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SHORT FINALS AUGUST 1999

Hello playmates, the season continues apace. The June comp at Hazlehead was declared a washout, **heavy persistent rain all day**, a great pity as we were organised and looked like we knew what we were doing. What is particularly galling is that Saturday was killer lift day, several members having flights in the region of 1 hour until rain stopped play. Thanks to our friends from Perth attending, pity we couldn't offer some flying.

Date rearranged for Sunday 8th August.

Radioglide as usual was busy, unfortunately this year was also wet. I had an unusual problem with a cracked boss on the servo output arm of my elevator, this meant that the splines on the servo output shaft did not engage with the arm all the time. The result was not just a double neutral on the elevator but an infinitely variable neutral, consequently I flew 3 slots of aerobatics before retiring, fortunately I brought the model back alive to fly another day. This output arm was taken from a redundant model and may have been previously damaged; it took very close scrutiny to find this problem. Of course in the middle of a slot you do not have much diagnostic time, and indeed between slots you do not have your transmitter available to do testing. Moral **CHECK, CHECK AND DOUBLE-CHECK** your equipment **BEFORE** you go flying.

This month's model is an article about a hand launch flying wing, all the dimensions are in the article to enable you to produce this aircraft, if you need a printout of the root and tip template give me a call.

This months bumpf appropriately includes how to trim the said flying wing, I would suggest this method is also most suitable for conventional glider trimming once you are past the initial safe test flights and are looking for a bit more performance. Next and logically we have a piece about tow hook location and winch launching followed by general flying tips.

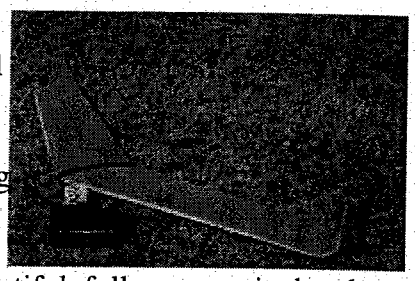
The club winch has been modified by the addition of a solenoid to energise the motor via a footswitch; this offers a better stance and controllability of the line tension. In light of the recent spate of wrecks on the line I would suggest everybody ready the article on winch launching and has some dry runs at tensioning the winch **prior to launching a model.**

I have now modified my wing cutting board slightly to simplify and automate tapered wing cutting, there are probably another 2 boards under construction by club members, this has proved a very useful addition to the workshop and makes repetitive wing production very simple. We could maybe knock up a simple and cheap model and have a one-design club comp, any suggestions for a spec for next year next year??

HERK STOKELY'S HANDLAUNCH FLYING WING

AS PRINTED IN FLYING MODELS MAGAZINE FEBRUARY 1997

NOTE! THIS IS NOT HERKS PAGE. IT IS PART OF ANDY MACDONALD'S FLYING WING PAGE



I've finally managed (with some help) to build a model that I have wanted to try for a long time. Ever since I became infected with handlaunch fever,I have wanted to try a handlaunch flying wing. A flying wing planform just seems right for hand-launch. It's light, couldn't be simpler, and it represents a very interesting design exercise.

My friend Tom Broski from Charlottesville, Virginia builds beautiful, fully composite hand launch wings that work very well on models like the DJ Aerotec Monarch. Tom is an artist and his wings are each small works of art. I have been impressed with his skill, craftsmanship,and artistry since I first met him at one of our Eastern Soaring League contests. I talked to Tom this summer about the idea of collaborating on the development of a handlaunch flying wing. He was quite interested, and I knew that he could make excellent surfaces for the plane. When he agreed to make wings for a prototype, I told him that it would probably take several of them to work out the details and get the plane flying well. For that reason, I suggested that he keep these development versions as basic as possible, not to waste his time making them beautiful. Later I was somewhat sorry that I had said that.

I had done several layouts for this plane over the last several years, but had never actually begun building one. I know from previous flying exercises that an effective flying wing with good performance could be developed. My own ideas had evolved to a swept wing with a cambered airfoil at the center and a symmetrical airfoil at the tip. With a linear blending of the airfoils in between, the inner part is where the lifting work is done, and the outer part, where it becomes symmetrical, does the job of the horizontal tail on a conventional design.

The late Dr. Walter Pannekin has developed equations for calculating the aerodynamic analysis needed to make this kind of arrangement fly properly. Alan Halleck from Oregon turned these equations into a computer program some years ago. Since Alan sent me a copy of the program, I have used it to check enough different flying wing arrangements that I was confident it would get me into the right ball-park for setting up our first prototype. I was not at all sure that it would get the plane right-on at the first cut. I believe this program is available from B2 Streamlines, PO Box 975, Olalla, WA 98359-0975. As always a SASE is appreciated when requesting info like this.

