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The NEW RC Soaring Digest

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In The Air

Sometimes dreams really do come true.

Terence C. Gannon

Leonardo Horta launches in his giant, diaphanous Leprechaun at Parque Rola Moça, Minas Gerais, Brasil in November of 2020. (image: Regis Labatte)

With eleven issues of the New RC Soaring Digest out there in the wild — and a reception by the readership better than I had any right to hope — I think it's time for me to come clean about something. There's no point in mincing words, so here it is:

I have no formal qualifications for editing the New RCSD.

Whew, that feels better. That said, my *informal* qualifications are utterly without parallel: an insatiable passion for the subject coupled with a modest talent for stringing words together in a relatively clear, inoffensive and hopefully mildly entertaining way. That and an uncanny ability to sit very still for long periods of time while moving only nine fingers. I also waded into the exercise with an unbridled optimism I could do the job — substantiated by next to nothing, as it turns out.

So with that haywire resume, it also stands to reason I had absolutely no clue what I would encounter when I started out. I likely still don't know what's coming down the road more than a few days out. I suppose it can't be entirely beginners luck, though, that each issue has launched with more than its fair share of great content, the vast majority of it written by talented volunteer contributors whose writing and photography skills I hope to approach some day. If I'm lucky.

One of the few benefits of not knowing what the hell you are doing is sometimes you don't realise what's impossible. Or, stated another way, I'm probably too dumb to know any better when it's clear I'm punching above my weight.

You can therefore imagine my profound shock when I asked one of my writing idols — Peter Garrison —if he might be interested in contributing some material to a future issue. **And he actually agreed**. Yes, *that* Peter Garrison, of *Flying* magazine fame. Since the late 1960s, his *Aftermath* and *Technicalities* columns in that fine periodical, along with his many feature articles and widely-read books, provide a rich syllabus of aeronautics knowledge any formal program would envy. Amongst Peter's many qualities is a superior ability to take complicated ideas and make them very easy to understand. It's the aeronautical engineering degree I was never able to obtain in real life.

My admittedly thin premise in approaching Peter was whether he might contribute source materials to help readers who are of the Power Scale Soaring persuasion build a PSS rendition of his iconic *Melmoth* design. The short version of the story is that you'll find that material in the *PSS Candidate | Melmoth* article in this month's issue. I also opportunistically use that same article to explain my personal obsession with *Melmoth*. I won't repeat that here, but suffice to say for now it's related to reading Peter's article entitled *The Compass and the Clock*, which was published in the December 1975 issue of *Flying*. I was just 14 years old when I read it for the first of many, many times.

Don't ever doubt the power of the written word to change lives. I can say with absolute certainty my life was never quite the same after reading that article, for reasons I attempt to explain in my *PSS Candidate* piece. I hope you, the readers, will briefly indulge me in the rambling prose therein.

I have always thought if you scratch an RC modeller you'll find an aviator just below the surface. So for those who fit this description — that's all of us, right? — here's the blockbuster: in addition to his invaluable contribution to the *PSS Candidate* article, Peter also agreed to allow the publication of *The Compass and the Clock* in its entirety, right here in RCSD. I hope that this additional provenance will provide a powerful incentive for one or more (or many!) scale *Melmoths* to get built and flown.

If I can be permitted to say just one more thing on this before moving on to the other great content in this issue. While it's not an entirely objective measure — I do, after all, have *some* influence over whose work appears in RCSD—having my byline appear in the same issue of the same journal as Peter Garrison is quite simply one of the great honours and priveleges of my life. It's my equivalent of shooting hoops with Michael Jordan, talking movies with Tom Hanks or playing the back nine with Tiger Woods.

That, all by itself, makes me one of the luckiest guys alive. Sometimes dreams really do come true.

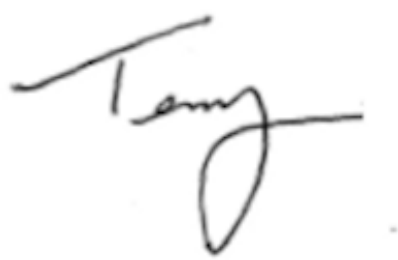
The editorial staff and I have come up with what we think is a bumper crop of great stories for this issue. First, we have a great new first time RCSD contributor: Marc Panton arrives on our pages with a comprehensively-illustrated and well-written tutorial called *What a Tool! Servo Templates for Dremel Rotary Tools*. Welcome aboard Marc, and we hope it's the first of many. Along with Marc, we also have another 'first timer': Rex Ashwell who contributes *Going Postal*. Actually, first timer is only true for the *New* RC Soaring Digest. Many of you will recognize Rex's name from his many articles in the legacy RCSD. It's always a thrill when a well known and respected contributor from the latter makes the leap to the new, digital-first publication.

We have very welcome return visits from a long list of past contributors: John Marien follows up his very popular *Cross Country Soaring with a Rabbit* with a deep dive in *Re-Envisioning a 30-Year-Old Classic Cross Country Design*; James Hammond provides Part IV of his acerbic series *So You Want to Be a Composite RC Sailplane Manufacturer?* Harry Curzon has written up a primer on an exciting new capability of Jeti transmitters. Peter Scott's third part of his *Kinetic* series is also out, this time looking at its relationship to L/D ratio. As I've said to Peter, if he had been my physics teacher in high school, things might have turned out better for me.

We also have our 'foundation' contributors: our regular visit from Sensei Norimichi Kawakami with the next buildlog instalment for his magnificent *Mita 3* — part eight of twelve. Tom Broeski is also back with another tip with its usual high quotient of "that's such a great idea!" Bob Dodgson adds to *The Dodgson Anthology* with an article which combines RC gliders and motorcycles. If he had somehow managed to shoehorn beer into the mix, he would have hit the journalistic trifecta for RCSD's core demographic. But two-out-of-three ain't bad and as always, Bob's article makes for exceedingly entertaining reading.

Well, that's it from the cluttered mind and desk of your Managing Editor. Please click the link below and head off to the first article in our November 2021 issue and, as always, please **let us know** how we did. And, seriously, thank you so much for reading.

Fair winds and blue skies!



Cover photo*: For the November issue, we're featuring this idyllic, late summer photo by Erik van der Kooij of his kids Lisa and Jelle retrieving Erik's ASH 26. It was taken in the Netherlands in 2010 and is used here with Erik's kind permission.*

Here's where you can find the ***first article*** *in the November, 2021 issue. Or go to the* ***table of contents*** *for all the other great articles. A PDF version of this edition of* In The Air*, or the entire issue, is available* ***upon request***.

Letters to the Editor

What's new from the readers' side of the typewriter.

[The NEW RC Soaring Digest Staff]

Have a glider stamp you would like to contribute our montage? We would love to from you. (images: Wikimedia and Flickr)

The term Letters *in the title definitely gives the impression the only 'letters' which qualify are those consisting of mainly text. Far from it. Have a great picture — like this one from RCSD contributor Chris Williams — you would like to share? By all means [fire it along] and we'll be happy to include it here. Don't forget to provide a few details to post as well.*

Hi Terry,

In our part of the world (Southern England) the advent of the Autumn/Winter seasons brings lots of little gifts, like frostbite and unfriendly storms, fresh from the Atlantic. It also brings forth mist and lingering low cloud, all of which can add plenty of spice to a photograph, evident here in this shot of Motley Crew's ¼-scale *Bergfalke 4*, caught one misty morning at White Sheet Hill a few weeks ago…

More than happy to oblige, Chris, and thank you for sending it in. It occurs to us that readers might like to use it as wallpaper for their desktop. So here it in gorgeous ***high resolution****. Send your letter via email to* ***NewRCSoaringDigest@gmail.com*** *with the subject 'Letters to the Editor'. Note that we are not obliged to publish any letter we receive and we reserve the right to edit your letter as we see fit to make it suitable for publication. We do not publish letters where the real identity of the author cannot be clearly established.*

Read the ***next article*** *in this issue, return to the* ***previous article*** *in this* *issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

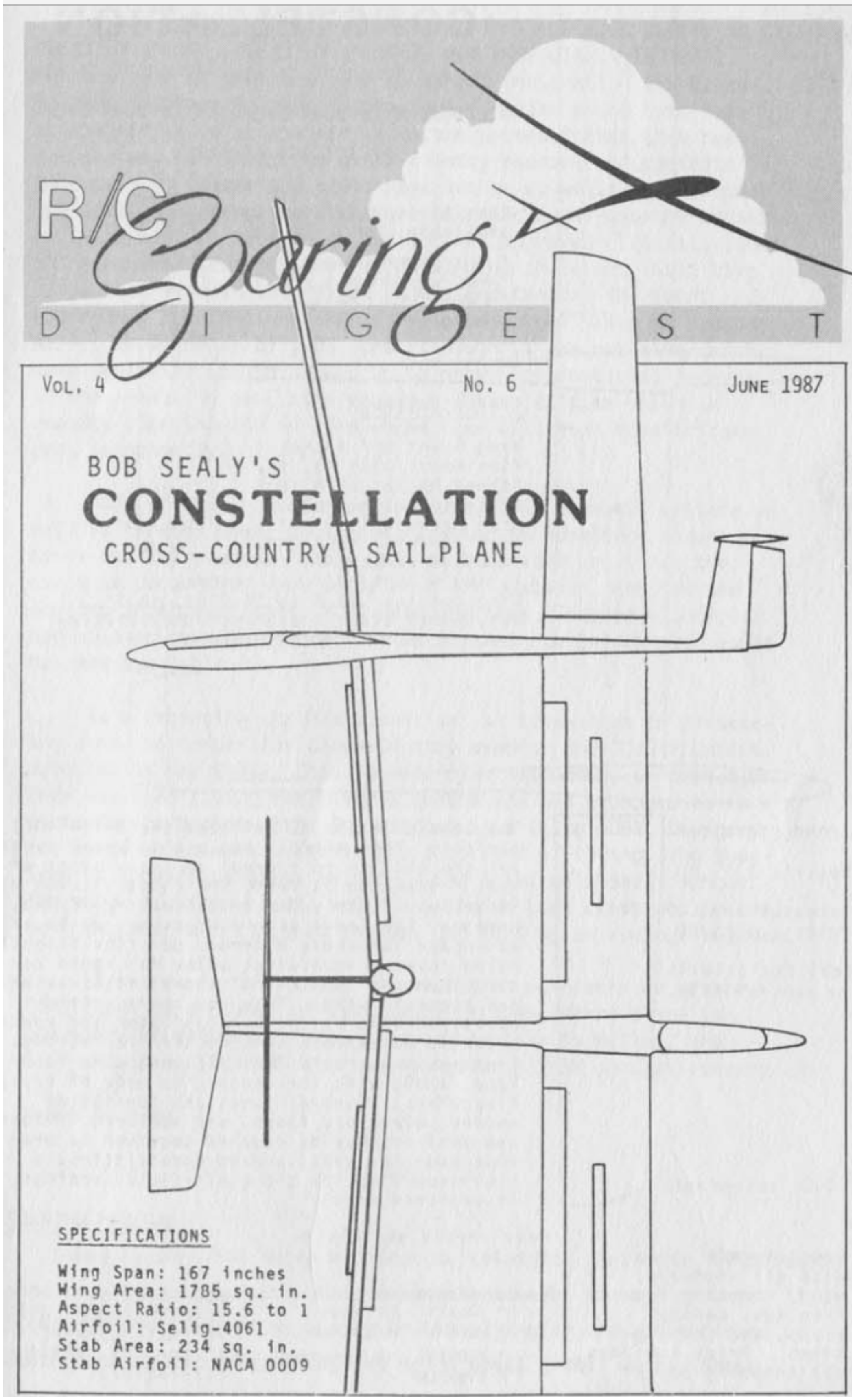
Re-Envisioning a 30-Year-Old Classic Cross-Country Design

Taking an iconic design from the 1980s and recreating it with 21st century materials and techniques.

John Marien

The 2021 version of the Bob Sealy Constellation cross-country sailplane.

I was flying cross-country soaring and a friend came by to watch. After a while he mentioned that he and his brother used to fly *Constellations* from early morning till late afternoon on a single launch while sitting in their lawn chairs. Sometimes, they would get in their Country Cadillac (pick up truck) and run down the road chasing the *Constellation* when it was flying fast. It sounded like so much fun. I decided to seek out a 30-year-old kit to begin my journey with the *Constellation*. But no kits were available.



Cover page of an RC Soaring Digest from 1987!

I asked around until I found someone who knew how to get in contact with Bob Sealy to see if he was still selling plans for his kits including the *Constellation*. A couple of calls later I reached Bob and was surprised when he told me he could make up a new *Constellation* fuselage set for me. A new fuselage and a set of plans were on their way shortly after that. The plans arrived and they were in line with the best plans of that day, 30 years ago and were for a builder's kit. Forget about what you see for plans for today's kits, if they have them, these plans had the basics in a scaled down plan set. After a few emails back and forth with Bob, I had all I needed to start acquiring the parts to put this beauty together.

Even back in the day, nobody built 'exactly' to someone else's plans. We all have our pet ideas on what works best for us and what is familiar. That is when the idea struck me to build this sailplane in the spirit of the original design re-envisioned using today's materials and techniques that were just not available back then.

The first change was to replace using white beaded foam as the cores for the wings, stabilator, and rudder. I went with *Hiload 60* blue foam from Owens Corning. I have used this foam for all of my vacuum bagged wings for the last decade, or more. Next up was that the original *Constellation*, *Connie* for short, had a polyhedral wing. With a span of 167″ those inner and outer panels were 42″ long and they had a 12-degree dihedral in them in the middle. Hmmm, they were not going to fit in my car that way.

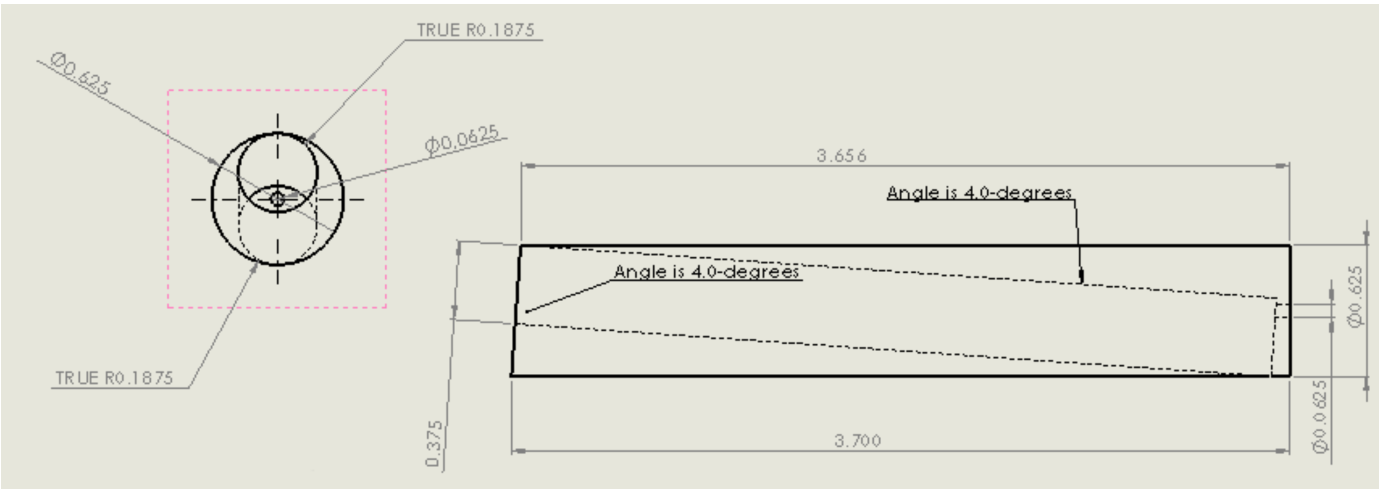
This led to the second change: each wing side would be made of two panels with a 12-degree joiner to ease storage and transport by packing flat. Although washout was not called for on the plans, I had 2-degrees of washout built into the inner panels for better flight characteristics. This would force the wing inner panels to stall before the outer panels and would still allow for some aileron effectiveness. By building the washout into the inner panels instead of the outer panels I could have more washout effect at the tips for the same number of degrees of washout. It is more efficient this way.

The third change was to replace the *Connie's* main spar, which was built up from spruce and shear webs, with a carbon fiber tube. The aft spar was relocated to be on the CG to make it easier to balance the *Connie*. This spar ran the full length of the inner panel and continued halfway through the outer panel. This allowed for a joiner to be fashioned from a steel tube bent to 12-degrees then trimmed to fit snugly in the carbon fiber tube. But what size carbon fiber tube would I use? I selected a strong carbon fiber tube with an inner diameter (ID) of 0.625" (5/8″) so that I could use 5/8″ outside diameter (OD) steel tubing for the joiner between the inner and outer panel. That worked out great!

Turning my focus back to the root of the wing where it met the fuselage, I ran into a problem. Since these wings plug into a 3.5″ wide fuselage at a 4-degree angle per side. Bending a joiner to make the 8-degree dihedral angle would be easy. But there was that fuselage in the way. I would need two 4-degree bends in the same plane ***and*** 3.5″ apart. This was beyond my tube bending skills. I did try though.

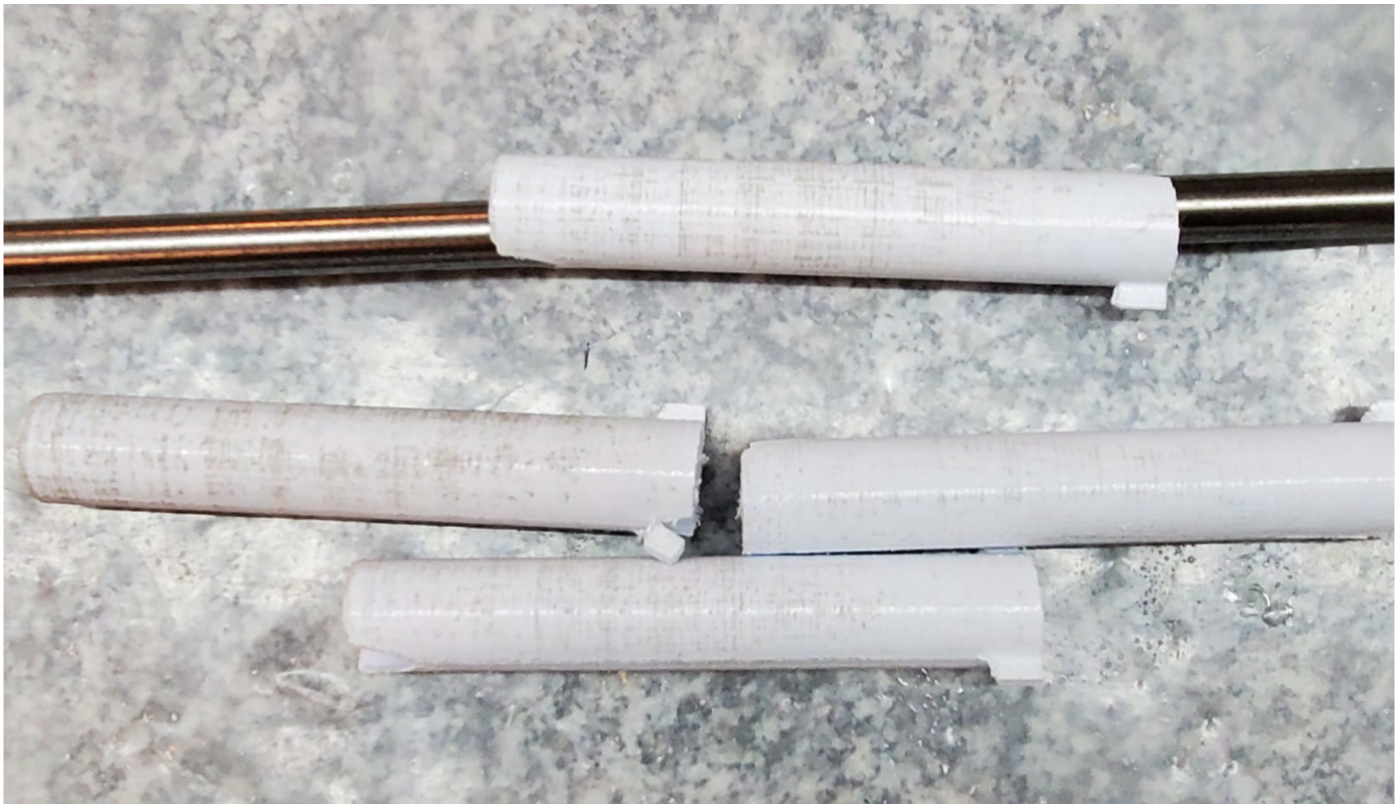
To solve this problem, I went back to Bob's plans for the *Connie* and saw he used a straight joiner through the fuselage into 4-degree angled tubes buried inside the spar trapped by spruce triangles. That was a great two-dimensional solution. But how could I do that with the carbon fiber tubes I was using as a spar in three dimensions? I needed a tubular adapter that slid into the carbon fiber tube and had a bore hole through the adapter at 4-degrees. I tried to manufacture these from wood, but ultimately failed because of needing a longer drill bit than I had available and more depth than my drill press could muster.

Then the answer came to me: 3D-print the part. A quick drawing in 3D CAD and off went the *Standard Tessellation Language* (STL) file to two friends who each had 3D printers. The idea was to 3D-print the adapter with a 3/8″ OD bore hole through it at a 4-degree angle.



2D CAD drawing of the dihedral adapter.

I planned to insert a 3/8″ OD brass tube into the adapter and then the 11/32″ hardened steel ejector pin would be the joiner. After the prototype adapters came in, we selected a different 3D-printing material and then printed the four adapters needed. Instead of using the brass tube sleeves, I went with a 3/8″ diameter hardened steel ejector pin as the joiner. I felt the thicker joiner would be more beneficial going through the fuselage than the brass sleeve would give me in the carbon fiber tube. The main spar joiner assembly was now solved. That left the second spar to deal with.

