink
Streckung	Aspect ratio
Flugelfläche	Wing area
Maximales Fluggewicht	Max weight

REINFORCING FIBERGLASS FUSELAGES  
By BRUCE ABELL

I use lite-ply (SIG Mfg. Co. trade mark) for the two aft bulkheads, and hardwood or regular plywood for the front one. These bulkheads are fitted into the fuselage by a cut-and-try method. A brad-awl is attached to each bulkhead, and used as a tool to shove it down the fuselage while trying, fitting and cutting, until the fit is right. Then, I glue the bulkhead in place with 5-minute epoxy, and unscrew the brad-awl. Don't forget to drill all the necessary holes in the bulkheads, and slide the control rods, etc. into them first, before apoxying the bulkheads in place. (It can be done afterwards, but not without a lot of cussing and a big mess...JHG).

I always start at the tail end and have the 'stabilator' horn, fin, and rudder all fixed in place, with all the control runs in position, first. That way, when I slide the drilled bulkheads in place for fitting, they pass over the control runs.

Incidentally, I always use a closed-loop system for the rudder, and run the nylon-coated fishing trace wire (15 to 25 lb. strength) through the plastic tubing that is cyanoacrylate-cemented into the fuselage where it exits just ahead of the fin leading edge, and half-way down the sides. That way, I can set up the rest of the cables after the rest of the fuselage is completed.

The other runs are a Sullivan Ny-Rod for the elevator, with a long threaded rod in the end that screws in and out of a metal clevis clipped to the stabilator horn. In that way, I can adjust the trim merely by disconnecting the Ny-Rod from the servo (where I use a Z-bend) and screwing it into or out of the clevis.

I also use a run of 3/16" o.d. tubing the full length of the fuselage, and exit it just aft of the rudder cables, and on the bottom of the fuselage. This takes the receiver antenna wire and leaves only a few inches sticking out.

I stick my servos to the sides of the fuselage with double-sticky foam mounting tape, and have had very little trouble with the system.

I carefully mark the hatch out with ruler and marking pen (felt tip variety) and then, using the rule as a guide, score the fiberglass with the point of a razor saw, and keep at it until the saw cuts thru. I then cut the rest of the hatch with the saw. The hatch, of course, is cut out before anything else is done!

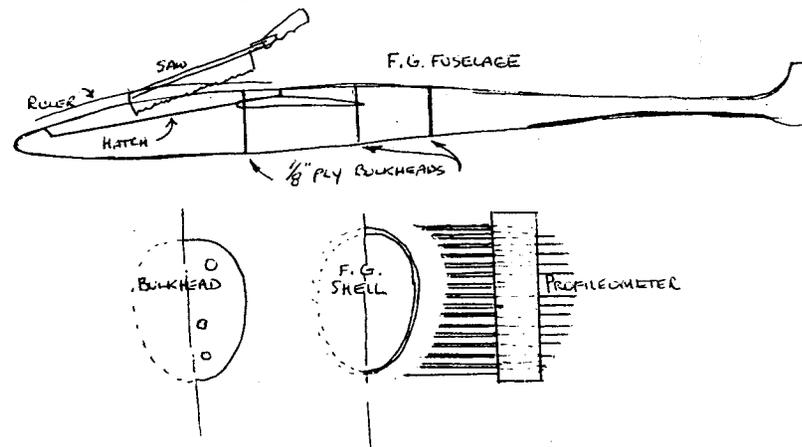
I ought to mention that the plywood bulkheads are arranged and spaced apart a convenient distance to act as supports for the wing-rod receiving tubes.