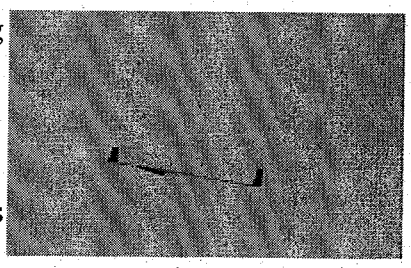
As I laid it out, the wing has a 60 inch span. The root chord is ten inches, the tip chord is six inches, and the leading edge sweeps back at a 22 degree angle. As I said, a very simple sailplane. I wanted the thin airfoils that I've come to appreciate lately; so for the root airfoil, I used the same SD-7037 thinned to 7.5% that I used on our conventional Skeeter-Hawk hand launch design. For the tip airfoil I chose the SD-8020 symmetrical airfoil thinned to 6%. Dr. Pannekin's equations showed that for proper trim with adequate stability, the wing tip should have eight degrees of washout and the balance point should be in the range of 7.5 to 8 inches behind the root airfoil leading edge.

Tom made a set of composite wings to my specifications and I put together the model and installed the radio. Battery, receiver, and servos are all located within the airfoil of the wing. The battery is four cells of 150 mAh capacity, just behind the leading edge of one wing. The 4-channel Airtronics receiver is in the same place in the other wing. HiTec HS-60 micro servos are set just far enough outboard that their leads will reach to the receiver with no extensions. These drive elevons that stretch along most of the span of the wing. I made a small keel that fits between the wing panels and extends about an inch below the wing. This provides a place to hold the model for launching. A cross dowel through the keel at the c.g. acts as a finger rest for hand-launching.

The plane is finished by putting on the fixed vertical fins at the wingtips. I flew it first without these, but I soon realized that while it did ok at high speed with extra nose weight, it would never be a good thermaller without some stabilizing fins. The ones I used are made of 1/16th balsa with a 4-inch bottom chord, 2.5 inch top chord, and they are 5 inches high. After actually throwing these off the plane a couple of times, I found that I had to fiberglass them on with a bit of s/4 ounce cloth and CyA adhesive.

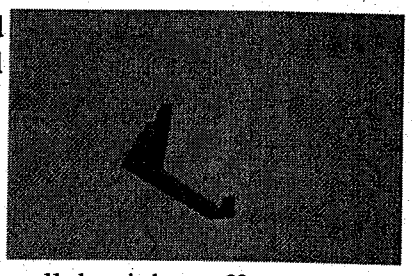
The prototype has performed beyond my most optimistic expectations. I'm really surprised that the plane came out so perfectly on the first cut. The programmed size, washout, airfoils and c.g. seem to be close enough that I can't figure out any changes that would lead toward improvement. Even the little towhook, that I put on to allow launching with a mini hi-start, seems to be just right. I've probably used up all of the good luck I'll get for a year on this one. Or maybe I should give a lot of the credit for this success to Dr. Pannekin.

At this point about 12 people have flown the plane through hi-start launch to landing, and several of these are advanced beginners who are most comfortable still with polyhedral sailplanes. I thought it would take two or three prototypes to get it flying well, but I love it just as it is. I have had some great flights with the plane. It launches beautifully both by hand, and with the mini hi-start. I've even flown it in its first little local contest where I got a score about 90% of the winner's.



It is a flying wing, and everyone has a bit of a problem adjusting to the visual aspect of this configuration. It's amazing though how quickly you can become oriented to its strange appearance. When finished, trimmed and balanced the plane weighs 11.8 ounces. With almost 500 square inches of very thin wing it is both light and fast. The battery and receiver are as far forward as I can place them. I'm using a 150 mAh pack, but based on the weight I had to add to the nose, a 250 mAh pack could probably be used. The balance point is 7.7 inches back from the nose of the plane. The keel is made oflight 1.4 lb./cu. ft. balsa with x/16th ply doublers on each side. The keel could bebagged with fiberglass and the ply avoided. I'll probably do that on a future version.