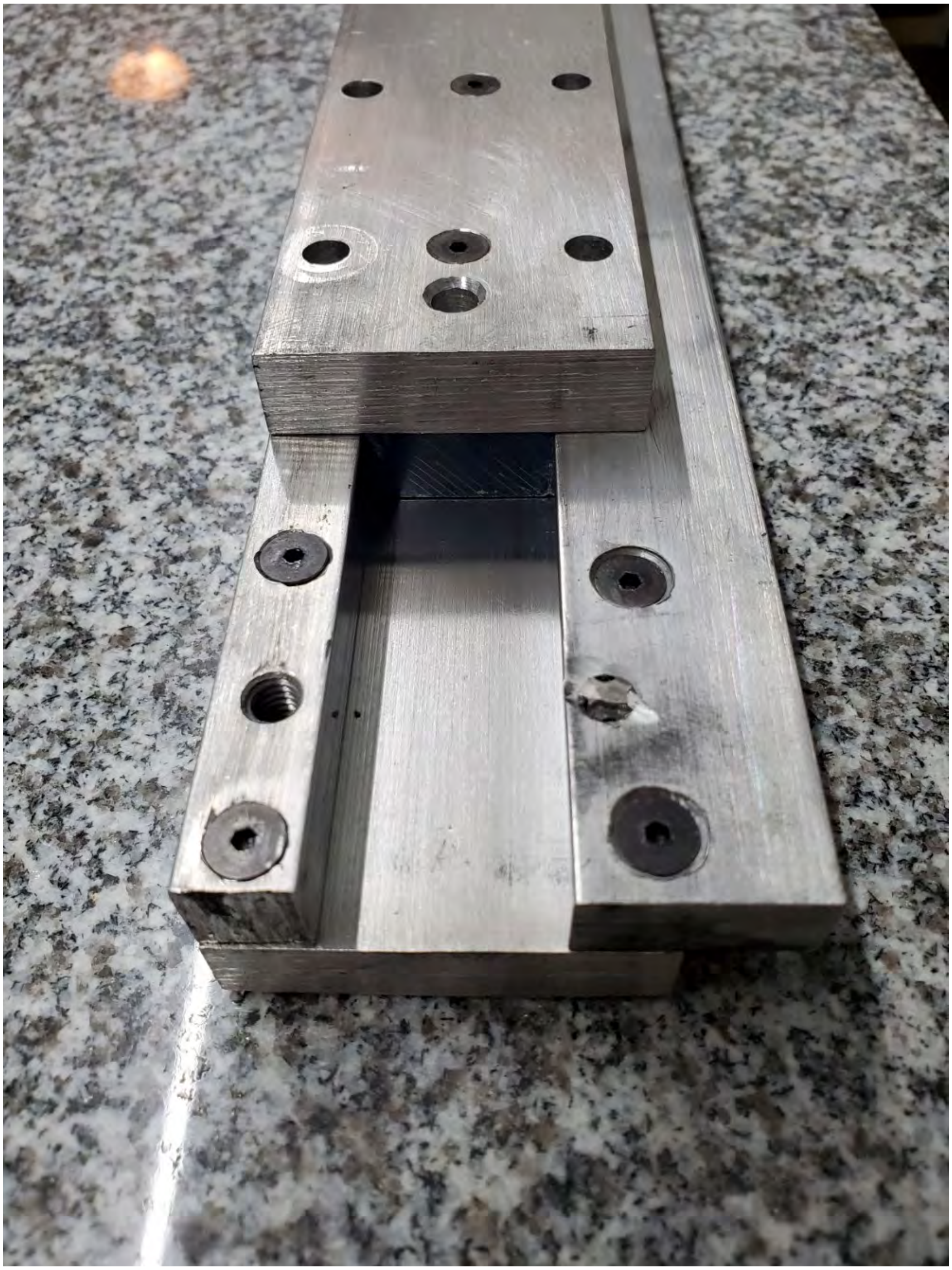


3D-printed dihedral adapter with alignment tabs and a 3/8" ejector pin as a joiner rod.

Here I opted to move the spar forward towards the thicker part of the airfoil up front. Instead of using a full-length carbon fiber tube for this spar, I only used a length of tube a little longer than the 3D-printed adapter. I added three laser-cut 3mm plywood ribs to support the tubes and spread the stress to ensure both of these carbon fiber tubes did not push through the bottom of the inner panels when the wings lifted up. However, I was not finished. A year before I ever knew about the *Connie*, I built a 48″ long carbon fiber spar press.

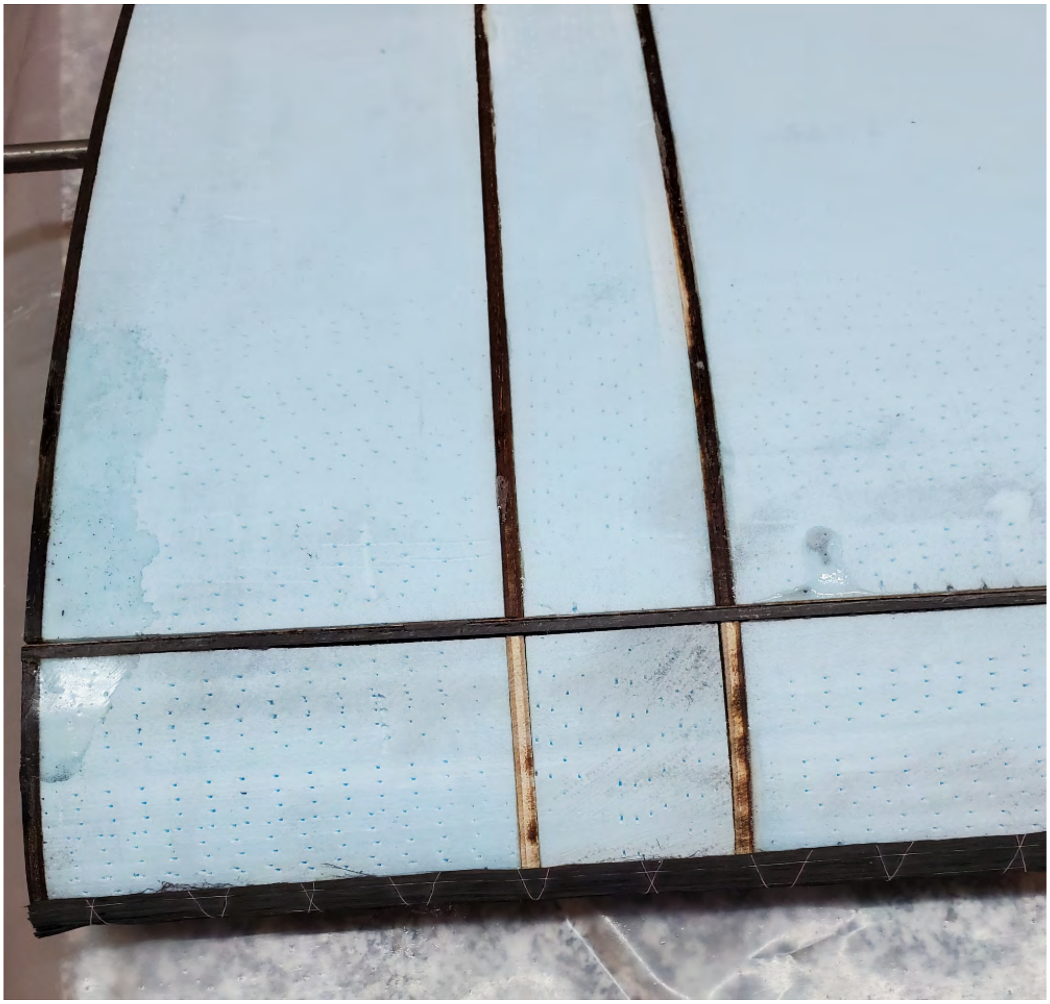
Aluminum blade jig made by the author.

This press allows me to seriously compress carbon fiber while the epoxy is curing and to squeeze out as much epoxy as possible. The entire jig fits into a long heavy carboard mailing tube which served as a hot box or hot tube. Using MGS epoxy, 24 hours in the hot box, and I could get six layers of C68 unidirectional high modulus carbon fiber and one middle layer of 1.7-ounce *Kevlar* at a 45-degree bias compressed down to 2mm. I decided the *Connie* would benefit from a blade spar like this. I cut the groove for the blade spar using my table saw with a blade kerf to match the thickness of the blade spar.

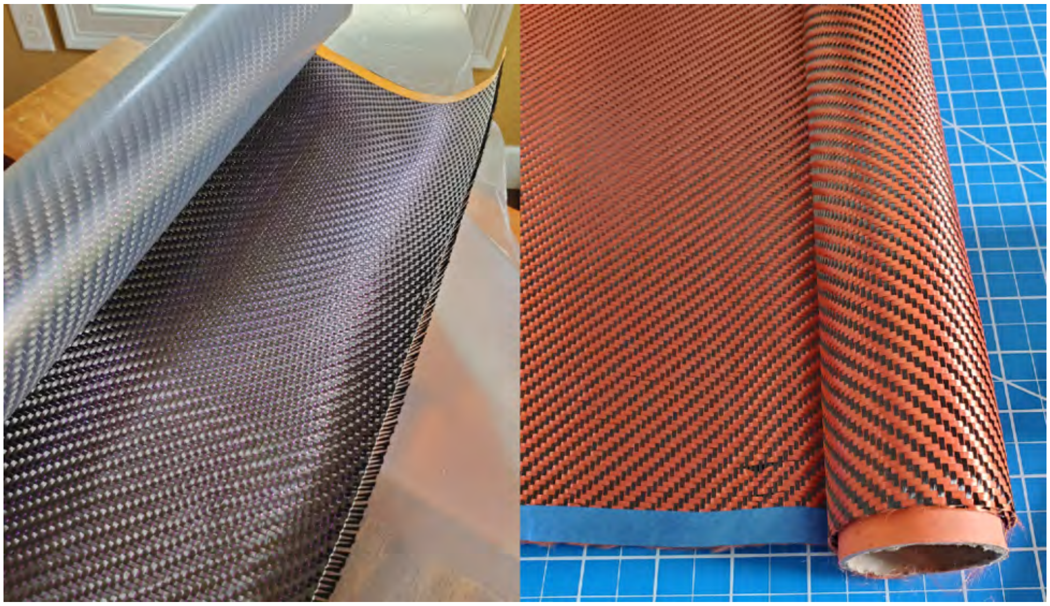


Blade spar jig end view. In use, the top and bottom would be aligned.

The spar was 1.00″ wide, and I located the kerf cut exactly at 1.00″ thickness of the airfoil and scraped up against the back of the forward carbon fiber tube spar (the short one). This gave me 6″ of overlap contact between the short tube spar and the blade spar. The tube spars were glued in place with MGS epoxy along with the three plywood ribs and the blade spar and the assembly was allowed to cure overnight.



Left inner wing panel showing the three 3mm plywood ribs supporting the hidden tube spars and the visible blade spar and showing the carbon fiber leading edge material.



Left is the heavier carbon fiber cloth for the inner panels and on the right is the lighter carbon fiber plus Kevlar weave for the outer panels.

Right inner panel after vacuum bagging the top and bottom skins in place showing the dihedral joiner adapters (in white) glued inside the carbon fiber tube spars. The painter's tape is just to prevent scratches to the panel as it is moved around and fitted to the model.

The next change on the agenda was that the original white foam cores were sheeted with 1/16″ balsa. I chose to use a 5.9oz per square yard carbon fiber cloth in a twill 2x2 weave with an interlaced thread of purple nylon (adds sparkle) for the inner panels. For the outer panels I used the same 2x2 twill pattern but used C68 carbon fiber running lengthwise and orange-dyed *Kevlar* running widthwise for three-quarters of the outer panel with the last quarter being just 1-ounce fiberglass cloth, no bias.

The bottoms of both inner and outer panels were laminated with C40 unidirectional carbon fiber. The blade spar contacts the top and bottom of the foam cores so that the carbon cloth of the top and bottom of the inner panels contacts it and forms an I-beam and the wrap around carbon fiber around the nose of the airfoil completes the D-tube structure.

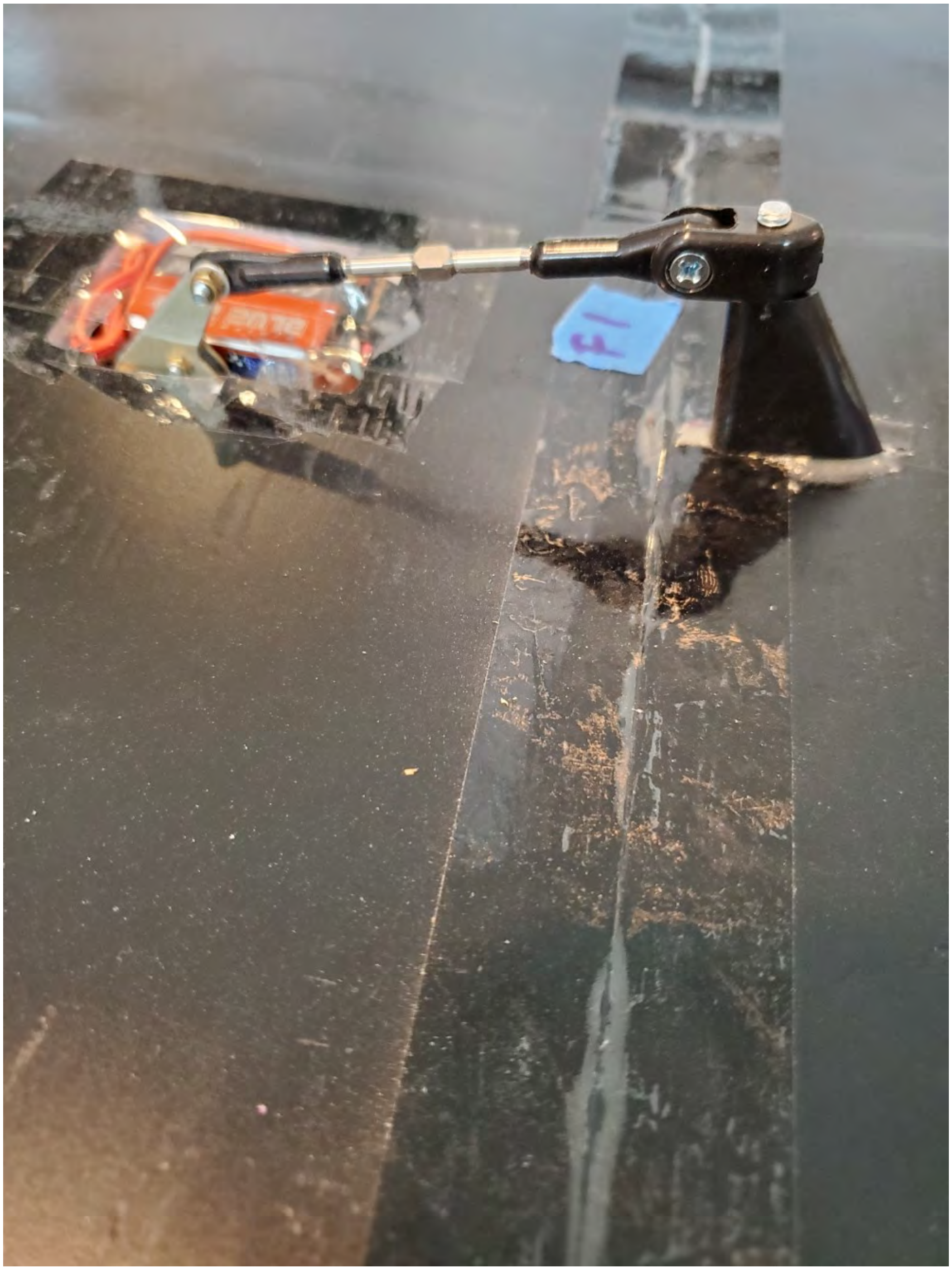
Having designed, built and flown, several cross-country sailplanes, I know there is a tremendous amount of stress on the inner panels when winch launching. The hollow carbon fiber tube might compress and bend under that stress, compromising the panel. To combat this, I obtained several very light hardwood dowels, one for each side cut to length. I made score marks along the length and a few divots here and there, and glued them into the carbon fiber spar tubes leaving the ends open for the adapter on the root side and the 12-degree joiner on the tip side. I used slow MGS epoxy so that I had plenty of time to get these dowels in the right place in the carbon fiber spar tubes.

When specifying the foam to be cut for the wings, I failed to recognize that while the foam inner panel I ordered would be a perfect rectangle and the fuselage intended to have the wing meet at a slight angle. Therefore, the root of the inner panel was intended to be a trapezoid. I discovered this after the inner panels were vacuum bagged while I making my first trial fitting of the wing panel to the fuselage. Why is there a gap at the trailing edge? *Sigh*. I did not want to cut away the root edge of the inner panel because of all the work I had done there to support the two spars and joiners. The only option left was to extend the fuselage wing fairing so that it mated to a rectangular inner panel. The process was simple. I used clear packing tape to cover the wing's root edge and up onto the wing itself both top and bottom. A little Maguire's paste wax was added as a mold release to the tape's smooth exterior. I attached the inner panels to the fuselage leaving the gap at the rear. Using 3mm clear packing tape, I sealed the gap on the bottom and rear of the joint. I mixed up a slurry of MGS epoxy with slow hardener, chopped fiberglass, and colloidal silica to act as a thickening agent, and proceeded to trowel it into the cavity. I used a toothpick to poke at the slurry to ensure all the air bubbles were released and to ensure the slurry made its way into the corners of the gap. A quick pass with a *MonoKote* heat gun (to remove small bubbles from the slurry) and then it was left to set overnight. The next day, I removed the tape to find a close to perfect fairing between the wing and the fuselage. Now, the moment of truth came — would the wing inner panel separate from the new fairing to the fuselage? I lost sleep wondering if I had done enough to ensure a clean separation. With a slight tug, the wing's inner panel separated from the now cured slurry mixture. Success! There were a couple of minor imperfections that I fixed with the next batch of slurry and a finish sanding and all was good to go. There was also the added benefit of a much thicker, and stronger, fuselage side wall to support the ejector pin joiners going through the fuselage.

Here you can see the long flaps, the spoilers (retracted), and the tillerons at the end of the wing.

The *Connie* was designed as a rudder, elevator (t-tail), flap, and spoiler cross-country sailplane. The combination of spoilers and flaps intrigued me and I had to try it. But having flown several large rudder, elevator, spoiler (RES) sailplanes, I know they can wallow on landing unless you have a nice straight approach. On a cross-country course, you do not always have that luxury. I wanted more control. My solution was to keep the 12-degree dihedral between the inner and outer panels and to add a tilleron (small aileron) to the outside edge of the outer panels.

The spoilers on the plans were drawn in the traditional way with a pull string to a servo in the fuselage and a spring to pull them closed again. Great old-school design. I tossed that notion aside and purchased a set of electronic blade spoilers. After the wing was bagged, I marked the top skin and cut away the carbon fiber skin and then, using a hand-held hot wire jig, cut the trench for the blade spoiler and its little integrated servo. I located the spoiler right in between the two spars to avoid compromising the strength of the wing. I used shoe glue to secure the spoilers into their trenches.



Strong micro servo, double-truss servo arm, and slop-free 4–40 connections for the flaps.

All that was left to complete on the wings were the flaps. Instead of cutting out the 2.25″ wide by 20″ flaps, I used my table saw to cut through the top skin of carbon fiber and through most of the blue foam leaving the bottom skin intact. I enlarged the flap chord to 3.00″. I like flap authority. I calculated, like any engineer on a napkin, the amount of drag and down-force the 18″ spoilers were going to generate and balanced that against the up-force the flaps were going to generate. I used a hobby knife to cut through the remaining blue foam to expose the 45-degree bias 1.7-ounce *Kevlar* hinge I had built in before vacuum bagging the wing skins. The flaps were born! The kerf of the table saw allowed for the flaps to have reflex capability for speed mode. As a side note, I go over every hinge with a very thin smear of silicon sealer to form a living hinge and on the other side I use a 1″ strip of book tape to ensure my hinges don’t fail in flight, from a high-speed run, or hard landing.

With all these changes, someone might think I was done. Not so. We have yet to speak of the elevator and rudder servo installation. I don’t like pushrods that flex. Cross-country sailplanes are heavy and have a lot of stress on them. I decided to mount the servos in the vertical fin. What? Servos in the tail! That is a huge weight penalty! Ah, but think about it. Servos back 30-years ago were analog and weak compared to today’s modern F3J-capable mini servos or flat wing servos! For the weight of half of one older servo, I could get two modern wing servos in the tail with three times the torque and direct solid linkages to the rudder and elevator. One custom 4-wire cable from the RX though the fuselage to the tail completed the servo installation. Oh, and yes, I used modern lightweight but very strong servos for the flaps and lightweight servos for the tillerons. My target weight for the *Connie* was the 5kg maximum weight for an F3H cross-country sailplane.

All the fuselage needed now was the flight pack battery, the 10-channel receiver, and nose weight for balance. I used the biggest battery I could fit in the fuselage, enough for a full day of cross-country flying, and used lead bird shot for the balance secured in a *Ziploc* bag and stuffed into the nose of the fuselage. All up weight, ready to fly was 5kg. I did consider making the fuselage in two pieces. In fact, it comes from Bob as a forward and aft section that is glued together with a 5″ overlap. However, I was running short on time and decided to glue the fuselage halves together.

Of course, no model is finished without graphics! I used my laser cutter to make up custom graphics for the *Connie* from self-stick reflective material. I cut graphics that included the name of the model, my AMA number, phone number, and my FAA number.

Custom, laser-cut graphics complete the *Constellation*.

The Constellation is being both weighed and having its CG measured using a modern electronic CG scale that was also 3D-printed.

I had some friends give me a hand doing hand tosses to ensure I had the elevator set at neutral and the flaps + spoilers were balanced. Yes, the flaps, and spoilers were both activated by the flap stick and were tied together through my computer radio. The first toss, made by Wally 'By-Golly' Adasczik LSF President extraordinaire, went perfectly. No adjustment to the elevator was needed. Not even one click.

Wally 'By-Golly' (left) steadies the Constellation before the first hand-toss as the author straightens out the gap tape between the left inner and outer panels. (image: Mike Bergerson).

The second toss confirmed this and that the I hit the correct balance of flap to spoiler so that no elevator compensation was required! I'd like to say that the painstaking calculations I did during the pre-build, build, and selection of throws and spoilers etc. was responsible for hitting that mark. However, it was dumb luck. Even a blind squirrel finds a nut once in a while.