COMMENTS - JHG

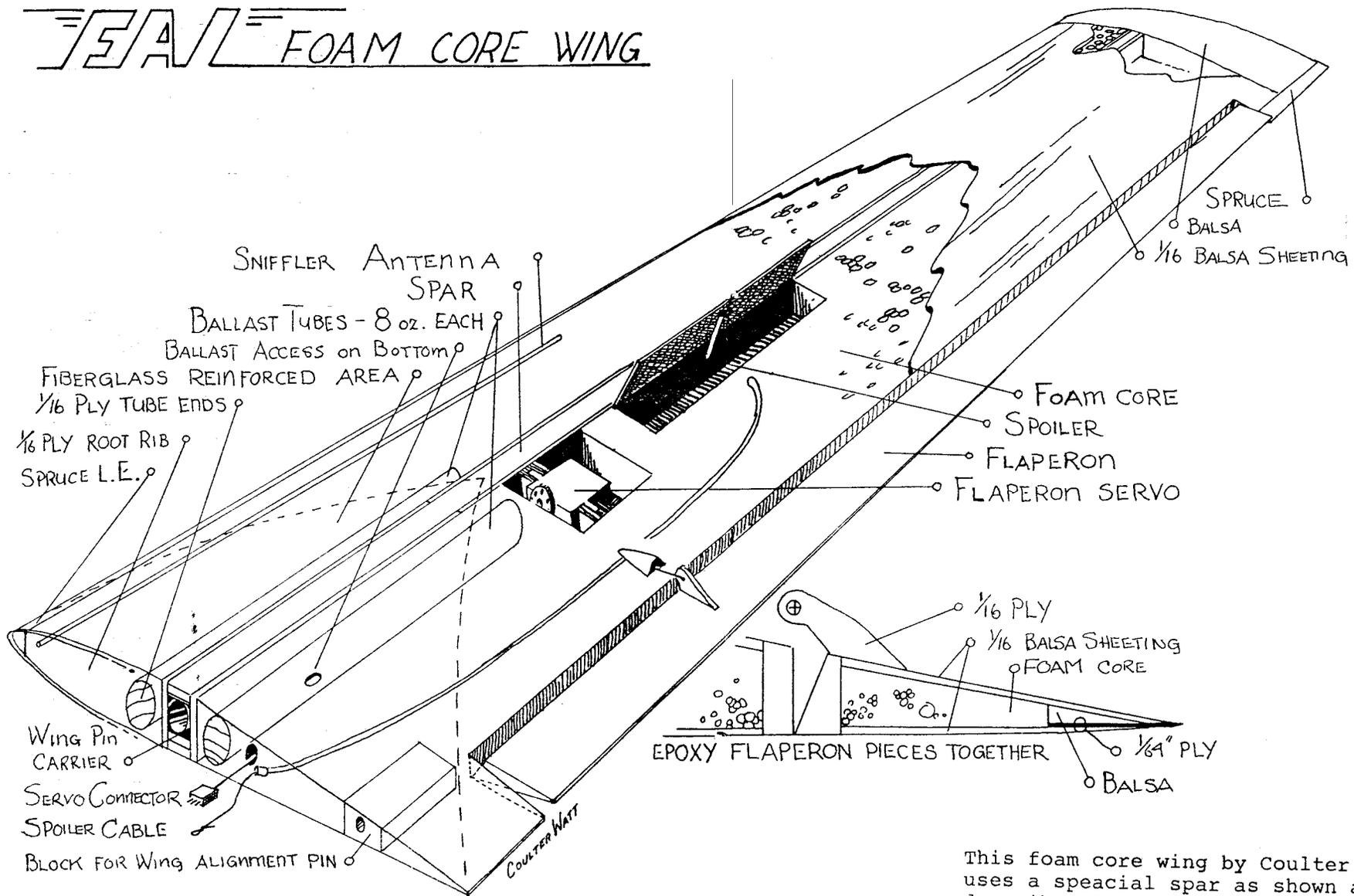
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It seems to me that there could be a simpler way\*.to use a profilemeter; one of those devices that measure the contours of a surface with something that looks like a bunch of pins held in a frame. Each pin slides back and forth, and all of them together outline the shape to be duplicated. In most cases, a capable modeler could build his own simple profilemeter, then simply transfer the outline to a piece of plywood (allowing, of course, for the thickness of the fiberglass shell. I admit that I haven't really done it, but it seems to be logical. Anyone care to comment? Success - failure - or???)

(\* To determine the proper former outline shape, that is.)



# FAI FOAM CORE WING



This foam core wing by Coulter Watt uses a special spar as shown and described in the July 1984 issue of RC Soaring Digest. Drawings, diagrams and descriptions by special permission of Coulter Watt.