There is a 5-inch length of carbon fiber arrow shaft mounted in the keel that fits into a 9-inch length of carbon fiber kite spar mounted in each wing. I also installed a 1/16th steel alignment pin one inch back from the nose. The elevons start 41/2 inches out from the root of the wing. At that point they are 2 inches wide. From there they extend along the trailing edge for 29 inches and have a width of 1.7 inches at their outer end. Elevon movement for elevator control is 5/16inch up and an equal amount down. For aileron control the elevon moves 1/4 inch up and 5/16 inch down. This reverse of normal aileron differential was necessary to stop a tendency of the wing to nose up in a turn. I found it was very necessary to good handling of the wing.



Well, I've wanted a handlaunch flying wing for a long time, and now I have one. I wish I hadn't suggested to Tom that he should avoid making it pretty. It would really look neat with one of his rainbow color schemes. However, all sailplanes are pretty in lift and I've had this one up there quite a few times now. It does fit the concept of a very simple plane. Just a wing and an arm. A bit of lift and some tight circles and away it goes. No chance of mixing this one up with one of the other models at the field. It has all the right stuff to meet my specifications; light weight, thin airfoils, smooth curves, good looks and good flying.

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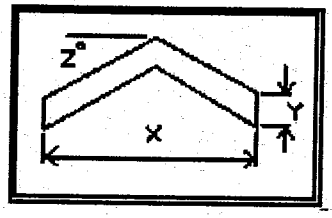

Mail

Mail to Andy Macdonald is with this:

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How to Trim Flying Wings

Comments!

[Courtesy of Mark Mech - Aerofoam, August 1998]

The goal in trimming a flying wing is to get the center of gravity as far aft as possible and still maintain stable control over pitch. Since the flying wing has very little tail moment there is a tendency for the wing to be very pitch sensitive.

I think some sort of exponential control is necessary to control most flying wings in the pitch axis. The roll axis is not as sensitive. Differential aileron mixing is not recommended because it usually results in pitch input while rolling.

The tail moment on a flying wing is the distance from the elevon to the center of gravity. This is usually not very far so the elevons don't have much leverage. This is why the CG. is so critical. If the wing is too nose heavy, It will require alot of upward deflection of the elevons to fly level.

This results in alot of unnecessary drag and sometimes a nose high attitude in level flight. It also makes the wing far more stable in pitch response so it is best to start the trimming procedure with some extra weight on the nose and a little reflex in the elevons.

I have used the following procedure for trimming R/C aircraft for some time and it is quite painless. You start by finding a neutral trim for the wing. This is best done by setting up everything as per the instructions (or your eyeball) and putting some additional weight on the nose. I use tape and lead. Then add a click or two of up trim and either run with the plane or ride a bike (mobile wind tunnel) while holding the plane level.

This will let you know if it is close to It's flying trim. At this point I like to use a bungee to simulate a hard throw. I tape a hook a couple inches in front of the C.G. so the plane will take off straight without trying to rotate as if it were on a hi-start.

This will produce a manageable launch that is high enough for trimming. On first launches I hold a little bit of up elevon just to make sure it doesn't slam into the ground. I usually have to put some down input to the wing after it comes off the hook because I always set them up with too much up trim the first time. At this point you will probably add some down trim and start launching harder. Once you have the wing flying level in trim, you can move the nose weight back an inch or two. This will cause it to have too much up trim so the process starts all over again.

I generally keep moving the weight back and re-trimming until I can barely control the pitch, then I move it forward until I like it. This determines the C.G. and the balance point you want for controllability. Once you are sure about the C.G. you can dial in the wing for It's best glide ratio and speed.This is very simple. When the wing is trimmed and flying level you

simply add a click of down trim and watch the wing. It should nose down a bit and speed up. If it pulls out of the shallow dive by itself add another click of down trim and watch it again.

You keep adding a click of down until it stops pulling out of the dive by itself, then add one click of up trim and you are finished. Most gliders actually have a normal oscillation cycle where they are going through the sky in repetitions of shallow diving and pulling out, but it is so shallow that it isn't noticeable if the plane is in trim. Get to know the speed that the wing likes to fly at when in level trim. It will probably be much faster than you thought it would be. It is important to let it fly at this speed if you are trying to maintain a good glide ratio. If you pull back on the stick and try to "float" it, it will sink much faster than if it were at It's cruise speed.

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This page was last updated on 04/14/99

This is an article that originally appeared in the Louisville Area Sailplane Society newsletter The LASS word. It contains a particularly simple description of winch launching as well as general hints on thermal flying.