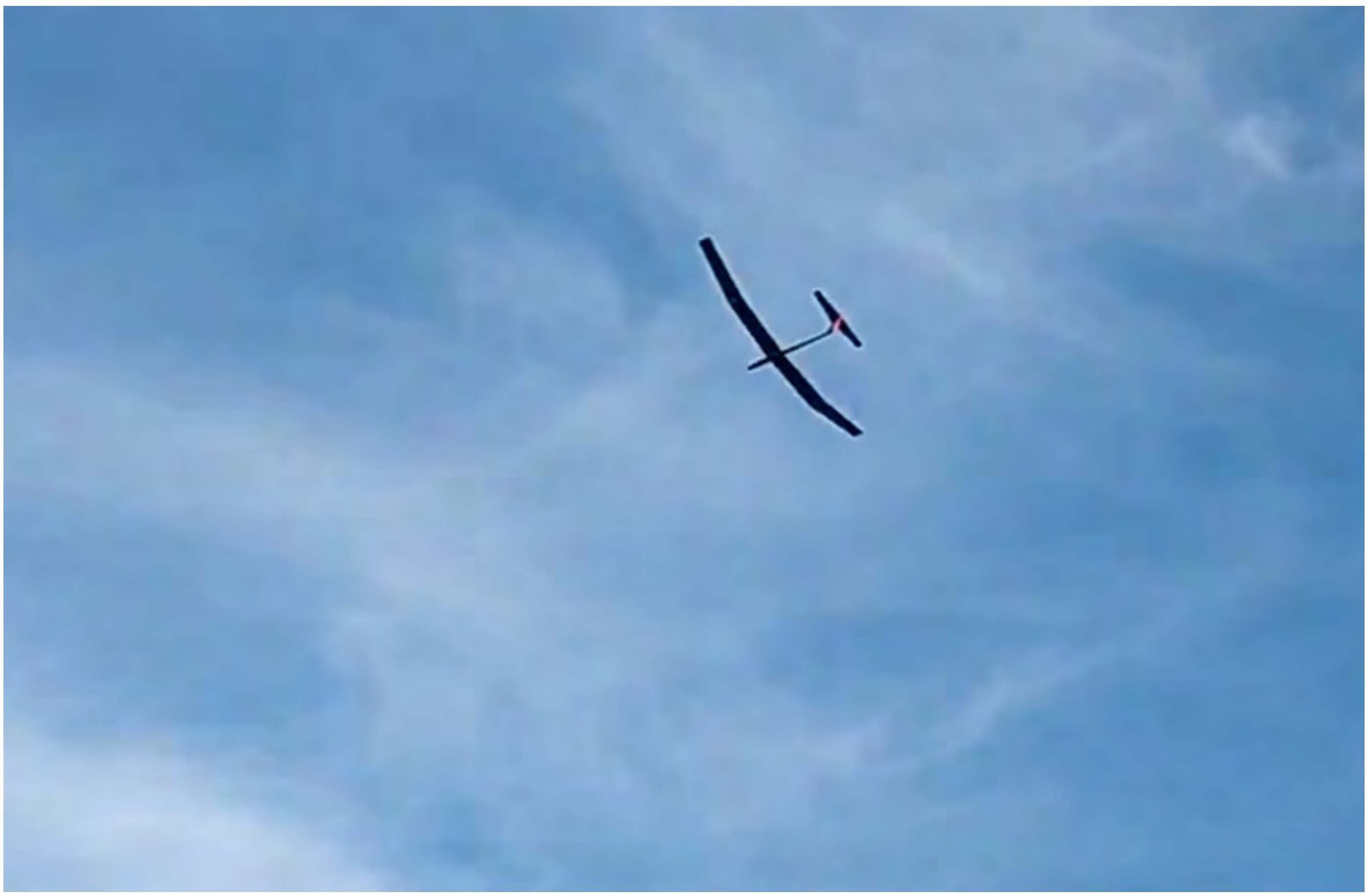
After two more hand tosses, Wally was tired and wanted to go home. In fairness, he had just finished being the Contest Director (CD) for a two day ALES contest. Now, it was time for the winch launch. Rise off Ground (ROG) was selected. Going back a moment, there is nothing on the plans that describes how much throw to put on any surface. I guessed that I would use as much throw as the surface could give me. That is how the radio was set up for the first winch launch. Get ready for a wild ride!

One helper held the wing tip level, another was recording the launch, and I stepped on the winch pedal and the launch commenced. If you have ever seen a graceful straight like an arrow launch from a winch for a new sailplane and the joy that brings…

The Constellation veering hard right on launch. (image: Mike Bergerson)

You would have been in shock at the sailplane veering hard to the left. But I kept it on the line and corrected its flight path, but overcorrected and the sailplane veered hard to the right. I corrected less this time and got her centered and up like an arrow she went.

We were going for an initial short line launch with 120m of line from the winch to the turnaround pully. At the top of the line as the *Connie* came off the line, she stalled, hard just like a Sailaire. I could see her going into the stall and pushed all the down elevator I had. After the stall, the *Connie* headed for the ground and I pulled up with everything she had and she pulled herself back up and into the second stall but this time dropping the right wing and turning as she flew and now heading downwind. I corrected, or overcorrected, and she came nose up again and stalled a third time to the left. I got her back out of the stall without inducing a fourth stall and now she was heading towards us. I can hear the photographer, Mike Bergerson, saying "John's just getting the feel for her and he's going to smooth it out any moment now". Another bystander, who was running for the safety of the pits, called out "the balance is off, she's tail-heavy." I love it how everyone is willing to give you advice when you are fully concentrating on flying your sailplane as if you have time to listen to them. But just as Mike said, and as if on cue, the *Constellation* calmed down and flew gracefully around the sky even gaining a little altitude when turned into the wind. A part of me wishes Mike had said that two stalls earlier.



Constellation soaring majestically overhead. (image: Mike Bergerson)

The plane was fine, I just needed to recalibrate my fingers on the sticks and stopping the pilot induced oscillations. I flew the *Connie* for a few more minutes and at around 50 feet high decided it was time to land. A 270-degree turn to head into the wind and set up for the landing, I engaged the flaps and spoilers and the *Connie* slowed down to a crawl but did not pitch up or down. The *Connie* made a beautiful landing.

I succeeded in resurrecting a 30-year-old design, building it with modern materials and construction techniques. I came away with a cross-country sailplane at 5kg that can take a full-pedal winch launch from a powerful winch without flexing the wings or having the sailplane breakup on launch.

I was very happy with my creation and I sent a note to Bob through email describing the changes I made in materials while keeping true to his design. Bob replied with a very heart-felt letter, an excerpt is reproduced here:

> *"I can't thank you enough for the feedback and pictures. I read your email several times. Your detailed descriptions of your construction techniques were awesome. It makes me feel good, make that great, seeing some of the old designs from 30+ years ago, flying these days… Your pictures and email bring back many fond memories of years, make that decades, ago. I can't thank you enough for sharing your experiences with me…May you have many, many, great flights with the Constellation and Catalina." — Bob Sealy (provided with Bob's permission).*

I encourage all of you to try your hand at resurrecting an older design, re-envision it with today's knowledge and materials, build memories, get out there, bring a buddy, and enjoy soaring!

The *Connie*, and my *Catalina* (see *Resources*, immediately below), are both vying for my attention at the flying field. The Rabbit is happy it gets to carry either of them into the air!

Resources

- **Cross-Country Soaring with a Rabbit** My adventures with my *Catalina* sailplane as recounted in the October, 2021 edition of the *New RC Soaring Digest*.

*Images by the author unless otherwise noted. Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

What a Tool! Servo Templates for Dremel Rotary Tools

An illustrated tutorial along with free-to-download plan.

Marc Panton

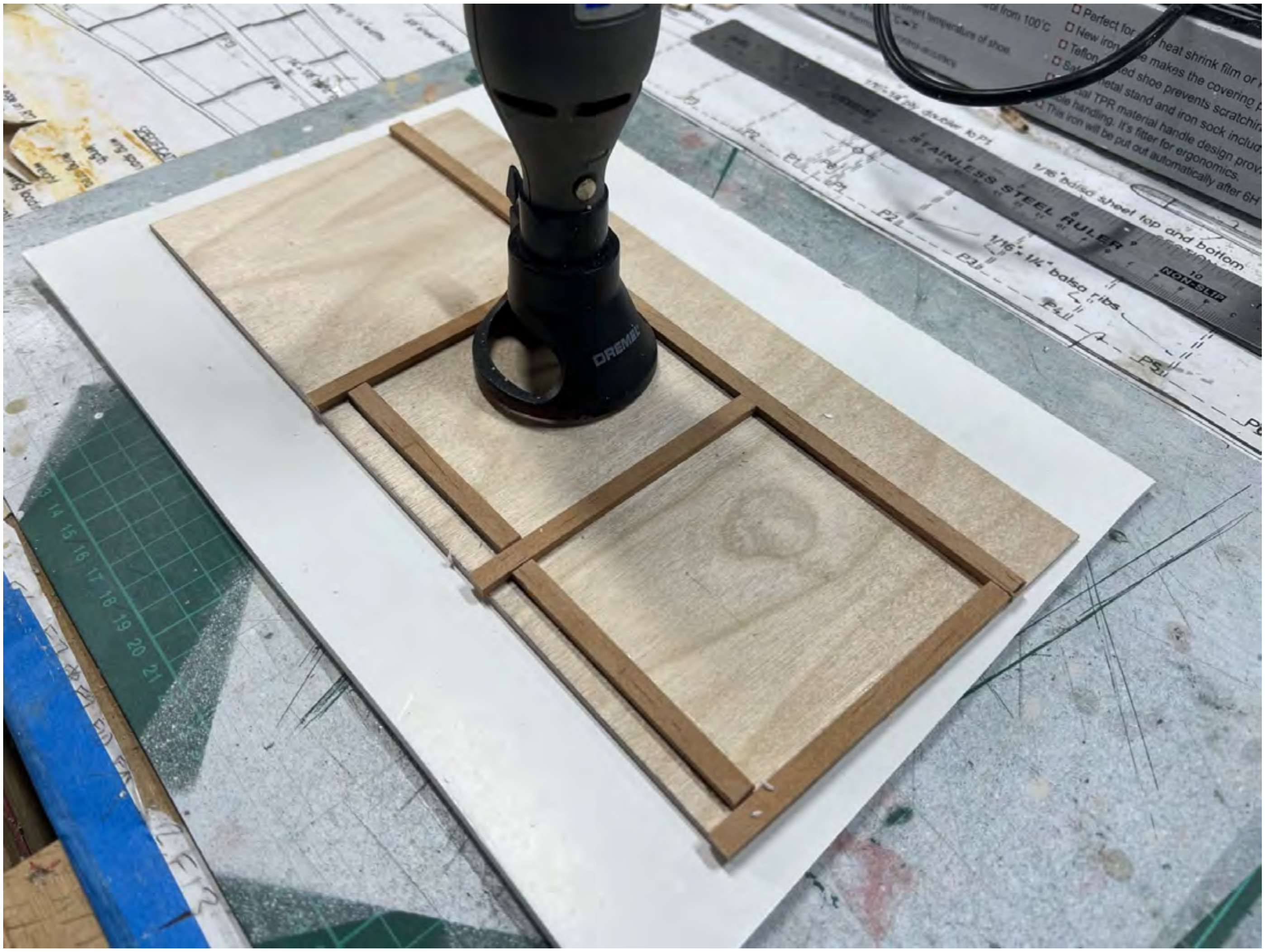
Now that building season is here in the Northern Hemisphere, I dare say there will be a few of you needing to fit servos into foam wings. If you've had shop bought/RTF foamies in the past, they probably had nice neat servo pockets and cable runs already neatly moulded into the foam with the servos pre-fitted. If you've bought ARF type kits, they too probably had the servo pockets pre-cut though the veneered wing skins, nice and neat, ready for you to just drop a servo in and go fly.

But what if you are scratch building or perhaps you are modifying by adding ailerons or flaps to a vintage model? You can hack away with a craft knife and some pliers, it will work but its not ideal. You might try reaching for the rotary tool and free-handing it. Again, it will work, but unless you're very good, its hard to get repeatable results.

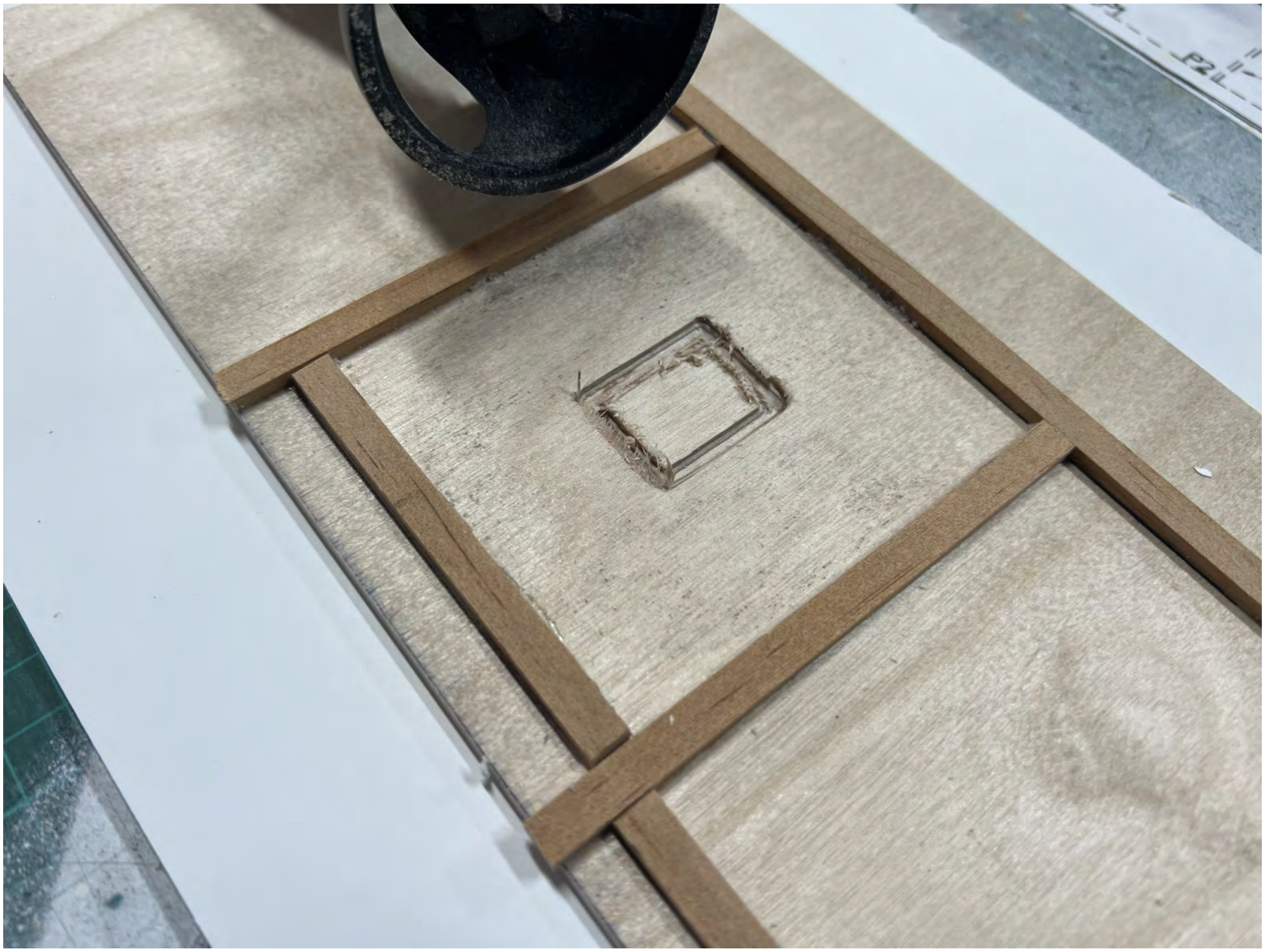
Faced with the need to fit some servos to a scratch build I have underway (for another article to follow in RCSD) and wanting to make a neat job of it, I set about creating a simple, reusable template to use with my trusty Dremel. In the world of woodworking and carpentry, jigs and templates are frequently used to make repeatable cuts and enhance accuracy, the same ethos works for modelling!

With the Dremel in 'router mode' (I'm using the 'cutting guide' attachment that comes with the drywall cutting attachments — see link in *Resources*, below) wherein the 'cutting guide' becomes the equivalent of a woodworker's router guide and depth is set from the same cutter guide. Now all that's needed is some measurement and 10 minutes with some wood from the scrap box.

Making the initial cuts to the template, after the boundaries were glued to the base.



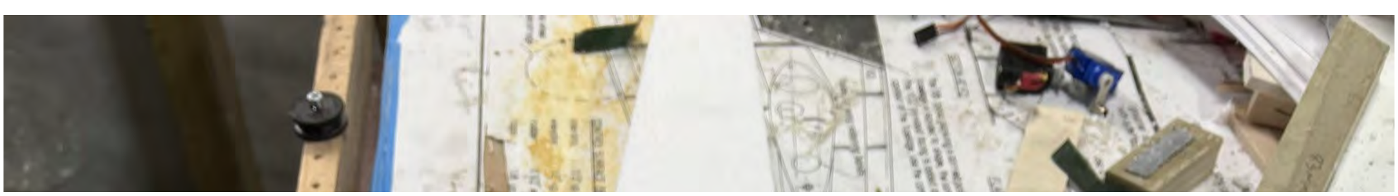
First pass, I’m not going the whole way through the 2mm ply.

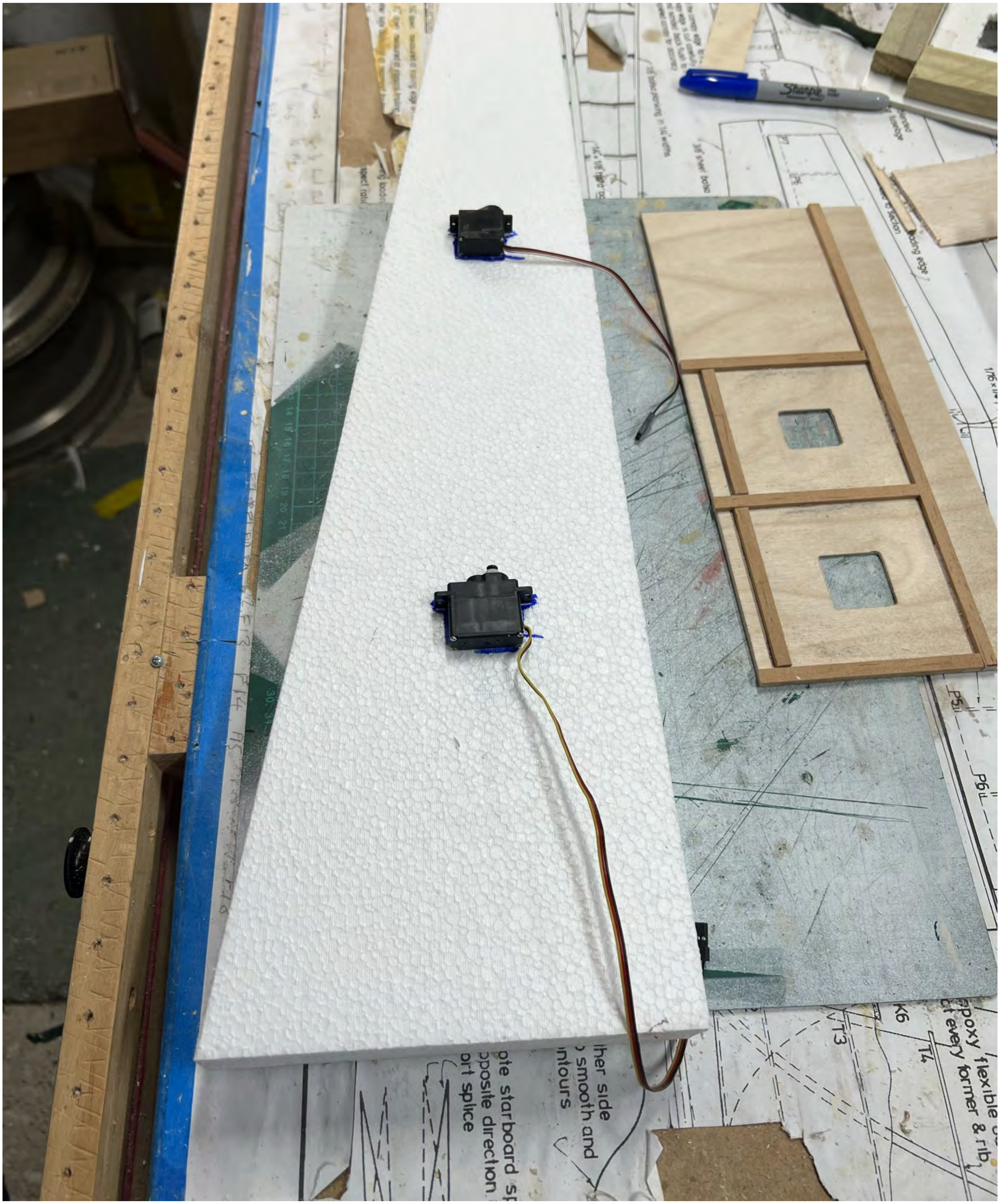


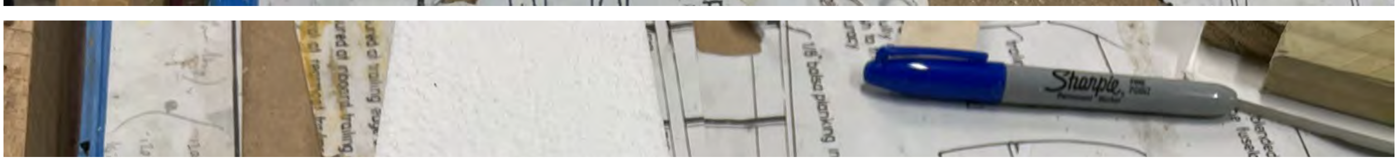
Second pass, I make the full depth cut through, ensuing there's something sacrificial underneath! Then neaten up the edges with a file or sandpaper.

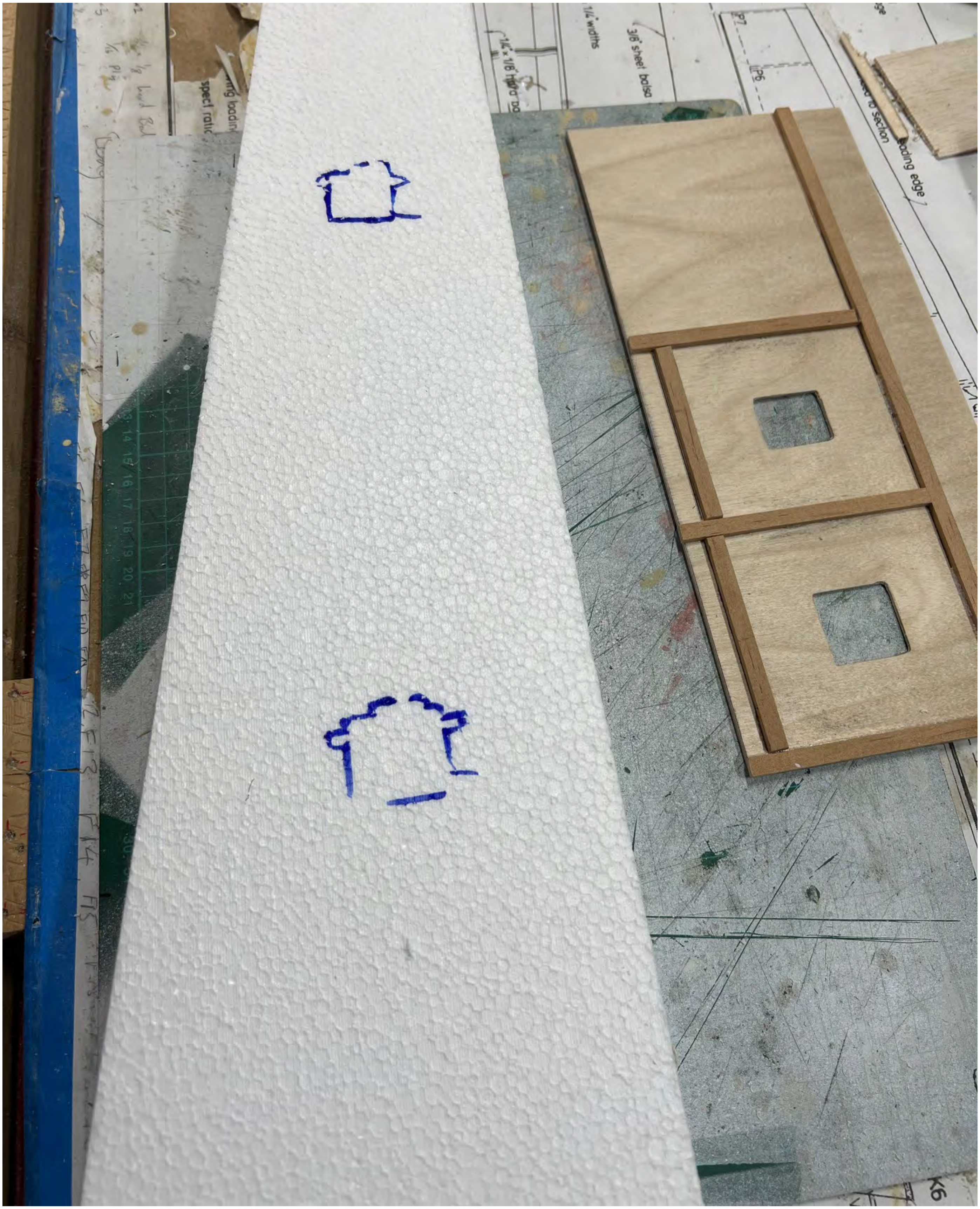
Time for a Demo: Let's Fit Some Wing Servos

Who doesn't love a demonstration!? Here's my wing, in need of a couple of servos, a no-name 9g and a Hitec HS-81. I've marked the locations (I used a sharpie for clarity in the photos) with the tabs and cable locations included. The template is offered up, the window being where the material will be removed from.