SAILMAIL ... Morning thermals and easy foam cutting ... Beckett

Tony Beckett of Rutland, England wrote about a couple of interesting things. First, was the terrific thermal activity he experienced one morning, and the second is his method of quickly making foam stabs and rudders...and of cutting foam cores, in answer to a question in RCSD: "On a recent outing, just before 8 a.m. on a Sunday in June, the weather was cloudless. There was dew on the grass and just enough wind to make launching comfortable. A test flight showed plenty of lift about. On the first flight - a 2-minute duration - I came off the line at half height and couldn't get down...overflowed the target time by 31 seconds. Four- and six-minute targets were no problem, and I had to lose height on those to make the time. Then, after a streak of bad lift on the 8-minute flight (made 4) back to a 10-minute flight and a couple of 15-minute flights...all before 9:45 a.m. During this time the wind had steadily increased, and cumulus built up - rather early for a normal summer day. By 10:30 there was complete cloud cover, and the wind was up to 15 m.p.h.; lift was difficult to stay with - even to find! I wonder if the dew evaporating off the grass had anything to do with it? We had rain the previous evening, and the drying-off took place during the main part of the good lift. Should I go flying early more often?"

I use flat sheets of polystyrene foam, cover one side with Obuchi veneer, add balsa leading edges, and sand the top side to section, and finally cover that side with Obuchi. With the 3/16th-inch foam I use it would be difficult to hot-wire cut it without problems on such small pieces. I use up my scrap foam and wood from wings this way.

On the wing sections (see sketch) I use foam thick enough for only one section, sand the bottom flat with a big block, and just cut the top, leaving a 'hook' at the difficult trailing edge. This hook is sanded off after the bottom skin is attached. Doing the trailing edge this way means the extra weight and trouble of a false trailing edge inside the veneer is not needed. I make it easier by cutting only 2' lengths of foam, making four 2-foot panels for a 100" wing. If I want a larger span, I join the foam after cutting. This would upset most expert foam cutters, because it wouldn't allow for the undercamber needed for most of the Eppler sections. However, a reasonable entry to the bottom of the section can be sanded in (at the nose) and the critical first 3/8" has to be carved and sanded into the balsa i.e. in any case."



STICK OVERSIZE VENEER  
THEN CUT TO THIS LINE X  
SAND SECTION BEFORE  
PUTTING ON TOP SKIN.

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... Steve O'Leary's comments about Zephyros - RC Hand-Launch ...

"...Because of the very small chord the Reynolds Number will be in the range of 70,000 to 80,000 at the m.a.c. and as low as 60,000 at the tips. Many of the commonly-used airfoils are not meant to operate at this low range, and the Eppler 205 is one of them. The flow in the laminar boundary layer has such low energy that at these Reynolds Numbers that it will separate from the upper surface of the airfoil, causing low lift and high drag.

"For the slope version of this model, I would suggest the NACA 0015, the NACA 2412, or the NACA 2415. The NACA 0015 is symmetrical and will give excellent inverted flight and aerobatic performance, yet ... will fly in less than a full gale. The NACA 2412 will provide higher lift coefficients for flying in lighter lift while sacrificing inverted performance only slightly. The NACA 2415 is similar to the NACA 2412 and works well with flaperons. Regardless of airfoil, expect this plane to fly about 50% faster than models with more 'normal' wing loadings.

"The same problem with R.N. will be encountered with the thermal version. The Eppler 214 is an airfoil that has been designed to operate effectively down in this range. I have used it on my 2-meter glider and recommend it. Another viable alternative is to turbulate the E-205. This will change the boundary layer from laminar to turbulent, and prevent boundary layer separation. Run a strip of striping tape along the upper surface of the wing, parallel to the leading edge, and somewhere between 3/8" and 1" back from the leading edge. Experimentation should be easy.

"Many members of my club, the Torrey Pines Gulls, have been building small thermal gliders for hand- and hi-start-launching. Based on their results, I would be very surprised if the Zephyros will weigh more than 16 ounces. Notice that all the airfoils I recommended are thicker than

SAILMAIL (Continued)...

ten percent.

"On a chord this small, the added thickness may be essential to provide the needed wing strength. Another alternative would be to use a thinner airfoil, but make the wing of solid balsa. Much of the information I have related in this letter is from Profilen für den Modellflug by Dieter Althaus, and contains wind tunnel test results on model-sized airfoils at Reynolds Numbers appropriate to gliders."