TOWHOOK position is **IMPORTANT** for maximum **LAUNCH ALTITUDE**. The closer the hook is to the C.G. the higher the launch, but the sailplane becomes UNSTABLE. Again, a compromise between stability and high altitude is necessary. In general, tow hooks should be located about 1/4-inch fwd of the C.G.. A really great way to determine if the hook is, in fact, fwd of the C.G. is to hang the sailplane upside down with a piece of towline, or other strong cord, attached to the towhook. If the hook position is correct, the sailplane will hang tail LOW.

New Folks will most likely use a **HIGH START** first to launch their sailplanes. For winch launches it's important to remember what the pull of the High Start feels like just before you launch the sailplane. Why? The winch intimidated me because I had no idea what to expect. Then, Jeff McComb instructed me to take-up enough slack in the winch line to simulate the pull of a High Start before launching the sailplane. It was one of the most comforting pieces of advice I'd ever received! I prefer winch launching over any other method because of the quality of the height of the launch and the winch's instant adaptability to different field lengths. When launching, whether from a High Start or WINCH, **THROW THE SAILPLANE HARD** to make sure the sailplane reaches flying speed before the nose rotates up into launch attitude. Forgetting this may cost you your aeroplane...

The winch is powerful enough to fold wings if you do not control its pull. The pull is controlled by (1) the frequency the winch foot pedal is tapped, and (2) the duration the winch foot pedal is held down/on. In general, the frequency is 2 to 3 taps per second with short duration. For heavier sailplanes, in basically calm conditions, the frequency is about 1 to 1.5 taps per second with longer duration between taps. In wind conditions, most sailplanes will kite-up on launch with 1 to 1.5 taps per second with **VERY** short duration. A good rule of thumb, for me, is to launch the sailplane with just enough pull to make it climb well and **NO MORE! WATCH THEM WINGS! FAILURE TO TAP THE PEDAL AFTER THROWING THE SAILPLANE RESULTS IN A NASTY CRASH!** At first its kind of like patting your head and rubbing your stomach at the same time, but it becomes second nature in short order. A good way to practice tapping is to operate the winch while a trusted fellow glider guider flies your sailplane up the launch path. Try it.

Winch line **POP OFFS** can be caused by (1) too much up elevator, (2) too much launch flaps, (3) mounting the towhook too close to, or aft of, the C.G. or (4) any combination of these factors. Building your sailplane according to plan will minimise pop offs. Of the pop offs I've seen, all of them occurred at sufficient altitude to recover and land. Recovery is fairly simple because pop offs usually cause the sailplane to loop. If the sailplane looks like it's just very nose high, but not entering a loop, momentarily apply **FULL** down elevator (the sailplane will probably stall) to lower the nose and recover flying airspeed, then level-off for landing. If the sailplane is obviously in, or about to, loop apply up elevator to complete the loop, level off and land. Steer the sailplane up the launch path toward the winch **TURNAROUND** pulley. When the sailplane reaches the top of accent, in many cases the winch line will simply drop off the hook. Sometimes you may have to coax it off the hook with a slight dive and pull up to level flight. If the winch line becomes stuck to the aircraft (I've seen it happen more than once) **DON'T PANIC!** Just turn one way or the other and make gentle, small -to-medium circles down to a landing. Don't fly in one direction very long, for obvious reasons. Once the aircraft is free of the winch line, and assuming it has been properly hand tossed and adjusted by an experienced fellow glider guider,

let her settle into that **STRAIGHT AND LEVEL, HANDS-OFF**, minimum sink airspeed glide. Fly left or right at about a 30 to 45 degree angle. Look at the ATTITUDE, the position, of the fuselage relative to the horizon. **NOW BURN IT INTO YOUR MEMORY**; whether turning, flying straight and level, climbing in a thermal, or gliding to a landing, maintaining that fuselage attitude controls minimum sink airspeed. Pull the nose up and the sailplane will stall at stall airspeed. Push the nose down and the sailplane will accelerate rapidly out of minimum sink airspeed; too much nose down for too long and the wings will blow off the airline. **MAINTAIN FUSELAGE ATTITUDE!**