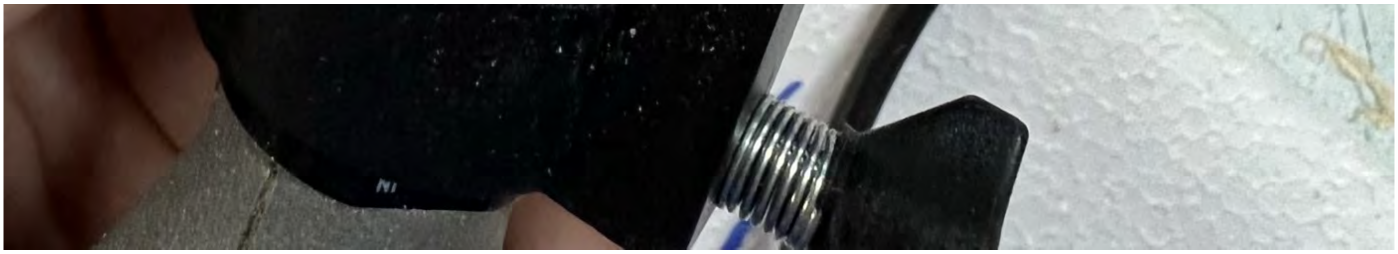






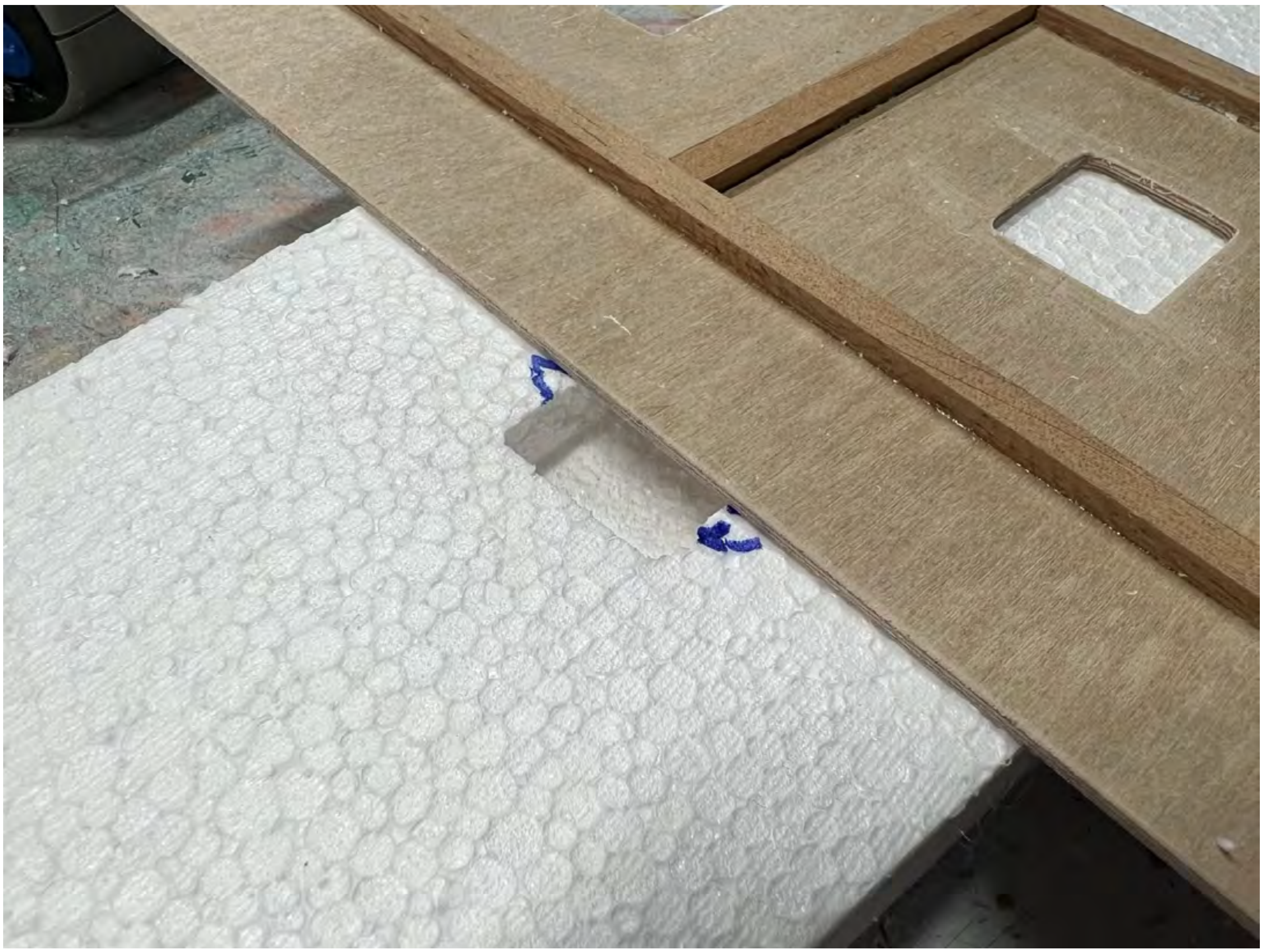


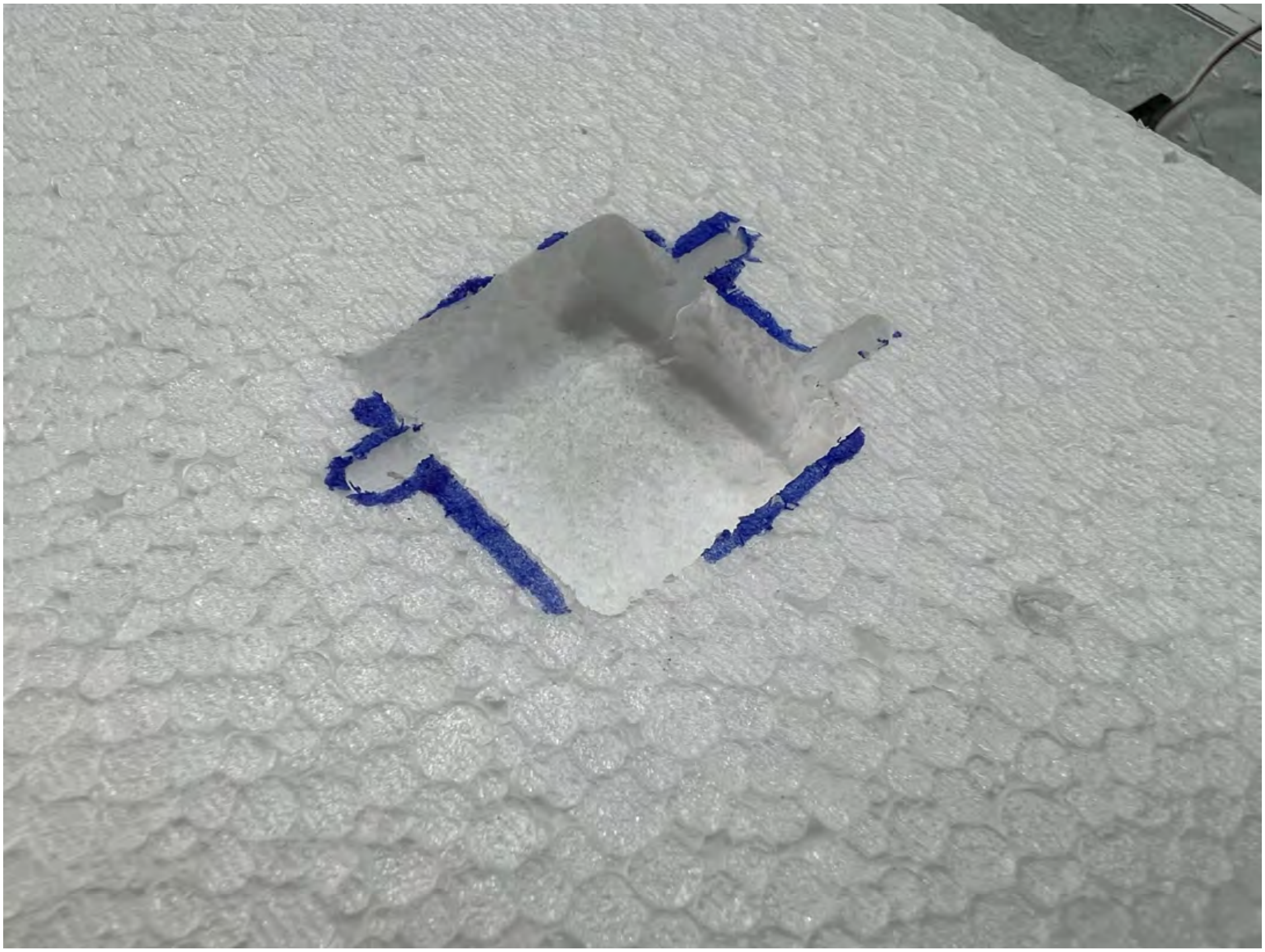
Set the depth to match the servo **plus** the thickness of the sheet and any clearance you need; 30 seconds with the Dremel, the material is removed and you have a nice neat pocket.



Set for the servo's depth **plus** the template thickness.

Next up, pockets for the tabs and the cable. Again, the template is your friend: line up the top edge of the template along the line of the tabs and route a few mm beyond each edge.





Cut servo tab pockets with the long top section.

Lastly, we can also use the template for cable management. Using the long top edge, we can cut a neat rebate (either shallow for a horizontal/flat cable, or deeper, for multiple / vertical cables). Where you need a junction or connection, you can set the depth a little deeper to create a pocket for the connectors.

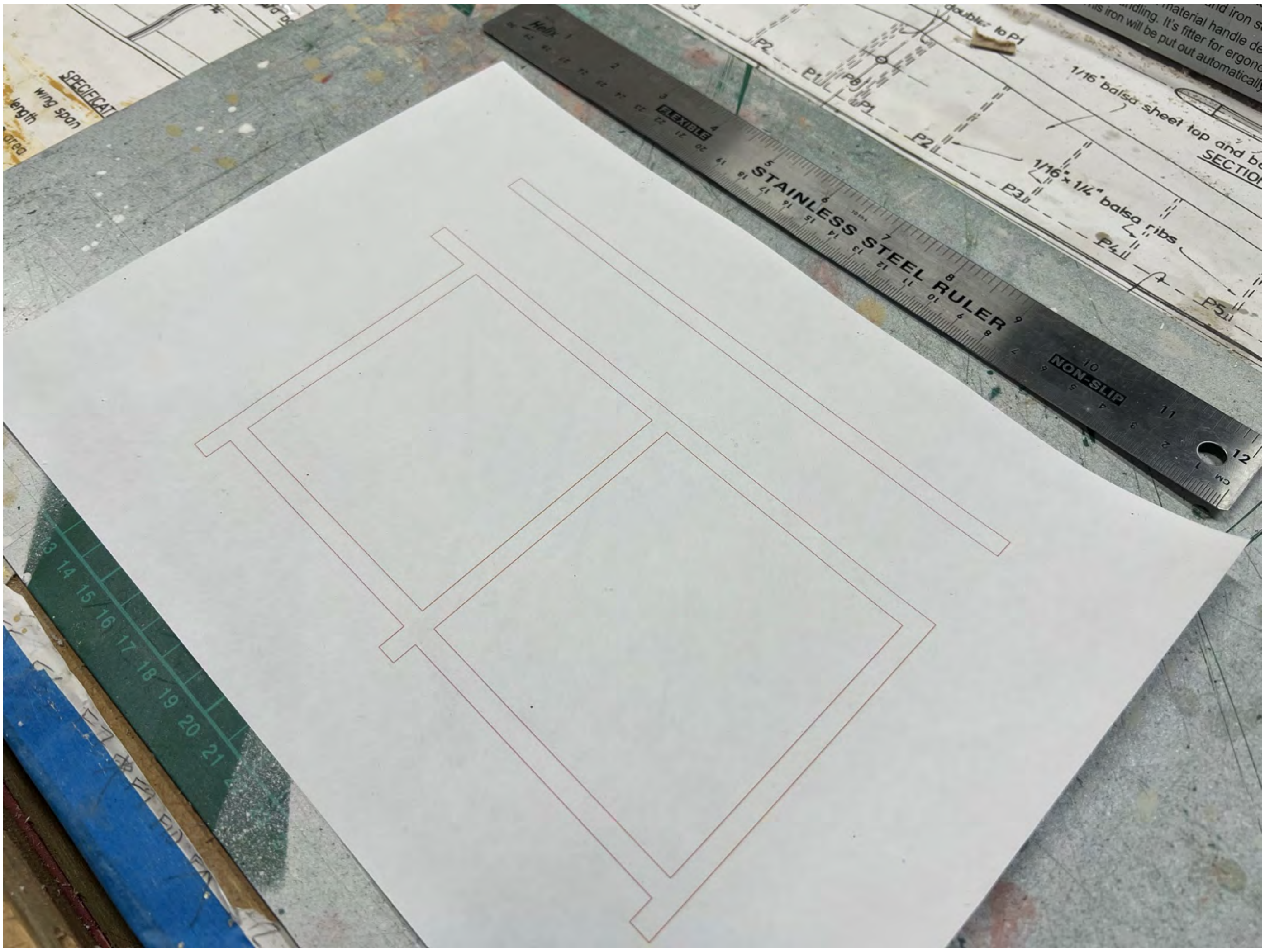
Make Your Own

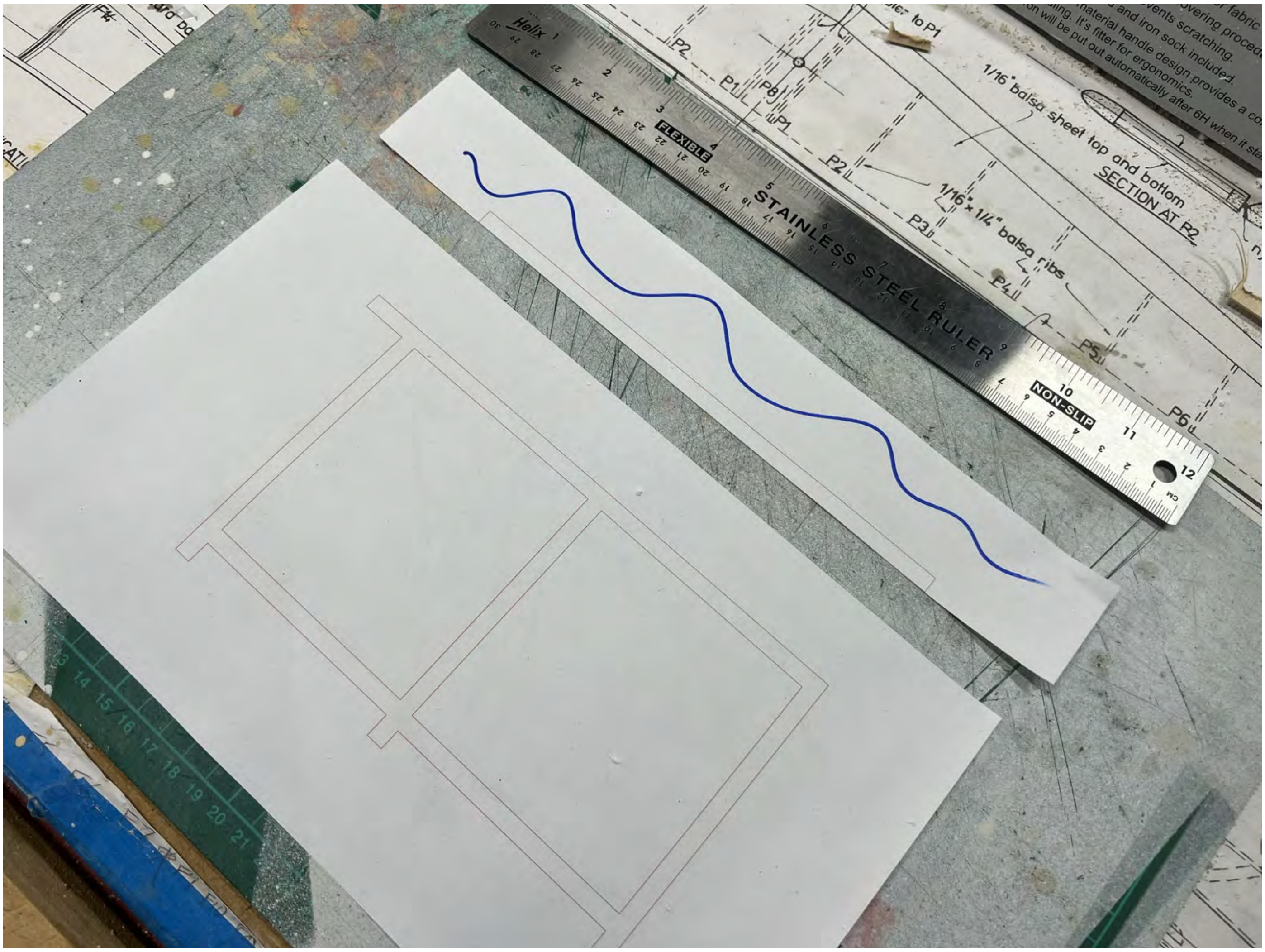
You will need:

- A flat sheet that will take a CA bond (I used some 2mm ply).
- Some straight strip material (I used 1/4" x 1/8" spruce).

- CA or other suitable glue (I used a high viscosity CA and a bit of kicker as needed).

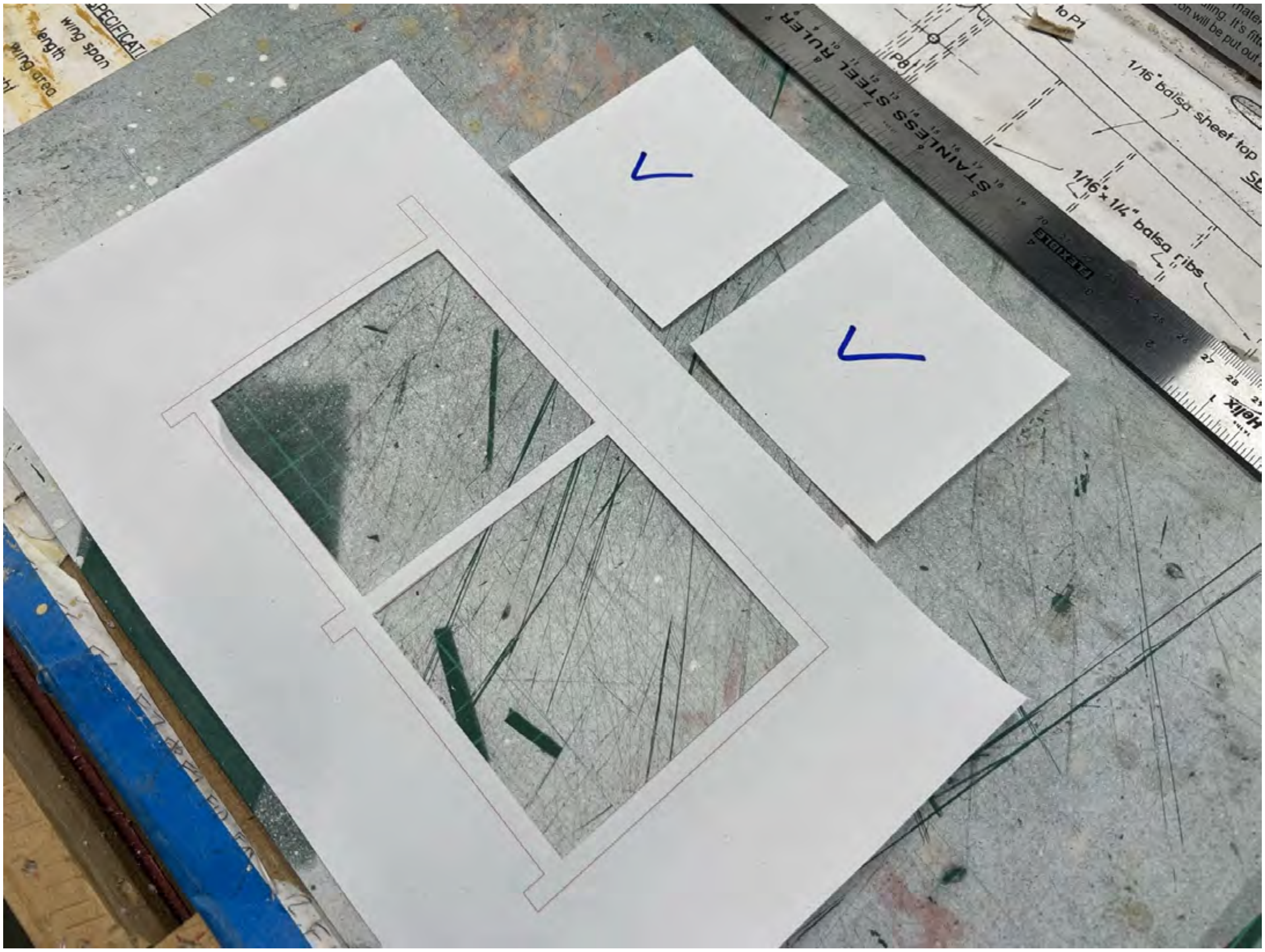
Print the PDF template ‘actual size’ and trim off the top section, cutting to the **inside** of the long, isolated rectangle. You don’t need this bit, you can dispose of it.





Trim the long section, including the rectangle.

Next, carefully cut out the two large squares. We will be using both the two squares **and** the area they were removed from for measuring/locating stuff in a moment, so cut carefully and keep it all safe.



Carefully cut out the two inner squares.