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Jerry Arana of Santa Cruz, California has had years of speed-flying experience with slope sailplanes, wrote with some suggestions for RCSD. (Last month, Jerry contributed the paper clip anti-flutter device that Don Edberg uses). First,, he thinks maybe a "Mystery Sailplane three-view, perhaps scale, would be neat. How about an instrument panel (drawing or photo) from a given (scale) sailplane? What do these airfoils have in common: GO 549; EP 205; HQ 2.5/10; HQ 1.5/10; Wort. 26? When you straighten out the camber line, they all look the same! See Reinhard Lahde's article in the January '84 issue of the Silent Flyer. Another good one is Lahde's article on lateral stability in the April '83 issue of S.F. Another Lahde article on "V" is very good, too. If you want to know more about this newsletter, write to the Editor: Steve Lewis, 2412 Brannan Place, Santa Clara, CA 95050, or call him at (408) 554-8539. Jerry also recommends the study on "Drag Awareness" by Oren Nicks that appeared in Soaring Magazine - the full-scale sailplane journal.

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Glen Spackman of Wellington, New Zealand has suggested that a video cassette tape exchange be set up among soaring pilots and clubs. A lot of clubs and individuals now have these recorders and have made tapes of flying activities, building sessions, contests, and the like. If you have video tapes to exchange, let me know and I will announce the information here in RCSD. Glen, that's a super idea and is part of what RCSD is all about: information exchange. Incidentally, Glen has published a comprehensive source list of glider plans that have appeared in model publications since 1975. As soon as I have room for it, I will publish it (with his permission) here in RCSD.

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Modesto R.C. Club holds its First Cross-Country Race, reported by Dan Timberlake. Fourteen teams entered. Dave Layne, CD, chose a modified 16.1-mile circle and required two laps over the varied terrain which included dry stubble, rolling hills, flat irrigated fields, and a 300-yard long water hazard on both sides of an iron trestle bridge approximately 200 feet long. June 9th and 10th provided the contestants with "exceptional" thermals gusting to 40 knots! This held the contest to one day - Saturday. Rich Spicer lost sight of his original design ship while entering the chase vehicle (Rich, not the plane!); Two Sagitta X-C's blew up...one seeming to hit a terrific wind shear within minutes after launch. Dan says it was not a record-breaking weekend, but a plane-breaking one. Ironically, Monday was calm. Larry Jolly, flying his Comet took first place with 12.4 miles; Arlie Stoner was second with 11.1 miles, flying his Sagitta XC; and Tim McCann and his Aquila Grande made third place with 5.0 miles.

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#### Peter Abell's Comments on Design

"Many things I read from the USA get to me a bit, because of their one-sided responses. Many kits are under-'designed.' This is quite a heavy statement, but the (Pop. 2-M) kit supplies and recommends 2"-long brass joiner tubes into the wing with little reinforcing. No good; agreed?"

"Another is the (Pop. 2-M). Moments and stab size, along with general appearance, were the reasons I didn't like it, but that's not to say I didn't do my own series of calculations to check. It still didn't fit. The Sagitta 900 and 600 are among the best things around, but still I can't exempt them from some criticism. First the stab: if built as per plan, it has a tapering thickness/chord ratio which must alter flying characteristics under various conditions (it also begins much too thin). It is also much too large to suit my taste at 12% of wing area (from memory). I am halfway through building a Sagitta 900 for my assault on a few State and National records. Here are some of the mods:

"1: Section change from E-205 (mod.) to Gottingen 795. The E-205 really needs to be built fully sheeted and flown at higher Reynolds Numbers to get the most out of it. The Gottingen 795 is thin at 8%, but wind tunnel tests point to it as being the solution. We shall see.

"II. Stab changes as mentioned. 10% thickness/chord ratio, and 9.5% of wing area. Pivot point has been moved aft a bit more to increase moment.

"III. Construction of wing trailing edge has been changed. Butt-gluing the trailing edge to the ribs tends to be prone to warping. The new trailing edge will be as per Aquila, but has 2-ounce glass and epoxy between the sheets.

"IV. Joiner system, modified a little.

"V. Allowance for about 30 Oz. ballast

"VI. Elimination of balanced rudder (removal of overhang) and change to normal fin/rudder.

"I think that's about it, and she should look the same (as good) as a normal Sagitta, but have improved performance.

"I could go on sometimes about this basic subject, and am one who believes in designing and modifying to suit one's individual taste, style and habits, but this takes knowledge and ability to recognize...and, of course, practice.