At some specific airspeed below minimum sink airspeed your sailplane's wings stop generating Lift, or **STALL**. Properly designed, with either Mechanical or Aerodynamic wing **WASHOUT**, the sailplane stalls basically "straight ahead". Washout prevents **TIP STALLS**, nasty critters which can destroy your sailplane if it's close to the ground...like on launch...or turning in the pattern for landing; if the wingtips stall first, the sailplane rolls left (or right) instantly, and pitches sharply nose down. Luckily for us, the sailplane responds to a stall by dropping its nose, exactly the direction the nose should go to regain flying airspeed (remember Gravity?). As airspeed is regained, Lift regenerates rapidly, pitching the nose up, causing another Stall; this porpoising continues, in most cases, until the sailplane hits the ground, unless you intervene. Assuming your sailplane has enough altitude, Stall recovery is relatively easy, whether flying straight and level or turning in a thermal or landing pattern. **BEFORE** the next Stall occurs, apply **DOWN** elevator. **NOT TOO MUCH DOWN, JUST ENOUGH**, to place your sailplane's fuselage back into that Minimum Sink Airspeed Attitude you have burned in your brain. Then return the stick to neutral; if she looks like she'll pitch her nose up again, **PULSE** down elevator until she settles into hands-off flight.

Turns, especially the **CONSTANT RATE TURNS** used in **THERMALLING**, can be relatively easy to perform. **SET THE BANK ANGLE**, by moving the stick to the left (or right), until the angle is established. Then return the stick to neutral. If the angle is too much, move the stick opposite the direction of the turn to flatten the angle, then return the stick to neutral. If you hold the stick in the direction of the turn, the sailplane will **ROLL** in the direction of the turn and will rapidly begin a downward spiral. When in a turn, aircraft tend to enter a slight dive. To arrest the dive, maintain fuselage attitude and minimum sink airspeed, and help the sailplane **GROOVE THROUGH THE TURN**, immediately apply slight up elevator as the stick is returned too neutral. The up elevator control input tends to tighten the turn, so opposite rudder is necessary to flatten the bank angle. **BANK AND YANK**! Flying is a careful balance of (1) forward and aft stick movements to control the airspeed of the sailplane (by controlling the attitude of the fuselage), mixed with (2) left and right stick movements, to control the angle of bank of the wings in turns. As your experience grows you will notice the stick is constantly moving... Most pilots find turns in one specific direction to be really uncomfortable feeling (for me it was right turns), so they tend to turn only one way. To over come that, practice, over and over, turning in the uncomfortable direction. It really works!

Wind Tip Number 1 - **AIRSPEED** and **GROUNDSPEED ARE NOT THE SAME**. Once the sailplane is free of the winch line it flies at whatever AIRSPEED you have it trimmed for. However, depending on which way the wind is blowing, the sailplane's **GROUND SPEED**, the speed at which the sailplane appears to be travelling over the ground, ranges from really slow (the sailplane fly into the wind) to really fast (the sailplane flies with the wind)! Many pilots panic when the sailplane's Ground Speed is really fast by applying Up-Elevator control in a vain attempt to slow the beast down; if the sailplane is flying at an Airspeed just above Stall Airspeed, the sailplane will Stall. If she's too close too the ground and in a turn, well..., hope you have another sailplane to fly! Don't attempt to fly the sailplane slower, just think faster than she's flying.

Wind Tip Number 2 - The wind always blows at some speed. When you thermal, the sailplane will drift with the wind. I'll leave the whole subject of thermaling to Dave Thornburg, but I will cover one topic; maintaining a constant rate turn in a breeze. Because the sailplane is constantly turning into and out of the breeze, the sailplane will tend to **BALLOON** up as it turns into the wind and will tend to accelerate rapidly (and appear to sink) as it flies with the wind direction. When turning into the wind, you may have to apply DOWN elevator to maintain fuselage attitude. When turning with the wind increase bank angle to maintain the integrity of the circle.

As previously stated, your stick will be constantly moving... Whether your sailplane is at 1000 feet altitude or 10 feet altitude, fly your sailplane exactly the same way. The only difference is you have less altitude in which to make mistakes. Near the ground, plan ahead, make shallow turns, and **DON'T EVER TRY TO HOLD THE AIRCRAFT IN THE AIR BY APPLYING UP ELEVATOR!!! MAINTAIN FUSELAGE ATTITUDE.**

Plan your landing ahead of time and fly a rectangular approach path, just like full size aircraft. Your fellow glider guiders will have you enter a **DOWNWIND LEG, BASE LEG** and **FINAL APPROACH LEG**, if they're experienced pilots. Landings should be made flying into the wind to slow down the GROUND SPEED of the sailplane. Downwind landings can damage or destroy your aircraft. Fly your sailplane to within a few inches of the ground, gently level off and let her settle onto the ground. Save those hard contest landings for next season! **BEWARE THE DOWNWIND TURN CLOSE TO THE GROUND!!**