Using the plan with the two squares removed, align the top of the plan with a long straight edge on the flat sheet. Mark the parallel, inner edge of the two cutouts on the sheet. Using the new marks, glue the 1/4" strip, ensuring it is straight and parallel to the sheet’s edge. You can use the plan again to confirm which side of the line the strip needs to be if unsure.

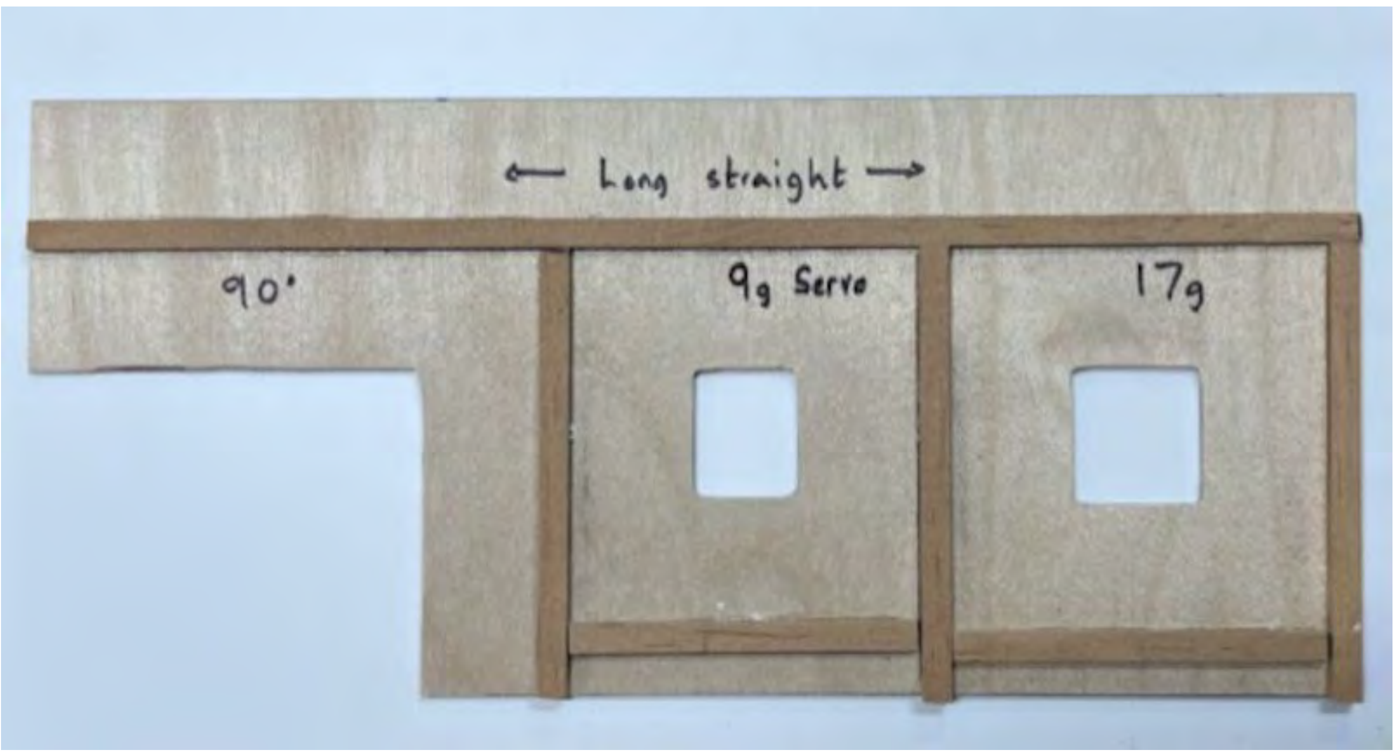
With the newly attached strip as a datum, three more strips, using the two squares as spacers to get the correct locations. The strips should be at right angles to the long top strip. Lastly, attach strips to close off the squares.

You should now have the basic template and be ready to cut out the central apertures.

I found it best to make two passes at cutting the apertures rather than trying to cut the whole depth in one go.

One More Thing

You may have noticed there's a third square, unused on the template. Feel free to use as you wish! In my case, I cut part of the square out, to give me a right-angle template. I can use this for more 'free hand' cut outs, or for rebating servo covers for example.



Thanks very much for reading. If you have any questions or comments please add them as a *Response* to this article, below, and I will do my best to answer them.

Resources

- Free-To-Download Plan (2KB PDF)
- DREMEL® Multipurpose Cutting Kit Attachments

All images by the author. Read the ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

Going Postal

A short primer on a venerable institution for which the time may have come (yet again).

Rex Ashwell

A squadron of Radians all ready for an ALES event.

Those of you who are regular readers of RCSD will have seen my letter to the Editor in the October issue (see *Resources*, below). Publishing that was Terence's idea, I just wrote in response to his question in the preceding issue, which wondered if anyone remembered postal competitions. Terence asked if I would contribute an article on postal competitions as a follow up to that letter and I agreed, so here it is. If you've read my letter (also in *Resources*) it laid out the basics of what we do here in New Zealand and I expect it's not significantly different to what many of you experienced in days gone by — that's assuming that this style of competition is not still operating wherever you happen to be. I suspect postal competitions are not that rare in some parts of the world, although from Michael Berends recent article about his efforts to get people started in a soaring competition, that is not the case everywhere.

Discussing tactics before an NDC event.

I suspect most will have an understanding of the way a postal competition works, but for the uninitiated this is an event where competitors from various locations can make timed flights and post their results to an organiser. All the posted results are then compared to find a winner. The type of event, the rules and the day (or days) that it may be flown are designated beforehand so that everyone theoretically starts on an equal footing. Of course there is no level playing field if the competitors are spread over a wide area as weather conditions are likely to be very different from place to place, but this must be accepted as an integral part of a postal competition.

In New Zealand we have a nationwide postal competition which has been operating continuously since 1966. This is the National Decentralised Competion (NDC) which is administered by Model Flying New Zealand, the governing body for aero-modelling in this country. At the beginning of the year they put out a schedule of monthly events in several categories: Soaring, Vintage, Free Flight and Control Line, with each category featuring several different events each month. In earlier times each event had to be flown on a particular day but this has been changed to a monthly basis, with the proviso that flights must take place only on weekend days or national holidays. This has levelled the playing field to a degree, as you now have more opportunity to avoid bad weather, although once you start a contest you must complete it on the same day so changing conditions can still make or break your day.

So for us as soaring pilots, in November this year we can choose to enter each of the following: F3K, ALES 200 or Thermal H, which is a winch launched 2m glider class. The soaring classes conform to our National Rules (which are based on FAI rules) with some simplifications — for instance in F3K we fly four of the recognised 10 minute tasks and use only the raw scores because there is no way to equalise them as would be done in a conventional contest. There are a few rules governing the way things are run but they have been kept as simple as possible to encourage participation. If you are interested in looking over the rules they can be found in the *NDC Information and Results* link in the *Resources* section at the end of this article.

We could of course organise our own club events, but having a schedule for the year provided like this makes it easy and we feel like we are part of the wider community of modellers which adds something extra.

The event calendar for 2021 can also be found from that latter link, immediately above. In soaring we generally have about three events each month with most requiring three or four timed flights, so not a hectic schedule unless all events are flown on one day. Some clubs fit NDC into their monthly calendar while others will look at the weather forecasts and pick their days. In my club the organiser will decide the coming Saturday looks okay and we will fly ALES 200, so the guys all turn up, probably fly a couple of trimming checks then, when someone is ready to go he'll ask another pilot to time for him and try for that elusive 10 minute time. Although there are often three or four models in the air at once we don't mass launch, it's just fly when you are ready, which makes for an unhurried, low stress competition — an ideal situation for us senior citizens.

Left: Trev Faulkner launching his Radian on a nice winter morning—timekeeper is Carl McMillan. **Centre**: One of Garry Morgan's scratch built designs — this is an early version, about 3m wingspan. **Right**: It won't match a Plus X but the venerable Spirit is still fun to fly.

For an individual, postal competitions provide an easy route into competition without the need to travel. You learn about the different class rules and national safety standards, you can compare notes with others on flying techniques and you will find that your flying improves (you'll stop landing at the other end of the field!) and your ability to set up your models and understand the capabilities of your R/C equipment will take a quantum leap. You will undoubtedly start to look enviously at some of the more exotic models that others fly, but having said that, most of the electric soaring competitions can be flown with nothing more complicated than a Radian with an ALES switch. That means competing is affordable and it's surprising how competitive a simple foam model can be.

For additional information I refer you to the *Resources* section immediately below and in particular the *Success in NDC* article which I wrote for *Model Flying World*, the MFNZ magazine a couple of years ago (pre-COVID). It gives some idea of how one club approached the problem of getting competition started.

From the left: Robert Evans, Peter Smith, Phil Elvy, Trev Faulkner, Phil Sparrow (in front), Rex Ashwell, Carl McMillan, Allan Baker, Brian Mogford. **Absent**: Garry Morgan, Paddy Gordon and Peter Deacon.

Best of luck with setting up your own postal competitions. If you have any questions, please leave a comment below in the *Responses* section and I will do my best to answer them.

Resources

- Letters to the Editor from the October, 2021 issue of RCSD where I also discuss postal competitions.
- RC Soaring Diaries from the September, 2021 issue of RCSD where Michael Berends laments the lack of interesting in competition flying.
- NDC Information and Results The NDC homepage on the MFNZ website.
- Success in NDC The article I wrote for Model Flying World, the MFNZ magazine a couple of years ago (pre-COVID) which gives some idea of how one club approached the problem of getting competition started.
- Model Flying New Zealand The New Zealand national modelling organisation's website.

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So You Want to Be a Composite RC Sailplane Manufacturer?

Part IV: Shoulda, woulda, coulda.

James Hammond

Forza wings in quality control.

In the last article of this series, I am going to take a look at what happened and what I could have done differently — twice. Hopefully after reading this comedy of errors you'll learn a few things that might be helpful — JH

Sebastian Frankel — test pilot for the E-Alpenbrise 4M model — my latest with my new partner. (image: Sebastian Frankel)

> *"It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness…" — Charles Dickens*

And at Aeroic, it was the age of disaster. What a comedy of errors. You'd think all those highs and lows and examples of misplaced trust should have taught me something. In fact, although my experience until that point was not good, apart from the last part it was not totally bad either because valuable lessons had been learned. Determined to find out but still mystified and wary I sat down to re-think the entire proposition. What had happened? How had it come to such a calamity? What had I done wrong? Was it my fault? These questions rotated noisily around my mind like a can dumped in a garbage disposal unit. I had to set it straight and as always that required analysis, so my trusty list came out. I jotted down my thoughts on what had been done and what the outcome had been — good to the left and bad to the right.

Adding it all up, taking it all away, multiplying it, and trying a few other mathematical tricks unfortunately always produced the same result. I was effectively considered worthless by the company I'd been trying to help, and though the reason for the catastrophe was baffling; it was nevertheless there before my eyes. Until, finally, the proverbial penny dropped.

Show Me The Money

The shocking fact was that since I had not demanded money, taken money, nor invested money then I had no value. The catalyst, I deduced, was that at the time of the calamity many would-be designers had been in contact with the company and so they must have deduced that designers, those previously elusive people that had had so nearly caused their closure a couple of years back, now seemed to be two a penny. And, after all a designer is a designer — they are all the same...right?

Forza 108″ Allrounder (2.5M) held by Ya-Ya.

The whole thing, baffling for me until then, slowly began to materialize in my poor brain. On reflection I realized that my motives for doing what I did must also have been hard to understand for the company I was involved with. I wanted to make good models available, for reasonable prices, to younger, or maybe not so well-heeled people who did not have so much cash available to pay the prices the European concerns were charging. But the new investors — as I soon found out, were entirely profit driven and everything and anything to do with money was a priority.

As experienced businessmen, they knew well indeed that how much you invest can be a good gauge of how much you were likely to make. Ergo:

something that did not cost anything — like myself — was not worth anything. Added to that I knew that I was really far too soft and easily manipulated, and I just didn't see the monster lurking in the cupboard.

Looking back at it now, after more than a decade has passed; I made a shed-load of mistakes but I cannot help feeling somewhat gratified to observe that it was always, and in fact still is my designs that are the top sellers for this company. And to this day I have never seen a model produced by them that was 'designed by a world champion'. Indeed, several times there have been third-party overtures to try to woo me back into that fold. Needless to say, all were sternly resisted.

More Corsa parts in quality control.

What? Not Again!

Yes — I'm completely out of my mind; certifiably bonkers. I was going to do it again but do it commercially, and do it right this time. As usual I sat down to consider my options. I knew I could design models so that was not in question. But as I had made abundantly clear to myself, I was yes-way an engineer and no-way a businessman. The problem was, how to manage the whole thing — how to actually produce models, and at good quality, and for sale?

Sale was a new word in the equation as far as I was concerned as I'd never done it before. First, I had to find a new manufacturing partner. That proposition, in principle turned out to be simpler than I had anticipated. With the passing of time, several new companies had sprung up all started by former workers who did their time at my original partner company. I was going to find one; partner with them on my terms; and get it right this time.

Second Time Lucky?

Soon enough I guess, the word got around that I was a designer adrift, and I was contacted by three of the spinoffs from the original venture. One in particular turned out to be a small outfit with only two people, but with a lot of enthusiasm, and for reasons that I cannot even now explain, this attracted me. This time I invested a lot of time and money into the project — a mistake I'm still regretting. Gradually, over a period of six years I brought them up the skill levels and quality required to be real contenders in the market. At the end there was a new factory, a full order book, and good production processes and controls, plus a bunch of skilled workers. They had seven of my models in manufacture, for which the CNC work and production moulds I had financed completely. Of course, as with any business it wasn't smooth all the time, and as always dealing with Chinese companies, things could get a bit crazy on occasion, but overall, we were generally making progress.

Corsa parts about to go to final quality control.

Go West Young Man?

Well, dammit, that's what happened. Almost inevitably it seemed, it began to go west. Things started to go horribly wrong with the quality, just as the company moved to pretty good profitability. The owner stopped supervising the workers and decided that as he was now a captain of industry, nay, a full-blown Tycoon, so he might as well start acting like one. To cut a long and nasty story short he decided that he was going to be the new boss of the entire enterprise — including me. As he put it, (quote) "after all you are only the designer", so he was going to "take over my business and all of my agents and distributors" and "kick me into the gutter".

Tycoons say things like that, apparently?

Well that particular threat and several others like it didn't materialize, but the 'coup' did leave me with my model business cratered, a $60,000 USD hole in my finances, and more financial tatters if you count lost business, but more importantly no way whatsoever to recover any of it. Later I discovered that even if I had had a cast iron contract from the get go, which I didn't, it still would have been totally useless. Though I wanted to put an end to it by litigation, I soon found out that nothing can be done with intellectual property rights (IPR) disputes as the laws in China heavily favors the OEM manufacturer while the legal processes are normally decades long and incredibly expensive.

Its apparent that a verbal contract is not worth the paper it's written on.

Third Time Lucky? So Far Yes!

What?! I went and did it again? By now you are probably doubting my sanity, and truth be told, so was I. But here I do readily admit that a lot of my next maneuverings were at least partially motivated by good old-fashioned revenge. But as the man said, revenge is a dish best served cold, and by the time I decided to make my next move into manufacturing my brain was operating at zero Kelvin, minus 273.15 degrees Celsius, or indeed negative 459.67 degrees Fahrenheit. I had icicles projecting from each ear and my beard had turned a frosty white.

Yours truly with the second Alpenbrise — the really strong SS type this time.

I made a deal, and signed a contract with a new outfit and tried really hard **not** to do anything I had done previously. As part of the contract, I set down how the models would be produced to the finest detail, and I sought and received agreement that **nothing** in the model construction could be changed — not the material nor the procedures without prior discussion and written consent. Three years have passed, five models are in production and we are going through an expensive but needed move to new and much larger premises while the manufacturing standard operating procedures and instructions are being reviewed and revised to suit. So far? Its looking good and its my hope that as a result, the model quality will climb up another rung on the ladder.

Shoulda, Woulda, Coulda

Now after two decades, let's have a hard look at what I should have done had I had the experience I have now. This could maybe make a template or a checklist for a newcomer wanting to go the same route. One thing above all else — if you have the chance to do this by yourself, with your own people, in your own facility then this will always be the best choice. Whatever mistakes you make will be your own fault — but if you can do it well, so will **all** the profits.

The Model

Things to consider and things to make sure of:

- **Target market** — The model you design has to fit the market segment you have targeted as exactly as possible, and there has to **be** a market.
- **Model Cost** — Your plane has to be in the right 'cost envelope' that will make it a good value proposition for the dealer — or for the flyer if you intend to sell directly.
- **Model Fashion** — Your plane has to be fashionable. It doesn't matter how much you know and can prove one design feature is better than another, if it goes against current fashion, it will not sell.
- **Durability** — It must be durable; designed to withstand a certain amount of rough handling such as bad landing stresses and tail whips, with the right strength, and the right diameters, all in the right places.
- **Testing** — The model has to have been thoroughly flight tested and any kinks ironed out.
- **Ease of Production** — The plane has to be as easy as possible to produce, with no complex mechanisms, or hard to make features.
- **My Baby** — There is no room for the dreaded 'my baby' syndrome here, so listen to suggestions from the OEM who probably has a lot more

experience of durable and reproducible construction than you do.

The OEM Partner

At this point most of the OEM manufacturers are located either in the Ukraine or various other dissolved ex-soviet Eastern European countries, or in Mainland China. I'm not sure this is going to be the case forever as the cost advantages of manufacturing in either region are eroding just as fast as their economies are improving.

It's probably better for an intelligent startup to consider manufacturing on their own doorstep and improving the production processes to make cost savings rather than hunting around the world for lower labor costs.

- ***China***

I choose China for good reasons: I live in Taiwan, close to China and under normal circumstances a quick trip to see the OEM is not a big deal timewise or financially.

Second: I speak the language, and this can and has made a great deal of difference at times.

Last, the Chinese OEM can be flexible in ways that could be a deal breaker in other places.

- ***Eastern Europe/Ukraine***

I have done OEM deals with at least one European manufacturer, but the main problem is that generally they don't really want to act as an OEM, preferring to promote their own models and brands. If you are someone well-known — especially as a designer — then that might make a difference. There could be a possibility to sell your model/IPR if its good enough. Costs of mould manufacture and models produced can be high.

The Business Side

- **Legal** — Sign a contract. It probably won't be much use to you if the kaka hits the electric cooling device but having one is a heck of a lot better than not having one — even if it's just for your own peace of mind.
- **Be a Businessman** — Don't have misplaced sentimental motives for considering an OEM deal to make your model. I don't care how you do it, it won't work.
- **Concentrate** — Understand and orientate your entire drive towards creating a commercial product and making money from it — or walk away.
- **Model Pricing** — I mention this again as its critical. Have a good idea what price point you want to sell your model at — will you sell it yourself? Or will you go through a dealer? What would you reasonably pay for this model? Remember that the more parties that are involved, the more diluted the profit will become, and also remember that the selling prices can be adversely offset by shipping costs.
- **Investment** — Understand that unless you sell the design, you will be asked to invest in your model — there is no other way — and investment is likely to comprise several thousand dollars. This could be CNC costs to make positive moulds only, or it could also include production mould making costs — it depends how you do the deal. These costs have to be built into your model selling price.
- **Partner's Share** — Know from the start that whoever you partner with will need to make his own profit — and that his costs and profits are all part of your cost. Negotiate, but be fair.
- **Baby Steps** — Understand that the profit from this venture is unlikely to be much in the beginning and indeed it won't be — but it could be enough to pay your modelling expenses — and we know the glider

widows really like that. So do a deal that will be profitable and will leave you with something to sell — because however small that profit is in the beginning it can be built on as your sales and reputation grow.
- **Ferrari** — Don't order one.

So, finally we reach the end. If you do decide to go further then please let me wish you the very best of British luck!

A table full of Alpenbrise 157″ 4M.

Resources

- So You Want to Be a Composite RC Sailplane Manufacturer? Part I: The Road to Perdition Awaits
- So You Want to Be a Composite RC Sailplane Manufacturer? Part II: Inside the Devil's Fireplace
- So You Want to Be a Composite RC Sailplane Manufacturer? Part III: Welcome to the Hotel California

All images are from the Hammond Collection*, unless otherwise noted. Also, there's a bankable rumour out there about a new James Hammond series being in the works; the third in the New RCSD. Signed up for the* ***RCSD mailing list*** *to be notified when that's out. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

Kinetic Theory and Lift over Drag Ratio

Mount Everest, Yertle the Turtle and pollen grains are just part of the story.

Peter Scott

"Art Larson piloting the Lethbridge Glider Club's primary glider, ca. 1933–1937. This in-flight photo was taken with a camera mounted on the left wing tip, using a string routed from the shutter to the cockpit." (image and caption: Galt Museum & Archive in beautiful Lethbridge, Alberta)

In designing our model gliders we seek to keep them in the air as long as possible from a given height. We also want full-size gliders and some models to go as far as possible. I hope you have read my articles on kinetic theory explanations of lift and drag (see *Resources*, at the end of this article). Turning those words over in my head I wondered if kinetic theory could also be used to think about flying performance. As you know by now, as a physicist I am fond of thought experiments.

We seek to increase lift or to reduce drag or both, or in other words the ratio between the two — 'lift to drag ratio' (L/D ratio). This is a measure of the aerodynamic efficiency of the aircraft. The resulting equation couldn't be simpler:

> *L/D ratio = lift / drag*

Being a ratio (fraction) with the same unit top and bottom it has no unit of measurement.

Note that drag includes not only the drag from the wings but also 'parasitic drag' from the rest of the aircraft. It is called parasitic because it is from parts of the aircraft that do not contribute to lift. It is also called 'form drag' and 'profile drag'. It's one reason why we use folding props on our gliders and fair in the servo arms and push rods.

Photo 1: FrSky ASI installed in the canopy of an ageing Hobby King Bixler.

To get the greatest distance or time from a certain height we want to maximise another ratio called 'glide ratio' but also known as 'glide angle'.

Using FrSky telemetry I have measured it on a real model in still air. I programmed the transmitter (Tx) to speak the height given by the vario every ten seconds, which gave me the sink rate. It also spoke the air speed from an airspeed indicator indicator (ASI). This was better than trying to read the data off my Tx screen and I was able to integrate many readings in my head to get more typical average values. There is nothing worse than glancing at the screen only to realise that you can't see your model when you look back.

The values for the Bixler were 1m/s fall and 6m/s air speed, giving a glide ratio of 6:1. Full size gliders and, I imagine, high performance models have ratios between 30 and 60, though 40 is most likely for a high performance machine.

And now for the delightfully simple jump to the effect of L/D ratio on glide performance. Guess what?

> *Glide ratio ≅ L/D ratio*

The '≅' in the above means an approximation, but close. As the *Bixler* weighs about 1000g this tells me that its total drag is 1000/6 or 167g. Interestingly in a single-model climb and glide competition someone who changed to a folding prop usually won until we banned changes to the specification.