"I was particularly taken by a statement in Al Doig's column, in which he wrote: 'A top pilot is one who has the knowledge, ability and skill to get out of almost any situation faced, but is rarely ever seen in the situation that requires these skills.'

"That quote may not be exact, but it is basically what he said, and it has affected my ways ever since. I feel that being one of the top few, now that people are watching me more, expecting the miracles I sometimes perform - not in recovery, but in thermal hunting and consistently landing within 3 metres. When asked, like most, I find it difficult to put into words what has become an automatic response to a situation. You can only edge around it and say 'practice, practice, practice; watch, listen, and then practice some more. I think this is where all will agree: practice.'"

\*\*\* \*\*

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## SOARCES

Proceedings of the MARCS Soaring Symposium are now available from Al Scidmore for only \$7.00. Write to him at 5013 Dorsett Dr., Madison, WI 53710. This is the symposium I mentioned that had the video tape (VHS) made, and covered about 6 hours of discussions on such subjects as: Sailplane speed events and performance analysis (Stan Watson); Launching systems (Al Scidmore); Hand-launched R/C gliders (Milwaukee Thermal Soarers); Computer-aided wing construction (Lee Murray - includes the program); Kitting a sailplane (Scott Christensen); Radio systems - past, present and future - (Peter Waters); Composite materials (Keith Scidmore); Panel discussions on contests and cross-country soaring. Approximately 100 pages in all. Note: \$8 if you want this by first-class mail.

English glider supplies, kits, plans, etc. Many of you have written to me to ask about sources for these items. Here are a few: Scale glider plans: 1/4-scale Grunau, ASK-13; rib plans for ASK-18; Canopies for ASK-18 and ASK-13; Plans of Hutter H-17. Cliff Charlesworth, 41 Spring Road, Frome, Somerset BA11 2JN, England.

--more--

West Mendip Sailplanes: 1/4 scale VEGA, 1/5 scale DART 15, NORSEMAN; DOMINI; SOLUS; 144" DART; ORION, etc. Send for catalog to Pat Teakle, 16 Byron Road, Locking, Weston-sur Mare, Avon, England.

--more--

Silhouette: 142" or 132" span, 2 to 4 channel high-performance sailplane by Roy Garner. Uses all stock wood sizes. Suits individual requirements. Variable-camber wing shown on plan. Glass fiber fuselage with long hatch for easy access to radio and spoiler linkage; battery pack will fit within one inch of nose, eliminating a large amount of balance weight; Computer-drawn wing ribs included; Wing section E205 or transitional; 1190 square inches. Write Soaron Sailplanes, 27 Brook Street, Wolston, near Coventry, England.

Please mention RCSD when you write these "soarces."

--more--

Model and Allied Publications Plans Service: Has plans for nearly any type of powered plane or sailplane ever published in an English publication. Post Office Box 35, Wolsey House, Wolsey Road, Hemel Hempstead, Herts., HP2 4SS, England.

--more--

Veneered foam wings: for plans, kit replacements, own designs; personal service, advice. Dalesman Models, 58 George Street, Saltaire, Shipley, West Yorkshire, England.

--more--

Chris Foss Designs: 448 Upper Shoreham Road, Shoreham, Sussex, BN4 5NE England.

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PAPER SCULPTURES - SCALE BIRDS IN LIVING COLOR. Ariel Company, c/o Sarah Taylor, 2894 Meadowbrook Boulevard, Cleveland Heights, OH 44118. These are absolutely beautiful bird sculptures in paper. They come in flat packs, all printed in color. All you have to do is cut them out to outline and glue the pieces together to make a lifelike, absolutely scale bird. The OSPREY is a 60-inch span, and retails for \$25. Other, smaller birds include an owl, a pigeonhawk, and songbirds. These make extraordinary and beautiful gifts and displays. They look real and can be built in a day or two. Ideal family project for fun. THEY ARE THREE-DIMENSIONAL when you are finished. Send for catalog. Most are priced in the \$4--\$8 range.

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REQUESTS ... Good Idea Department

Howard Honor of Milwaukee, Wisconsin would like me to make a survey of sailplanes in use out there among you readers; particularly kit-built sailplanes. If you'll send me the info in a letter or on a post card, I'll print the survey results and analysis. This should be fun for all. WHAT DO YOU FLY? WHICH IS MOST POPULAR? ETC.