What Does This Mean for the Best Shape for an Aircraft?

So, physicist's hat on. Thought experiment — 'I am an air particle'. An aircraft is moving towards me and looks certain to thump into me. Which bit of it I hit is a matter of chance. If I hit the front of a leading edge or the nose I will be knocked back through 180° and my whole impulse will produce drag. This is shown in Figure 1 as path A. If I hit a more sloping surface some impulse will be drag and some will be lift depending on the angle of the surface. This is shown in paths B and C.

The shape of the object is oval because it is more like an aircraft.

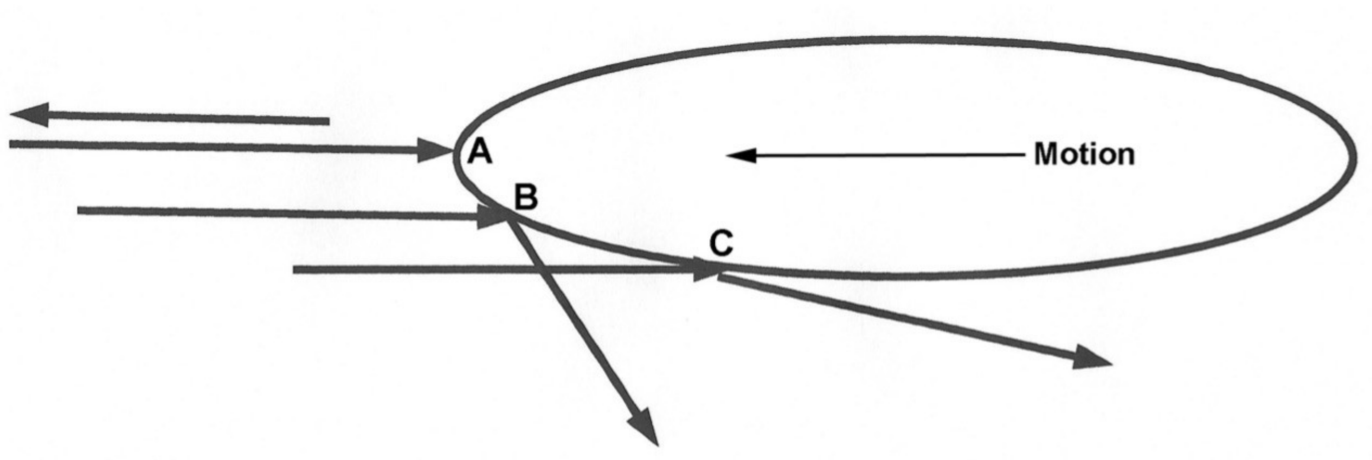


Figure 1

Let us examine one of these paths — C. If you were awake during your Physics lessons you might recall the difference between scalars and vectors. A vector is a quantity that has both size and direction. The relevant example here is force. To work out the effect of a force you need to know both how big it is and in what direction it is pushing. Scalars have size but not direction. Examples are temperature and energy. So when analysing the effect of a force we must model both size and direction.

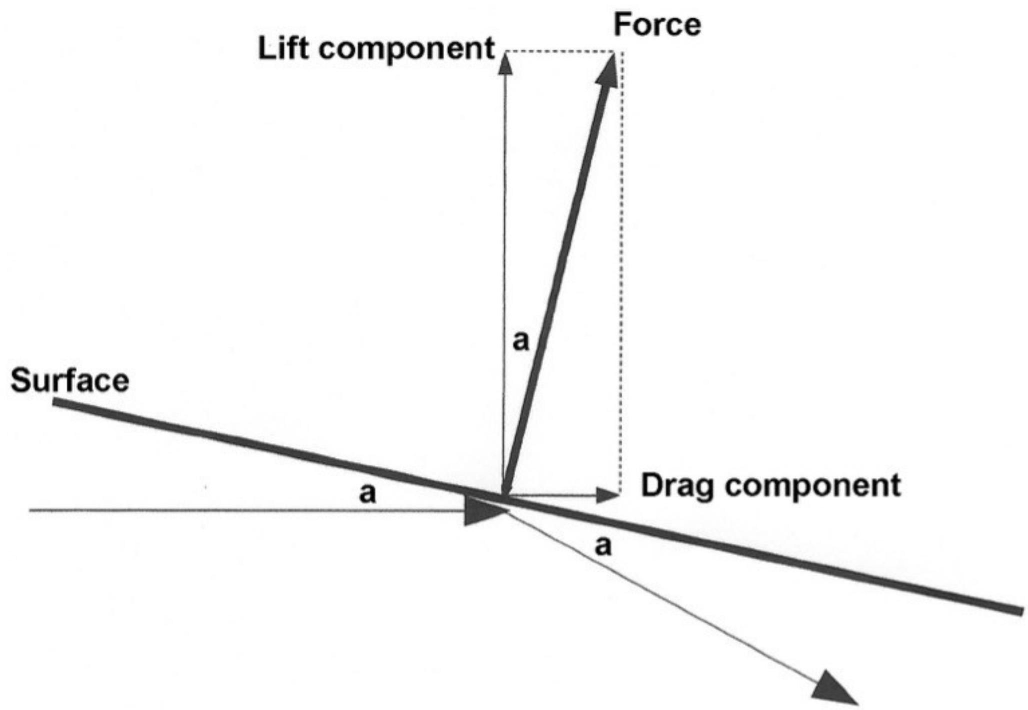


Figure 2

The direction of the impulse force from the bouncing particle will be roughly at right angles (normal) to the surface at the point of collision. Being a vector, the force can be split into two parts, called 'components', at right angles to each other, using a diagram and a method called 'resolution'. The shallower the angle a of the impact is, the smaller the drag component and the higher the lift component will be. It will produce a smaller overall impact force on the surface but the drag component will be much less than the lift one. This is shown in Figure 2.

So what determines the ratio of lift to drag is the ratio of the sums of all of the vertical components to the sums of all of the horizontal components of the impulse forces of all of the particles that hit the aircraft's surfaces at all kinds of different angles. (I usually avoid long sentences like that.)

What about Flaps?

What happens when we lower flaps? Angle a shown in Figure 2 increases.

This means that the impulse force is much larger. It also means that it is more evenly divided between lift and drag. As you see from Figure 3, drag goes up much more than lift. This has the desired effects of both reducing airspeed and increasing lift. A greater angle such as in air brakes or 'barn door flaps' will produce much more drag than lift but we usually only use those on, or just above, the ground.

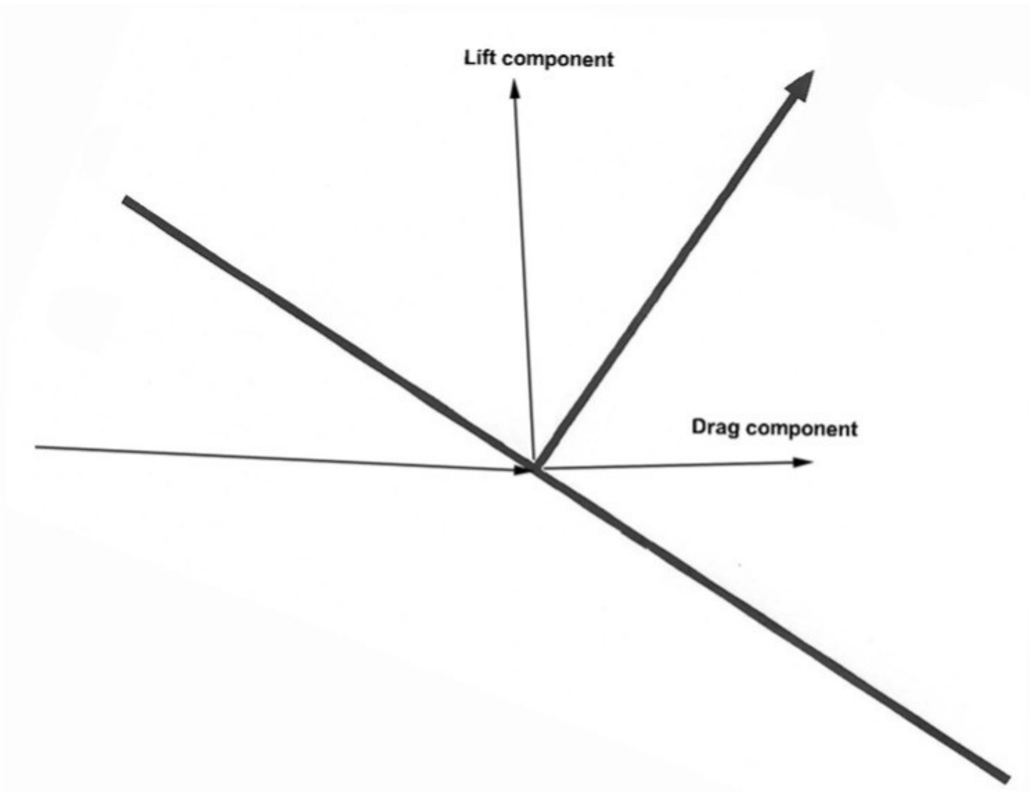


Figure 3

Figure 3 also shows the effect of any projections into the airflow including surface roughness. More of that later.

What Does This Tell Us about Design and Construction?

First let's consider parasitic drag, which is the drag from everything but the wings. The angle at which the particles hit the surfaces should be as low as possible. Gently sloping shapes with sharp points and edges are better than more angular ones. Projections should be kept to a minimum and where they can't be avoided a fairing should be added. Any sudden change of a surface such as canopy edges will also act as a projection.

Similarly, as mentioned above surface roughness will have the same effect as many small projections. Remember that the particles are minute compared with any roughness. For them it's mountainous. A nitrogen gas molecule (80% of the air) is effectively (collision diameter) about 360pm (picometres). For polished surfaces the roughness peak to trough will be around 2µm (micrometres). One micrometre equals a million picometres. So the number of molecules piled up to equal that much roughness is 2,000,000 / 360 or about 5,500. 5,500 average people standing on each other's shoulders will be 8,250m high, which is roughly the height of Mount Everest. So a particle compared with the roughness is like a person compared with Everest. By the way that's another calculation that I had to do several times before I believed it. It reminds me of Dr. Seuss' story of *Yertle the Turtle*. It also sounds like the usual queue to get up the mountain.

Of course surface roughness does rather mess with the idea of the force on the surface being at right angles. But we are dealing with the averages of countless collisions, and the roughness will not be in sharp peaks like a mountain range, so the variations due to roughness will average out.

For wings the situation is much more complicated. Aerofoils are developed by studying them in wind tunnels though software does a good job too. Angles of attack and airspeeds are varied and the lift and drag forces are measured. Control surfaces including ailerons, flaps, slots and airbrakes are moved and the effect measured. Smoke streamers or tufts are photographed to show how the air is flowing.

The finish on the wing surface is important of course. Highly polished sheeted or glass coated surfaces are best, though are usually heavier. Next best are built up ones with shiny covering such as plastic film. Spars, edges of sheeting and leading and trailing edges that produce projections not parallel with the airflow should be shaped or buried to minimise the projections. I remember cutting endless ribs with holes for buried spars when I flew free flight A/2 F1A gliders. No laser cutting then!

Photo 2: Model Sopwith Tabloid from Norfolk, UK.

The joins between control and flying surfaces are ideally filled in with film or tape though there are practical limits to that. I wonder if anyone has tried flexible trailing edges rather than hinged ones. Early aircraft, like the Sopwith *Tabloid* shown in Photo 2, sometimes had wings that twisted to cause roll rather than using hinged ailerons. Now that would be an interesting project for a model glider.

Servo arms and control linkages should be enclosed in fairings if possible. There was an RCSD article ingeniously showing how to use the clip-on tops of spray bottles to make fairings. You trim them, hopefully leaving tabs to help to hold them on when glued. There are examples in Photo 3:

Photo 3: DIY servo arm fairings fashioned from discarded spray bottles.

Can Computers Help with Kinetic Theory Modelling?

Of course we now have super-computers capable of modelling the random motion of each of thousands of millions of particles as they move around an aerofoil — in other words we could build a mathematical kinetic theory model. However there are times when a visible analogue computer, which is what a wind tunnel is, is cheaper and better than mindless digital bludgeoning. Designers can experiment with small changes to the profile of the aerofoil and experience the effects rather than looking at numbers and graphs.

To further illustrate using an example in a different field, the London School of Economics has an analogue computer model of the economy called

MONIAC. It has water in pipes with tanks and valves to model such things as money supply and inflation.

Low Drag Flying

The first thing is to minimise the aircraft's drag by good design, construction and finishing. Then we need to pay attention to the trim of the model and our behaviour:

- **Trim** For minimum drag, control surfaces should be exactly neutral. Trimming should be done by adjustments to the centre of gravity.
- **Behaviour** Once trimmed into a 'hands-off' stable state, control surface movement should be at the absolute minimum. Every control movement increases drag by adding projections into the airflow. The exception to the 'minimum rule' will of course be to maintain circling when lift is found. Then because of the rising air we can afford the reduction in glide ratio, though we have all experienced dropping out of a thermal due to clumsily done circling.

Of course you knew all of that. But the science behind it helps understanding.

The Gimli Glider

This is one of the classic heroic stories of aviation dating from 1983. The skill of the pilot Captain Pearson, who also flew gliders, in gliding a Boeing 767 for 17 minutes over 65 km (40 miles) from 12,500 m (41,000 ft) altitude, was unsurpassed. The reason I include it here is that the glide ratio was calculated at 12:1 by the air traffic controllers. That enabled them to select a disused military airfield at Gimli, Manitoba, Canada as being at a suitable distance for a landing. No doubt they took the prevailing wind into account too. The coolness and skills of the ATCs was as outstanding as the pilot's. The glide ratio is surprising considering the parasitic drag from the engines. No folding props there.

Photo 4: The Gimli Glider as it came to rest in Gimli, Manitoba, Canada. (image:)

Actually the airfield wasn't entirely disused as people were at a car event there. They were somewhat taken aback by the sight of a huge, silent aircraft heading straight towards them. It came in at speed as the usual flaps were out of action. Fortunately the 767's nosewheel hadn't locked by gravity so it collapsed and the aircraft's nose scraped along the ground. It stopped before the end of the runway.

In 2014 the 767 C-GAUN was scrapped, but you can buy 'lucky' key rings made from its skin. Many have asked what is so lucky about running out of fuel at 12,500m.

Kinetic Theory, Brownian Motion and You

In 1827 a botanist called Robert Brown was looking through his microscope at pollen grains suspended in water. He noticed that the grains were jiggling about in a random pattern with no apparent cause. It became known as 'Brownian Motion'. The mystery remained until 1905 when Einstein suggested that it was the invisible moving water particles that were bashing the pollen hither and thither. He reasoned that the particles must be moving very fast as they were too small to see so must have much lower mass than the pollen.

If you have a microscope with enough magnification to see pollen, you can repeat Brown's experiment. Ideally dip the lens into a water drop on a slide into which you have mixed a little pollen, and use lighting from the side. It might also enchant your kids and grand-kids when you explain that's what keeps you in the air when you fly.

Your Comments

As a scientist I expect and welcome criticism and comments about my ideas in the three kinetic theory articles by leaving your thoughts in the *Responses* section below. I accept that you might destroy my ideas but that is the way that science works. However what usually happens is that the ideas are improved.

Resources

My Other Articles in the Kinetic *Series*

- Kinetic Theory and Lift from the September, 2021 issue of RCSD.
- Kinetic Theory and Drag from the October, 2021 issue of RCSD.

Wikipedia

- MONIAC (Monetary National Income Analogue Computer)
- The Gimli Glider
- Brownian Motion

With My Thanks

- Soar! A History of Gliding in Southwestern Alberta The source of the key image from this article found above the title

Read the ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

PSS Candidate | Melmoth

Be only the second person in history to build one.

Terence C. Gannon

Melmoth over England in 1975. (image: James Gilbert)

Early in 1976, my lifelong career dream of flying for a living was crumpling in the face of the lingering effects of the first oil shock on the world economy. For every commercial pilot position, there was a seemingly endless line of potential hires, all of whom where way more qualified than I even dared to dream. Also, as I approached the end of my relatively successful high school career, there was subtle parental pressure to attend university — a good one. An 'undergrad' spent sleeping on a hangar floor in La Ronge, Saskatchewan — the most sure route into commercial flying at the time — was not what my folks envisioned for their kid. They rationalized that if I was good enough to be acclaimed onto my high school's *Reach for the Top* team it followed — in their mind — I was 'pretty likely' to be accepted and succeed at MIT or Caltech. My folks' almost pathological optimism is still endearing to this day.

It was in this context I angrily tore into the December, 1975 issue of *Flying* magazine. I was now reading my favourite magazine not as a source of career advice, but as an aviator wannabee with my nose pressed up against the airport fence — another spectator at the airshow gawking up at people way luckier than me. But in that fateful issue, I stumbled on writing that without a hint of exaggeration, was to change the course of my life from that moment forward. The quickly dog-eared issue contained, starting on page 44, Peter Garrison's *The Compass and the Clock*.

While I was vaguely aware such things were possible, Peter's article was an eye-opener — he demonstrated it was actually possible to design and build your own, real airplane in your own backyard. However, that was nothing compared to the central narrative of the article. Garrison took his homebuilt airplane—christened *Melmoth* — and, accompanied by his clearly very understanding partner Nancy, did something I still find hard to comprehend to this day.

He flew it across the Atlantic.

I was utterly transfixed by the idea. I couldn't sleep I was so excited. My grades began to slip as I used my classroom time to sketch my own version of a plane which could fly the same distances as *Melmoth*. I started reading all the books both by and about Lindbergh, looking for the same kind of insight that the self-taught Garrison clearly had. I even did calculations on fuel burn and the capacities of the tanks which would be required and drove myself to distraction figuring out where all that fuel was going to go. Come hell or high water — an ironic metaphor, in retrospect — I was going to do that someday. Like Garrison, I began to look at globes and see only great circle routes and the far off places to which they led.

(image: Peter Garrison)

If, after a couple of years, any of the *Melmoth* magic was beginning to wear thin, a *Flying* magazine thunking down on the front door step in early 1977 brought still more of the exquisite torture. In it, there were yet more of Garrison's tales about his prodigal, prodigious travels in *Melmoth*. It was right there on the cover taunting me: a picture of *Melmoth* and the headline "To Japan and Back — In a Single". This latest adventure included a non-stop leg from Cold Bay, Alaska to Chitose, Japan — a stunning 2,650 miles virtually all of which was over the forbidding and empty North Pacific.

Of course, even the most crippling love affair can burn itself out, and my *Melmoth* dream inevitably died, crushed under the weight of a university admissions process that had me not succeeding, cum laude, at MIT or Caltech as my parents dreamed but instead flunking out at UBC. Following my blinding *Melmoth* epiphany, I had decided that designing and building aircraft was sufficiently adjacent to flying the finished product. And an engineering degree was good enough for the folks, so seemingly everybody was happy. The only fly in the ointment was that UBC was not exactly the centre of the aeronautical engineering universe. Besides, there was a kind of pouting, miserable injustice in being in the same classes as the kids who partied right through high school while I was at home writing and rewriting my essays on the folks' Coronamatic. Life after my ill-fated post-secondary school career became the best of the also-ran, pick-me-up careers for the next few decades.

The RV-6 for which my wife and I built the wings, tail and some of the fuselage. It's very rough resemblance to Melmoth is no accident. (image: author)

In that period, I satisfied my aviation bug with model aircraft, eventually settling on sailplanes as my particular cup of tea. There was a diversion for a time while my wife and I built the tail, wings and some of the fuselage of an RV-6. That dream died, too. I eventually gave the completed assemblies along the with the rest of the kit to my nephews. One of them in particular approached it with the compulsion necessary for such an undertaking. He finished it and it's now flying and it's utterly magnificent. I take consolation in knowing the thousands of rivets Michelle and I set eventually found their way skyward. But if you look at its lines, and squint a little, you can see *Melmoth* in it. It's no accident. Its rough resemblance to the plane of my childhood dreams was an important reason why I chose this particular aircraft for my stab at homebuilding.

During this period, I had taken it upon myself to get in touch with Peter Garrison via this newfangled thing called the internet. He made the mistake of politely answering my first email, which gave our electronic pen pal relationship a life it likely didn't deserve given the silly questions I was asking. But he patiently and promptly answered all of those emails. He even sent an autographed copy of *The Compass and the Clock* which I framed and hung near the RV-6 project, like a talisman to help urge me forward through the endless project. Sadly, not even the *Melmoth* magic was up to **that** task.

But then came my opportunity to edit the New RC Soaring Digest, and it provided yet another plausible excuse to think about *Melmoth*. Once again, I impinged on Peter's peaceful existence and asked him whether he might be interested in contributing drawings and other material to a *PSS Candidate* article for the magazine which I now edited. To my great shock, **he actually agreed**. And so, if you scroll down to the *Resources* section at the end of this article, you'll find lots of digital artefacts which will be great feedstock of a 1/4- and/or 1/3-scale model of the fabled *Melmoth*. Its clean, compact, sailplane-meets-fighter lines will make for a sweet slope soarer. And you'll be only the second person in history to build one.

Now, a smarter man than me would have left Mr. Garrison in peace at this point given that the *Melmoth* dream, at least in a vaguely poetic way, had finally been brought full circle.

But I'm not that smart.

I asked Peter whether he still owned the copyright on *The Compass and the Clock*, which he does along with much of his other work, a lot of it originally published in *Flying* magazine over the years. So, it is with the greatest honour — and boyish excitement — that I present *The Compass and the Clock*, in it's entirety, right here in RCSD.

It's as fresh and inspiring now as it was when it was first published well over four decades ago. See if it works its strange and wonderful magic on *you*.

(image: James Gilbert)

Resources

- Watch this space. On or about 2021–11–15, Peter has committed to making the *Melmoth* files available and their links will appear here. If you want to be the first to know, we will announce their availability on the RCSD Twitter feed.
- Peter also added that if an RCSD reader "decides to build a model, I will be glad to communicate personally and provide additional documentation, photographs…" So there you go, folks—quite conceivably a once-in-lifetime opportunity to get your reference material directly from a bona fide aviation legend.
- The *Compass and the Clock* by Peter Garrison. Yes, right here in RCSD.

*Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

The Compass and the Clock

A speck upon an endless ocean, a work of science and of art, Melmoth strikes eastward to test the mettle and endurance of its maker.

[Peter Garrison](https://medium.com/)

I am drawn by the thought of flying long distances. It is my mountain climbing, my archery, my test of strength. I don't know why it appeals to me so much, but I like to look at a globe, mentally measuring the great-circle routes and translating them into hours and into pounds of fuel. The more remote and the lonelier the route, the greater its magnetism for me. My reason sees such long flights as long sits, merely tedious waits for a machine to tick up its appointed number of revolutions; but in my heart, they appear as the door handles of eternity, glimpses of the inaccessible and the sacred.

When I designed an airplane, it was natural that I would design it for range. It was not optimized for range; airplanes *optimized* for range have long slender wings like an airliner's or a sailplane's. Though graceful, such wings are ungainly and hamper maneuverability. My airplane would be as compact as a fighter and would achieve its range by means of low drag and a large internal fuel capacity.

The thought of flying around the world was always in my mind; a convenient design parameter was offered by the distance from San Francisco to Hawaii, which I came to think of as the longest unavoidable stretch of open water on an imaginary circumglobal jaunt. (Actually, that stretch is avoidable by following the northern Japanese islands into the Aleutians, but the uncertain weather on that route makes it impractical.) From San Francisco to Hawaii is about 2,100 nm; a range of more than 2,800 nm would be necessary to make that flight comfortably.

The airplane I built is named Melmoth. It took five years plus two more for tests and alterations, and it has a paper range of about 3,000 nm on a fuel capacity of 154 gallons. The fuel is carried in two tip tanks that hold 35 gallons each and two integral wing tanks holding 42 gallons each. The tanks can be selected manually, or else a pair of tanks — both tips or both mains — can be selected manually and the fuel system set on "automatic," whereupon it switches from one side to the other by itself every five minutes, keeping the plane balanced.

The engine is a Continental IO–360-A of 195 horsepower, with 210 available for takeoff. It is a six-cylinder, fuel-injected engine; mine has been carefully overhauled so that it uses little oil — a quart every 12 hours or so. It runs smoothly on very lean mixtures.

The airframe is small, less than 22 feet long with a 23-foot wingspan. The cabin seats two, with a large baggage compartment in which a single jump seat can be used by a third passenger of great limberness and endurance. A large all-flying T tail provides a wide CG range.

The airplane is fast and maneuverable when it is lightly loaded, climbing at nearly 2,000 fpm, doing a roll in three and a half seconds, indicating over 180 knots at sea level. It gets fairly good gas mileage: 25 nmpg at 115 knots and about 18 at 160 knots.

With this airplane, on paper at least, I could fly 3,000 miles with a passenger and more than 100 pounds of baggage and remain aloft for more than 24 hours. The "door handle of eternity" was within my grasp.

Nancy and I decided at random to cross the Atlantic. A date, remote but not absurdly so, was tentatively set. The scheme seemed thereafter to gain solidity and momentum of its own accord, until it could no longer be stopped. The first preparations were abstract ones. At the beginning of the year, I sent letters to the governments of the countries we expected to visit requesting permission to operate an experimental airplane in their airspace. I ordered a subscription to the *International Flight Information Manual* from the Government Printing Office (it was never to come — though I did mistakenly end up with a subscription to the domestic *Airman's Information Manual*). I wrote to Canada for a detailed account of their requirements for single-engine aircraft departing their shores for Europe. I obtained Ocean Navigation Charts for the European and eastern Canadian areas, and GNC 3N, the Global Navigation and Planning Chart for the North Atlantic.

A meteorologist lent me a book compiled by the U.S. Navy, in which a statistical summary of Atlantic weather data for the last 20 or 30 years was presented in cabalistic form, preceded by an epigraph observing that the improbability of a disaster was small comfort to its victim. I copied this caution down and kept it for a long time.

It appeared that the month of August, during which Nancy was most likely to be able to take a month's vacation, was as mild a month as might be found for the crossing. The winds would probably be light for the return flight, there would be little chance of icing, and there would be few storms. Disasters were therefore improbable.

Throughout the spring, the tempo of preparations increased. I collected fuel-consumption data from the engine manual. I installed Collins Micro Line VHF navcoms and an audio/marker panel, a Narco ADF and transponder. The Canadians required dual ADF capability, but it turned out that a portable radio with a null-seeking system of some sort would do for the second ADF. My father had an ancient Nova-Tech Pilot II, which I pressed into service. I had an Eastern Aero Marine two-man life raft and two life vests that I had obtained a year earlier for a Caribbean crossing; the raft contained every item required by the Canadians except a waterproof, buoyant ELT. It turned out, however, that my Emergency Beacon Corporation ELT, which could be removed from the airplane easily and sealed in a plastic bag — I used quintuple-redundant plastic bags — would meet that requirement.

An autopilot of some sort is practically indispensable for very long flights and for single-pilot IFR. I had the simplest kind I could get: the under-$1,000 Edo-Aire Mitchell Century I. A wing leveler with VOR/LOC coupler and turn-command knob, but without heading hold, it is nevertheless able, with careful trimming, to hold a heading within a degree or two for as long as an hour at a stretch, which is better than most unslaved DGs will do.

The first set of tip tanks I built had an irreparable leak; I had to build a new pair and did not finish them until a couple of weeks before our date of departure, which, by the second week of July, was finally fixed as August 2.

They turned out to hold more fuel than I had calculated they would: 70 gallons rather than 60. The only problem with them was one of fuel pressure; it fluctuated in hot weather, evidently a result of vapor lock. I fumbled about with that problem a great deal and finally satisfied myself that in cool weather, such as would certainly prevail over the North Atlantic, vapor lock would not be a problem. But I was always nagged by a lingering doubt about the tanks.

I went through the engine carefully; installed a set of AC platinum plugs; cleaned injectors; replaced filters; checked compression. I kept lists, files, volumes of data and advice. I got Jepp charts for all of Europe, the Atlantic and eastern Canada. That trip kit turned out to be the key to getting around in Europe, since the ONC charts were useless and native European charts were almost impossible to find. I answered hundreds of times the two questions that people hearing that we were planning to fly across the Atlantic all asked: "What will you do for a toilet?" and "Have you seen *Jaws*?"

Nancy, who has no natural fondness for flying, reserved until the last the right to remove her name from the manifest and take an airliner. I was concerned about her state of mind, which I assumed would become increasingly anxious as the fateful flight drew nigh. I was also concerned about what I would say to her if we ended up in the raft.

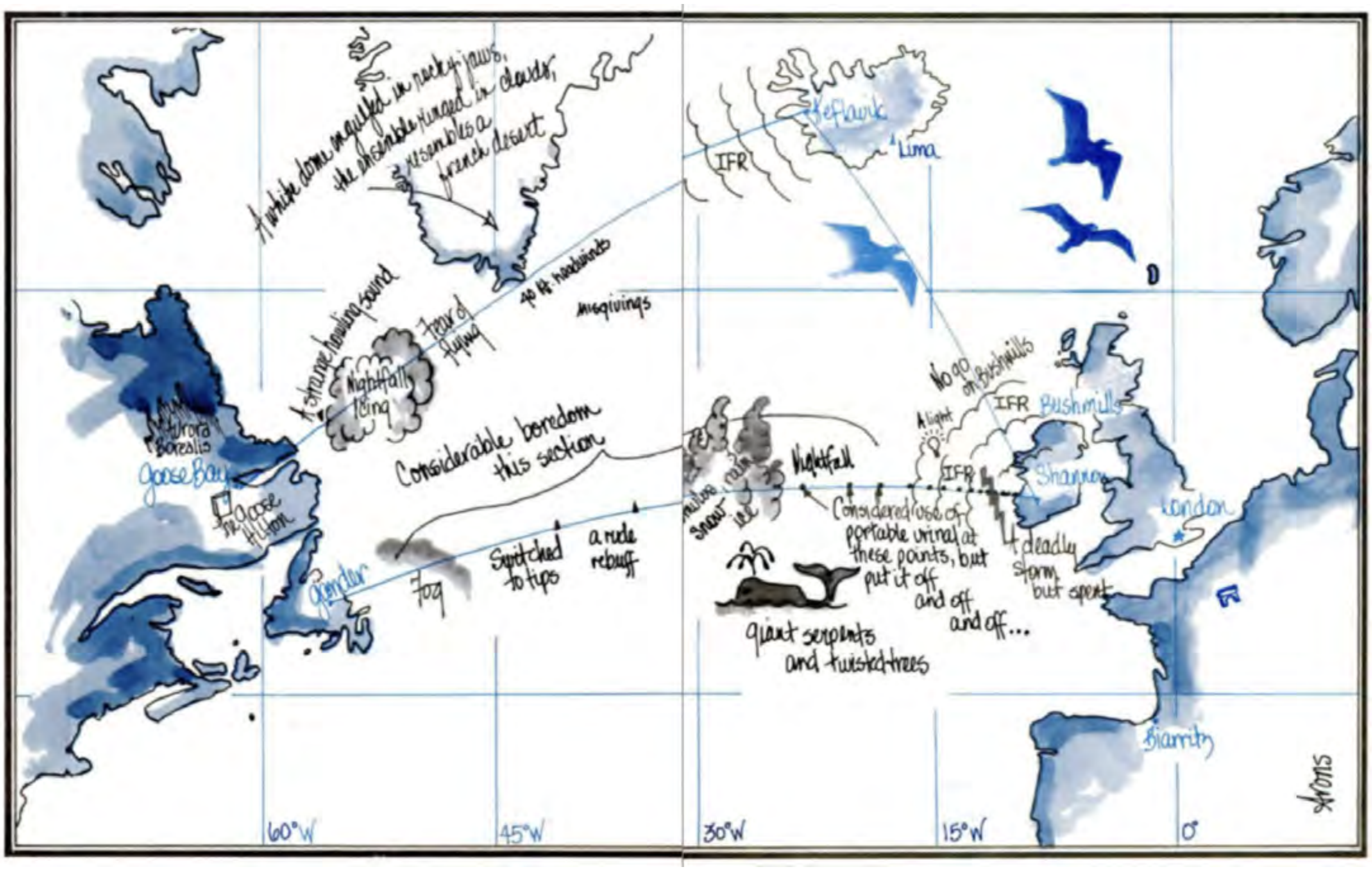
In July, I installed a Silver Fuel Guard, which is a fuel-flow gauge and totalizer that lets me know how much fuel I am using at any moment, how much I have used since the beginning of the flight, how much remains aboard and how many hours I can continue flying at the present fuel flow. It made possible a phenomenal increase in confidence and also quickly revealed that my fuel-flow data, based on manufacturer's tables, were quite inaccurate.

With the Fuel Guard, it was no longer necessary to depend on my rather slipshod fuel-quantity gauges for a measure of remaining fuel, nor to rely on a guess about the rate at which I was consuming it. Everything was out in the open; fuel status, hitherto the weak spot in my otherwise thorough instrumentation, was free of almost all uncertainty.

The last and most difficult piece of equipment to acquire was a high-frequency radio. HF makes possible communication over ranges in the thousands of miles — sometimes — and it is required for position reporting in the North Atlantic. (The Canadians require an IFR flight plan with position reports every five degrees of longitude, or about 200 nm.) After much phoning around, I arranged to rent one from Globe Aero of Lock Haven, Pennsylvania, a ferry firm that flies from Gander to Shannon several times a week with airplanes having various numbers of engines, including one.

The HF antenna would consist of a foot-long mast projecting downward from the floor of the cabin. At its top end, below my knees, was a reel; at the bottom end, the antenna cable would be secured to a dime-store plastic funnel. It would trail behind me, 30 or 40 feet long, for the entire trip.

You can prepare forever and never be ready, because the first time across you simply don't know the ropes. No one can tell you everything in advance. And so, a well-prepared tyro, I left Los Angeles on the afternoon of August 2 with 20 pounds of charts, a handful of routine permissions to operate in foreign countries, raft, sleeping bags, perhaps 40 pounds of luggage for almost any climatic eventuality, survival gear, camera, a few tools and spare parts, and the beginnings of a sentiment of fear that would remain with me almost until we landed at Shannon.



Gander, Newfoundland. We arrive at nightfall. It is clear, and the lights of the airfield are visible from far out in the gray that grades into darkness. A cold wind is blowing. Nancy dashes off to the terminal to put on something warmer while I wait at the plane for the fuel truck. Next to me at the fuel ramp is a Navajo chock-full of 500-gallon drums; it is a Globe Aero ferry job on its way to Johannesburg. I had chatted a little with the pilot at Lock Haven, and now we chat again. How does he like the work? I imagine the romance of distant places, the long hours over water, the uncertainties, as adding up to a particularly attractive way of life. He hates it; dull flying; none of the places he goes really interests him; but at least the money is good. The plane is due in Johannesburg in two days, so now he's hustling over to Tenerife, in the Canaries, crossing the Atlantic during the night. The thought enters my mind that probably he's got a woman somewhere whom he hates to leave, and all the time he's traveling, he's wishing he were back.

The fuelers don't kid around. Gas gets spilled all over the place, but when they're finished, the tanks are brimful. I bring the oil up to 10 quarts, pay the bill and taxi to the light-aircraft parking ramp. The plane is strange with its 924-pound fuel load; the oleo struts are almost fully compressed, the tires, cooled and squashed, bulge out below the wheels, and it takes a lot of throttle to get rolling. I wonder if this lead pig with bumblebee's wings will get into the air.

The night before you cross, you put in for a weather folder. They make up a forecast especially for your route, altitude and time, including the winds in each five-degree weather sector, photocopies of several graphic synoptic charts on which puffy masses of cloud spread and coil like protozoa on a slide, terminal forecasts in an indecipherable code for everywhere you could possibly end up going, all packaged in a personalized, blue folder. It's a nice system; it means that you have all the weather data handy for consultation should some question — such as the limits of an area of high winds or low freezing levels — arise in the middle of the ocean.

The weather office is on the mezzanine of the terminal building; we go up, passing a little museum of transatlantic flights, which includes a painting of some luckless fellows clinging desperately to the flotsam of their airplane in stormy seas. Their haggard and terrified faces remind me of the faces of the damned in the Sistine Chapel. In the met office, a beaming forecaster takes our order. On the wall is a huge Mercator map of the world. I like the Mercator version these days, because it exaggerates the length of the Atlantic crossing, which on a globe or a GNC seems quite unimpressive — it is about as far as from Los Angeles to Detroit. Each time I see one, I gaze at that ragged patch of northern ocean over which Greenland hangs like a bunch of grapes and imagine myself vaulting it in a single bound.

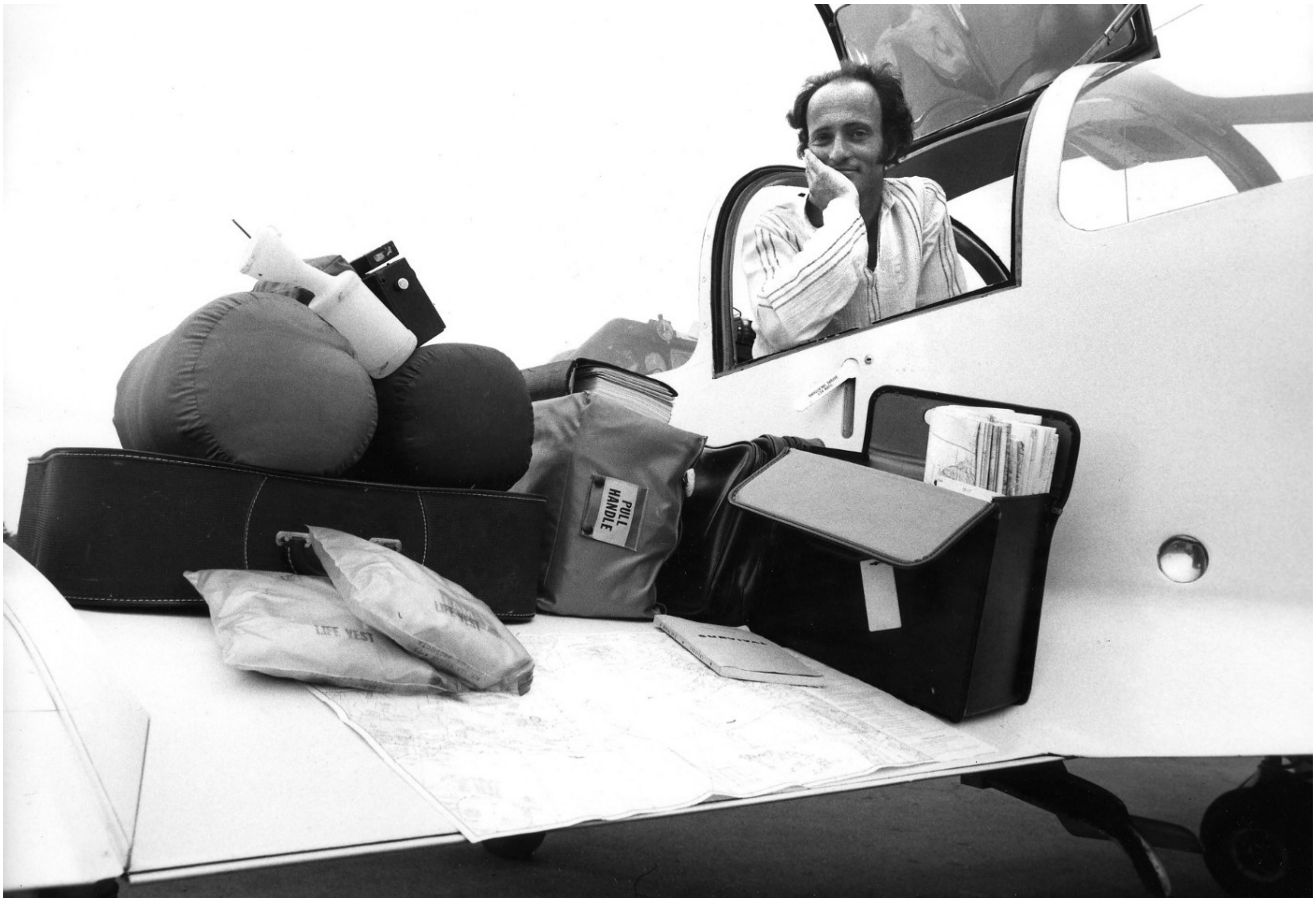
The people of Newfoundland seem dour and gray; unsmiling natives direct us to a hotel and a restaurant, and by midnight, we are in bed. I fall asleep easily — I almost always do — with the specter of the crossing hanging like a fog bank off the shores of my consciousness.

In the morning, the airport is zero-zero. Disheveled corpses litter the terminal. The butterflies in my stomach awaken slowly. It is necessary to check out of customs, get the weather briefing, file a flight plan, have a bite to eat and go; this simple series of events somehow devours two hours.

The weather forecast calls for intermittently strong cross-track winds, but the bored and unsmiling met man, friendly beneath the frost, I feel, guesses the net component as zero. No weather at first, then some cumulus buildups. possibly to 11,000, in midocean, combined with a drop in the freezing level to 6,000 or so, then no "significant Wx" till the coast of Ireland, where there is a front with some thunderstorm activity. I am thankful for a mild day but disappointed in the wind.

The international flight plan form is unfamiliar, and it seems to be of the kind of which I always enter everything on the wrong line. It is curious about our survival gear. "We don't like to alarm people," the center chief apologizes, "but it's good to know these things."

I do not feel impatient at all; but finally, at nine o'clock, we get a ride out to the plane. The fog has lifted; there is now a mile or so of visibility under a 100-foot ceiling. The airplane is wet and dripping; a sporadic drizzle falls. Everything seems to contain a strange mixture of the everyday and the unknown. The engine starts up normally, we taxi soddenly, call ground: "November Two Mike Uniform, taxi takeoff. IFR Shannon" IFR Shannon — a little less than 2,000 miles across an ocean of legendary cruelty.



Alas, every traveler. even those with extraordinary airplanes and expansive schemes, most contend with baggage and other necessities of life. (image: George Larson)

After a long clearance readback, we are cleared for takeoff. We are 400 pounds heavier than the highest weight at which the plane has ever flown before. Full throttle. The prop surges, then settles down to 2,800 rpm. Acceleration is rapid; I realize now that air temperature and the density altitude affect the takeoff more than the extra weight. Here, on a chilly sea-level morning, we will have no problem. I hold the airplane down a little beyond my normal 80-knot rotation speed, then rotate gently. It's heavy all right; I can feel the weight, the lethargy in roll, the reluctance to become well and truly airborne. After perhaps 3,000 feet, the wheels lift off, settle and touch, lift off again, touch again; and then we are 10…20 feet above the runway, gear coming up, speed already above 100 knots, and into the clouds. At 110 knots, I bring the flaps up, watch the altimeter for a sag; it's there, but not serious. The air is dead-still, and the airplane solid as a rock. With 115 knots indicated, the rate of climb goes to 700 rpm. Rpm back to 2,600, still full throttle, all temperatures and pressures are good, climb is good — everything is okay.

We are in the fog for a few minutes and then break out on top of a seemingly borderless undercast, with blue sky above. We are climbing slowly to 9,000 feet. The sunshine buoys my spirits. I look over at Nancy; she is already settling in with her book for the crossing, adjusting her pillows, her face untouched by any hint of fear. She's going to be fine, it turns out. Perhaps everything will be fine.

We level off at 9,000 feet some 45 minutes after takeoff; the coast is now 60 miles behind us. Speed builds up slowly; 120 knots...125 — and, to my chagrin, 125 seems to be it. I had anticipated that the plane would be slow with a full fuel load but not this slow. We are doing less than 150 knots true at 70-percent power, burning almost 10 gallons an hour.

Anxiety wells up in me. All my range figures are predicated on our managing better than 19 nmpg; we are more than a quarter below that figure. I do a series of calculations on the pocket electronic calculator, which I keep aboard as a sort of chew-toy, and breathe easier; even at this mileage, we will make it with ample reserve, and this mileage is bound to improve. Still, this is not a pleasing discovery, because it makes me wonder whether the calculated range of the airplane could possibly be correct, or whether I could even make Hawaii with decent reserves from Los Angeles.

Gander Radar hands me off to Gander Oceanic; Oceanic assigns me a couple of frequencies. I turn my attention to the HF. The man at Globe had given me a quick verbal rundown on its operation, which sounded simple, but I worry that I may have missed some fundamental point, as I usually do in such cases, and might be unable to run the thing at all.

It turns out to be so simple that you could work it with no instructions whatever. I reel out the antenna until the tuning meter peaks on my primary frequency, set the friction lock, and that's that.

The undercast breaks along a wide, arcing front, revealing blue water on which scattered whitecaps graze like sheep. The air is glassy. The trailing edge of the white wing seems, as I stare at it, to extrude a pebbly-grained, navy-blue sheet. The ocean seems very remote and flat, like a lake, not the towering, tempestuous Atlantic that has propelled so many men and ships into history and legend. Toward the horizon, the water's deep blue pales in the haze, until it merges at times with the murk of a distant overcast or separates itself from the very pale aqua color of the horizon by a strip of thin, white clouds. The velvety, featureless whiteness of the wing and tip tank resembles that of a snowy mountain. From time to time, streets of puffy little clouds pass, or a grayish, dirty-looking band of overcast slides by just above our heads.

At first, everything is uncertainty, and time seems to race by, The first attempt at contact with the HF is unsuccessful, but I easily get a relay from an airliner. They all guard 121.5 over the North Atlantic and use the "party line," 123.45, as a frequency for casual talk. The airline pilot is friendly and efficient. The next leg is 202 nm, yet it seems to be gone before I have finished fiddling with the radios and making my fussy notes and calculations for the first leg. Again, no luck with HF; again, a relay.