Howard also suggested the possibility of a special issue listing want ads for buy-sell-swap of sailplanes, accessories, etc. At the very least, we might include an extra page insert if you think it's a good idea. Remember: classified ads in RCSD are always available. Just write me and tell me what you want to buy, sell or trade.

RCSD needs more subscribers. If you like this newsletter, and would like to see it grow, please tell your friends about how much you like it, and what you think it is doing for RC soaring. Please ask them to subscribe. I'd like to have 1,000 subscribers by December 31st. With more subscribers I can put in bigger print and more pages; but we must have the funds to do it, and that means you and yours!!!

COMPOSITES - WE HAVE THEM!

BORON FILAMENT - World's strongest material for its weight. .004" dia.

1000 Feet	.2076 Oz.	\$25.00 ppd.
2000 Feet	.4152 Oz.	\$40.00 ppd.

CARBON FIBER- 6000-strand tow. Epoxy compatible. About .150" wide by .015" thick. Ideal for many areas on your sailplanes.

112 Feet	\$6.00 ppd.
900 Feet	\$20.00 ppd.

CARBON FIBER UNI-DIRECTIONAL TAPE - Fantastic stuff. Makes carbon fiber easy to use. Use for sailplane wings & fuselages. Consists of 80 separate, 3000-strand tows, stitched together.

10 Feet	\$25.00 ppd
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COMPOSITE CARBON FIBER/KEVLAR TAPE - Similar to item above, but every other tow consists of Kevlar (the tough stuff). Tape 3 Inches wide by .010 Inches thick

10 Feet	\$25.00 ppd.
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SOLID CARBON FIBER SPAR MATERIAL - Cured with Shell EPON 828 epoxy. Can be glued with any slow-cure epoxy glue. About 35 times stronger than spruce. Cut these spars to fit your design. 4 Inches wide by .035 Inches thick by 60 Inches long. (Not yet in stock. Should sell for about \$5.00 per Foot).

1100 - H19 ALUMINUM SHEET, .001" Thick. For covering wings on FAI models. Stops all warps and flutter. The weight is just .0015649 ounces per square inch - or 639 Square Inches per ounce! Can be attached with epoxy, or with 3-M's #77 contact cement and ironed down.

15 Sq. Ft.	\$15.00 ppd.
34 Sq. Ft.	\$25.00 ppd.

KEVLAR CLOTH - 59 Grams per Square Meter. This is the lightest Kevlar made, similar in look and feel to heavy cotton muslin. Good all around material, great for reinforcing weak areas.

Per Square Yard -	ASK ppd.
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KEVLAR CLOTH - 176 Grams per Square Meter. Very loose, coarse weave. Ideal for laying up fuselages, but be sure to put in a thin layer of glass first, just in case you have to sand it. Has about 3½ times the strength-to-weight ratio of glass.

Per Square Yard -	ASK ppd.
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RC SERVOS - We finally found out who makes all those real good servos for the top Japanese radio companies. We handle only the very best ones. All have ball bearings, and the small one has a coreless motor. They all come with JR connectors, but we can change them to Futaba or Sanwa for you at no cost. Please specify connectors or you will get JR.

<u>Std. servo:</u> 1.5"x 1.5"x .75"	\$15.00 each
Weight 1.5 Oz. Torque 35 Oz./In. BB.	

<u>Mini Bantam:</u> 1.3"x 1.3"x .62"	\$20.00 each
Weight 1.0 Oz. Torque 26 Oz./In. BB	

<u>Micro Mini:</u> 1-1/16" x 1-1/8" x .5"	\$26.00 each
Weight 5/8 Oz. Torque 15 Oz./In. BB	
Coreless motor.	

FOR ENGINE LOVERS - I have a huge stock of COX and PICCO engines, and am running out of room. I'll sell COX' at close-out prices: COX .049 @ \$25.00 per Dozen! Glow plugs; etc.

The PICCO engines are very special - the new hot ones, and my prices are competitive. Write for quote.

RACING ENGINE OIL - The one that's setting the new speed records. It's 40:1 - write and ask for price and specs.

**MRL MODEL RESEARCH LABORATORIES**  
24692 Nympha, Mission Viejo, CA 92691