(image: James Gilbert)

I was told that you can pick up the BBC on 200 MHz just out of Gander. I try, but if there is a modulated signal behind all that noise, I cannot make it out. During the first hour out of Gander, I had stayed coupled to the VOR; now, and until an hour short of Shannon, I am reduced to dead reckoning, with the wing leveler holding the heading, which changes every 200 nm or so. I am ignoring wind altogether in my navigating. From the whitecaps, I can tell how it is blowing; generally it is a crossing wind. My position reports are based on time and my observed true airspeed. By most definitions, we are lost, because I don't know where we are.

I watch the main-tank quantity indicators and the Fuel Guard as the hours roll by. Fuel returned from the engine's fuel-injection system goes to the main tank on the side from which it came; before feeding from the tips it is necessary to partially empty the mains. My plan is to run 30 or 35 gallons out of the mains, then switch to the tips and empty them completely, and then finish the trip on the mains. After three and a half hours, the time has come to switch to the tips. I cannot wait too long, because if the tips, for some reason, fail to feed, I have to be able to return to Gander; therefore, I have to have at least half the main-tank fuel remaining, which I can always stretch considerably by slowing to a more efficient speed.

Nancy is asleep. I switch the selector to "tip" and watch the fuel-pressure gauge. At first, nothing; then, suddenly, the engine is completely starved and cuts out. Nancy awakens with a start and looks at me wildly; my hand flies to the boost-pump switch while my other hand makes placating gestures. After an eternal instant, the engine surges and backfires, and after gulping and sputtering, it is again on its feet. Nancy is still shaking. "Never do that without telling me first," she shouts into my ear.

Once one tip is feeding smoothly, I cycle the automatic switcher to the other, this time leading with the boost pump. The effects are less startling; in a minute we are getting smooth flow (except for that constantly flickering fuel-pressure needle) from that tank as well. The bubbles have been swallowed; 120 gallons of fuel remain.

The HF has so far failed to raise anybody; looking over my shoulder, I can see the useless plastic funnel trailing behind me, describing wide and random arcs in the air. One Pan Am pilot has reacted with surliness to my request for a relay, saying that if people can't get the proper radios themselves, that's their problem. I explain, In a wounded tone, that I am a tiny single-engine speck in a vast emptiness and how can he be so heartless? He, knowing that other airlines are hearing the conversation, retorts irritably that there is nothing in my N-number to reveal that I am a single-engine plane, but if I had any sense, I wouldn't be out here.

Band of brothers.

Incredibly, the DG has not precessed in four hours. Everything is smooth. Sometimes, when I don't think about the engine for a while, it seems to subside to a soft murmur; then at other times, if I yawn or turn my head or wiggle an earplug, the note of the engine seems to change. I listen to it intently. A prickly sensation moves up my thighs. The smooth hum seems to break apart into a stumbling tattoo, a medley of rumbles, warbles, hisses and snorts with no fixed rhythm; I scan the instruments — everything is normal. I pry my attention away from the engine sound, and it slowly retreats into a featureless, soft hum.

The engine sound is a barometer of my state of mind, which slowly alternates between blissful complacency and an anxious, hollow feeling of having gone too far. I wonder at times what I am doing out here, as I look out at the water stretching from horizon to horizon, the rugosities of its surface endlessly repeated, its color sometimes mottled as though there were sandbars a few fathoms down; but that is an illusion, for the water here is two miles deep, perhaps three, an awesome weight of liquid darkness through which "a pensive drowned man occasionally descends." The depth, the pressure and darkness, the vermin-devoured serpents, the twisted trees, they are repellent and awful to me; I feel as though I were suspended by a delicate thread above a yawning, hungry maw. Again and again I idly retrace the same nightmare path; the leaden depth, glowing worms, the bottomless darkness; the fragility of fuel lines; the inevitability — and therefore the unimportance — of death; the ennuis and chagrins of life that make one sometimes long for death; the sweetness of life, sunshine and breath; to lie in cold obstruction and to rot…full fathom five…alas, poor Yorick. I think of all the poor devils of past times and present who trusted their fortunes to fragile shells, who traced like tiny laborious insects the web of their travels across this gulf, and of them whom fortune failed, on whom the immensity and indifference of the universe dawned only when they were treading a thousand fathoms of water at night, crying vainly for help into the gale…

And then I dredge myself up from these thoughts into light air and daylight where we are smoothly sailing along. I think of the record — the Canadian inspector said that no lightplane had gone down for mechanical reasons, only fuel and navigational mistakes, since he had been there, which was years and years; and all the hours I have flown this engine without any trouble whatever, over 400 since overhaul, never the slightest problem, not even fouled plugs. I think of how this is only 11 hours, and there is no reason, if I have never had an engine problem in 2,000 hours of flying, I would have to have one now. My spirits brighten and relax then, and I review the instruments and the navigational progress and the weather and fuel, perhaps read a chapter or two of a book, stretch my legs and shift my position on the seat. After an hour or two, worry starts to come over me again; I think of the early attempts: Nungesser and Coli, Minchin and Hamilton and Princess Lowenstein — Wertheim, Hinchcliffe and Elsie Mackay, Bertaud, Payne and Witt…their epitaphs are written on the water. Again, the ocean becomes sinister; like Rimbaud’s boat, I long to see some European puddle again; the minutes stretch and the coldness of the ocean again seems to seep into our cozy cell…

Settled in after hours of overwater flight in a time capsule called Melmoth. Atop the panel are the fuel gauges, gear lights and angle of attack indicator. Nancy's legs conceal the Silver Fuel Guard at the far right of the panel. (image: Peter Garrison)

The OAT has dropped, as forecast, from 18° C at this altitude out of Gander to 1° here. The fuel flow has increased correspondingly but the speed is up 10 knots. Our fuel efficiency is gradually increasing. We move, as forecast, into an area of cumulus buildups.

Nancy has been alternately reading and sleeping. When she sleeps, I take her book and read sections of it at random; it is Zola's *Nana*, a sizable tome that she will nevertheless finish in the course of the flight. Sometimes she looks out at the ocean and the clouds. It is too noisy in the cockpit to talk comfortably. Sometimes I scratch her back. Mostly, however, she reads and sleeps. This galls me. Like most men, I would like an adoring female audience for my accomplishments; Nancy is not cooperating. I try to see things from her point of view; she is accompanying me on a possibly suicidal ego trip, from which she gets nothing at all but a cheap ticket to Europe, an economy she could easily forego. I have failed in the two aspects of airplane design that concern her most: noise suppression and comfortable seating. Furthermore, there is nothing to adore. I am not defeating monsters with *kung-fu*; I am just sitting here with my arms folded, twitching occasionally. I tell myself that I should be glad she is willing to keep me company on this gratuitous venture. Since I do not know where I am, and since I have not seen a single ship or even the contrail of an airliner, I have the sensation of being completely alone. Therefore, it does not occur to me, as I begin to climb to clear the buildups. that I am in violation of an IFR clearance; at 11,500 feet, I decide that we will not make it over the tops, so we start down, weaving among the pillars of cloud. This is the first time I have hand-flown the airplane since we left Gander. Nancy wakes up and watches curiously as we drop down to 5,000 feet, where we are finally below the freezing level, though still above the bases of the clouds. We pass through a cave of rainbows and showers. Sheets of rain and snow (snow! in August!) finally wash from the windshield the dehydrated remains of a huge bug that we acquired somewhere in Kentucky. The ocean below is blacker and its surface closer and proportionately fiercer. Gradually, however, it becomes calmer; it is interesting to see how we pass quickly across zones of widely differing wind and weather. Almost seven hours out, some time after I give a position report. Shanwick (Shannon-Prestwick, the oceanic control on the other side) advises by relay that we are below the floor of controlled airspace and will require a clearance to climb back up above 5,500. This seems to me like a laughable absurdity. How pompous of them to imagine that they have any control over what is happening out here! Nevertheless, I request clearance to seven as the temperature begins to rise. I duly get it and climb.

The sun sets. Its slanting rays burst in bundles among stacks of gray clouds, and silver paths and patches, mottled with the shadows of clouds, appear on the water. The glow in the sky lingers for a long time behind us; and suddenly, at one point, I realize that it is behind us and to the *left*. I scan the instruments; wet compass, remote compass, DG — they all agree we are on heading. How can the sun be to the *left*? I finally realize that as far north as we are, the sun crosses the horizon at a shallow angle, and its glow, after it has sunk from sight, continues to move northward along the western horizon.

(image: Nigel Moll)

At last I succeed in making HF contact with Shanwick; but it is unreliable, since the slightest rain seems to blanket the signal, and we are flying in and out of rain and cloud all the time now. In the last light, I have taken the measure of the surface wind; for hours it has seemed to be an intermittent quartering headwind; now it has reversed itself and we have a stiff quartering tailwind from the northwest. The water is rough and frothy. I began to think some time ago about how difficult it would actually be to ditch into this stormy sea and then to climb out of the foundering airplane — which, for all I knew, might do an immediate nose dive for the bottom — into a raft that would be half awash and blowing away, and to help Nancy out (she hates unsteady and slippery places) and to remember all the junk I want beside what is already packed into the raft, loose stuff like the ELT and the flashlight and spare batteries and jackets. And then we would be soaking wet, the wind would be 40 knots and the temperature would be 40 degrees…

As the ocean disappears in darkness, I know that if all that would be difficult and chancy in daylight, it would be next to impossible in the dark, and colder still, lonelier and sadder, a miserable way to die without even time to think back over good times or perhaps without even time for a parting kiss, although it is sentimental to suppose that kissing would even enter into it…

We have been flying for nine hours. Night is fully upon us. Nancy can no longer read; she is awake and looking out, and then suddenly — a light! There is a bright light down on the water. A boat! I know Lindbergh's feeling when he saw those boats, or any mariner's at the first birds he sees as he approaches land. Your heart sings with excitement. Nancy sees more of them to the right, several, a whole line of boats! The water around the lights seems peaceful. I don't know how far we are from shore, nor how far north or south of our course; there are thunderstorms and coastlines between us and the BBC, and I can't rely on the ADF indication. We plunge again into cloud; the nav lights' reflections brighten and fade with the changing density of the clouds. It begins to rain, heavily; a horizontal rain that resembles fine silver wires trailing behind us in the halo of the white taillight. It becomes turbulent; this is the front forecast to lie off the coast of Ireland. Roaring, bucking, rattling, we shoot through the glowing darkness. I have not felt so good in days.

Shannon is no go on VHF from 220 nm, as I expected; I turn on the transponder, but there is no reply light. I relay through an airliner on 127.9; not long afterward, at an amazing distance — about 170 nm — I get Shannon. After a while, he tells me that he has me on radar: yes, the reply light has begun to blink. I hadn't even noticed it. Shannon is clear, unlimited visibility, windy, warm. Where are we? The VOR needle is still waggling around in confusion. "It looks like you're spot on, maybe a mile south of course."

A mile! One part in 1,500. There's dumb luck for you.

Soon the VOR is centered and we are tracking; the transponder is winking brightly. Other aircraft, local flights, European flights, are talking to Shannon, and he to them. The BBC is clear, though schmaltzy. Radar tells us we've crossed the coast, and a few minutes later we break out of the clouds. Nancy points: roads. towns, headlights and, in the distance ahead, an airport.

We land, taxi to light-aircraft parking, shut down. Silence at last. We are 10 minutes late on our ETA — 10 hours and 55 minutes altogether. Forty-six gallons remain in the tanks, enough to continue, at best-range speed, to Rome. The gyros are spinning down, the airplane is rocked by a gusty wind. I lift a window; the air is balmy and sweet. I look at Nancy; I don't know what to say. We made it; there is something special about this moment, and then again there is nothing special at all.

A little yellow truck of the Irish Airport Authority drives up, and a uniformed figure gets out. Normal life resumes immediately.

I at once dreaded the return trip and was impatient for it. Perhaps I was merely impatient to have it over with. In midocean eastbound, I had felt at times like holding my breath, sitting very still lest evil spirits take notice of my existence; I asked myself, why am I doing this? At such moments, the sight of a tree would have been very sweet indeed; but there were no trees — there was nothing but thousands of feet of water. And now I reluctantly hastened to put myself in that place again.

Passing through Prestwick a few days after landing in Shannon, I had found out that, unlike the Canadian authorities, the Irish and Scottish ones would permit us to depart across the ocean without an HF radio. I had simply to file a VFR flight plan, or an IFR plan at an altitude below the 5,500 of the oceanic control zone. Since the winds were likely to be adverse, the low altitude would have been my choice anyway. We therefore did not pick up an HF for the return, and I removed the dangling antenna and mast from the belly of the airplane.

We arrived in Shannon direct from Biarritz, in the south of France, on the afternoon of August 28. I put in for weather direct to Boston, hoping for weak winds. Getting up at five, I found that luck was not with us: not only would the epic flight to Boston — nearly 3,000 sm — be impossible, but the headwind component at 4,500 feet would be around 35 knots, which would give only a two-hour reserve on reaching Gander if we flew at 75 percent power — which, in view of the headwind, we might as well do. The forecaster expressed great confidence in his winds, but could I be confident in his confidence? I decided to file to Keflavik, Iceland, refuel there, and go from there to Goose Bay, a hop of only 1,322 nm.

We took off in the middle of a warm-front passage; this time, the takeoff seemed almost normal — I was already used to the excess weight. It was an easy flight, less than six hours, two of which would be within range of good navigational facilities and the rest an easy shot across an area of crosswinds. We broke out of the weather after an hour and emerged on top of a broken undercast that eventually went solid and remained so to Iceland. I made some sporadic attempts to get position fixes from Bushmills Consol station; but either I was not using the dots and dashes correctly, or it was as a Canadian inspector had said; Consol is good for telling you where you are, if you already know where you are.

We arrived in Iceland on schedule and on top. The weather below was 300 and three quarters. While we were being vectored, it dropped to 200 and a half and was deteriorating. I had visions of diverting back to Shannon. I was not looking forward to an ILS approach, since my glideslope receiver had not worked at all in Europe (it resumed working as soon as I re-entered the U.S.). However, approach advised that this would be a PAR approach, and sure enough, onto the line came a flat Southern voice that gave me a neat, dispassionate, downhome GCA.

Iceland was cold, blustery, wet, muddy, foul. I changed a traveler's check into Icelandic crowns to pay for gas, and was told they didn't accept their own money — only American dollars. An apologetic airport official collected the landing fee, which, together with another fee for just being there, added up to $36. I got another weather folder from a brusque person who seemed quietly furious with me for still having trouble with the international flight plan form.

The wind was blowing harder — 25 knots now — and it had started to rain. We raced out to the plane, buckled in, I started up. Something was wrong: the engine was missing on a couple of cylinders, and though it finally caught on all six, it seemed to be running roughly. Though I was pessimistic about the prospects of Keflavik — which handles a few jet airliners and a NATO base with C-130s and the like — being able to service a Continental engine, I got hold of a mechanic through ground control, and he directed me to taxi to an immense hangar — a DC-8 could be accommodated in it with only the fin left out of doors. There we pulled the plugs — it was all we could do with tools left over from DC-7 days — found nothing wrong and put everything back together again. I suspected it might be a dirty injector; but rather specialized tools are necessary to remove the injectors from this particular engine, and Keflavik did not have them.

It was now raining harder, and the wind was blowing fiercely, I wondered whether it would be wise to attempt a takeoff in an overloaded airplane in such a wind and decided it was no more unwise than Iceland was unpleasant. I started up again; the engine sounded reasonable. I figured that I had been letting my imagination run away with me, and we went out and took off into the teeth of a sweeping gale that blew right down the runway, all the way from Goose Bay.

We flew for an hour or so in cloud and rain, and then it broke up and we were on top of an undercast that was to remain almost solid for hundreds of miles. I talked with a Seneca II on the way into Kef from Gander; he had had a light westerly component at 11,000, he said.

The tip of Greenland is 627 nm from Keflavik; thence to Goose is almost 700 nm. Based on the winds report from the Seneca, which I decided had to be more accurate than Shannon and Keflavik's secondhand versions of things, I estimated the Prince Christian NDB at the tip of Greenland about four hours and 20 minutes out of Kef. We arrived there *one hour* late. Below us, visible through gaping holes torn in the cloud deck by a turbulent wind swirling off Greenland's point, the whole ocean seemed to be stampeding toward Europe. The surface wind had to be 40 knots. Our groundspeed from Keflavik had so far been 118 knots; our true airspeed was closer to 160. The winds were not better than forecast; they were as bad as, or worse. At this rate, it would take us half an hour more to cover the 1,322 nm into Goose than it had taken to go 1,720 nm from Gander to Shannon.

It was off the tip of Greenland, which rose out of the ocean and clouds like some sudden Sierra, all craggy rocks and behind them a huge, smooth hump of snow, that Nancy realized that if we had to ditch, we would not be cozy in our little raft. She carried this unsettling thought with her as we flew along into a lengthy sunset, and as, after dark, we began picking up ice. We dropped to 4,000, then to 3,500, progressively shedding ice and then watching it reform as the freezing level pursued us downward. Finally, at 3,000 feet, we remained free of ice; but the MEA into Goose would be 6,000 after passing the coast. All this made Nancy truly nervous; we had once before had a close call at night with icing and heavy winds, and now there was a freezing ocean to boot; and to further compound her uneasiness, an eerie, low, wailing sound had come into the cockpit and stayed there like a mournful stowaway ghost. I said that it was caused by airflow over the ice, but in fact it had occurred on a couple of other occasions when there was no ice, and I still do not know what actually caused it.

After a long, uneasy period during which my fear was that we would have to drop right down to the deck in darkness — without a local altimeter setting — to stay out of ice, or that we would have to climb up to 6,000 in icing conditions and carry a load all the way to Goose, things improved. The sky cleared, we climbed to a higher altitude under a starry heaven; we picked up the Hopedale and Cartwright NDBs, one to the right, one to the left, and a rough triangulation put us right on course and now a little early; the winds had slackened considerably after Greenland. A pale but immense aurora was playing in the sky ahead of us, a reflection of monstrous cataclysms. Goose Bay VOR was good from 140 nm out; then a friendly controller, a distant brooch of lights in the black velvet ahead, vectors, localizer, landing. “Welcome to the Goose,” said a cheerful radio voice.

Nobody, not a soul was around as we parked beside a Baron on an otherwise empty ramp. It was no different from any other ramp, but I felt a difference somewhere. Perhaps I was only breathing easier; the ocean was behind us, our feet were dry, we were back home.

This article originally appeared in the December, 1975 issue of Flying *magazine. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents***. *A PDF version of this article, or the entire issue, is available* ***upon request***.

Google Maps on Jeti Transmitters

A Lua app can now put Google Maps on Jeti transmitters with lots of useful functionality.

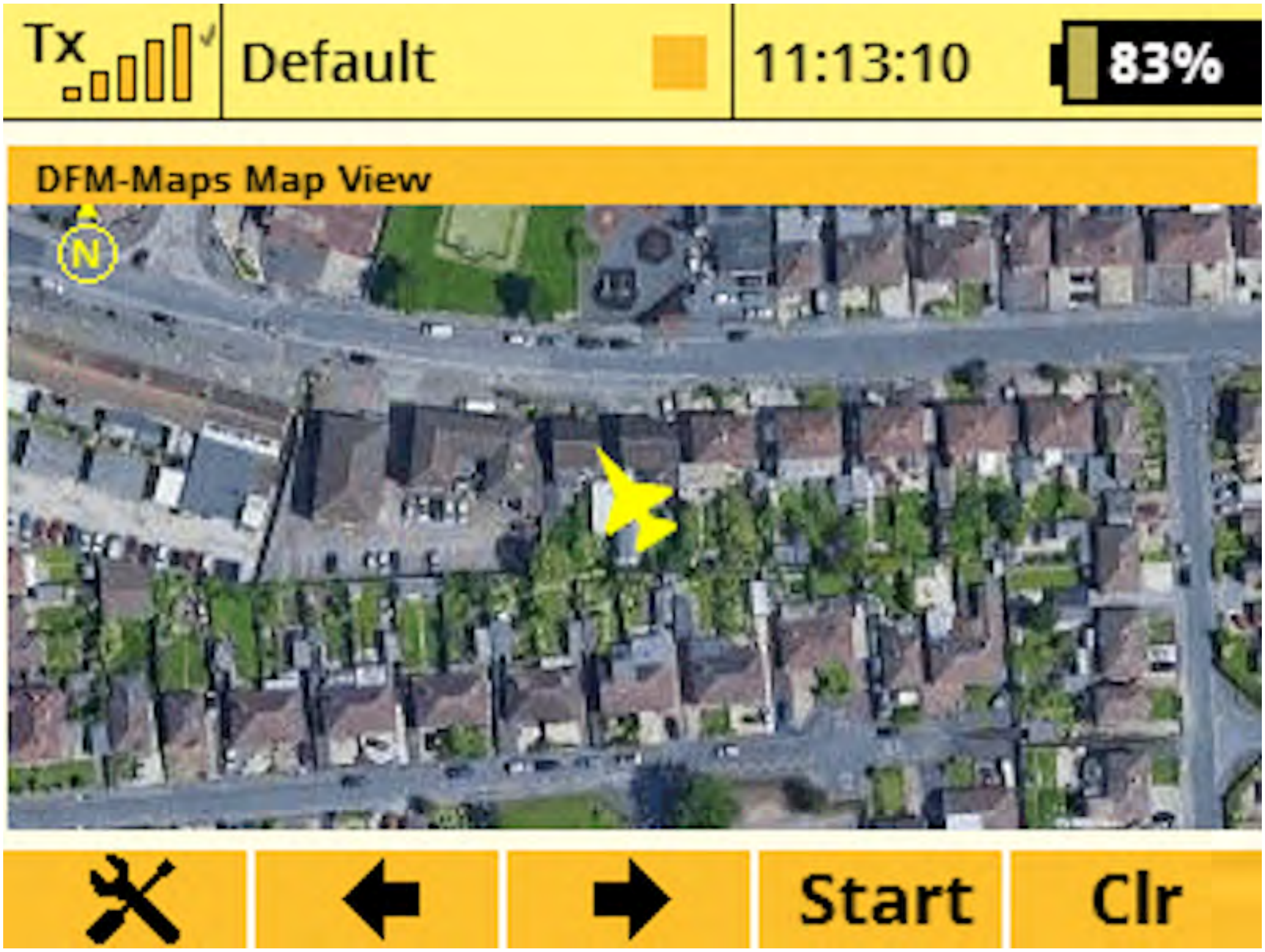
Harry Curzon

In the July 2021 issue of new RCSD, I wrote about Dave McQueeney's Lua application for Jeti transmitters (see *Resources*, below) that gives pilots a very fast method of trimming for crow brake. Now I can present Dave's latest amazing app for Jeti radios: Google Maps on the Jeti transmitter screen. With this you can see the position of the model in real time, see its track history, colour code the track with a telemetry value, get spoken warnings about no-fly zones, and do GPS triangle racing for gliders with spoken directions around the race course and calculation of race points. This app has taken a lot of development but it is very sophisticated and we are sure that you will find it very useful. Any information that the pilot needs to know during a flight is spoken by the transmitter, so there is no need to take your eyes off the model and look at the screen while the model is flying. In fact the transmitter screen can display other telemetry screens, not the map, and the pilot will still be given all the spoken warnings and steering directions.

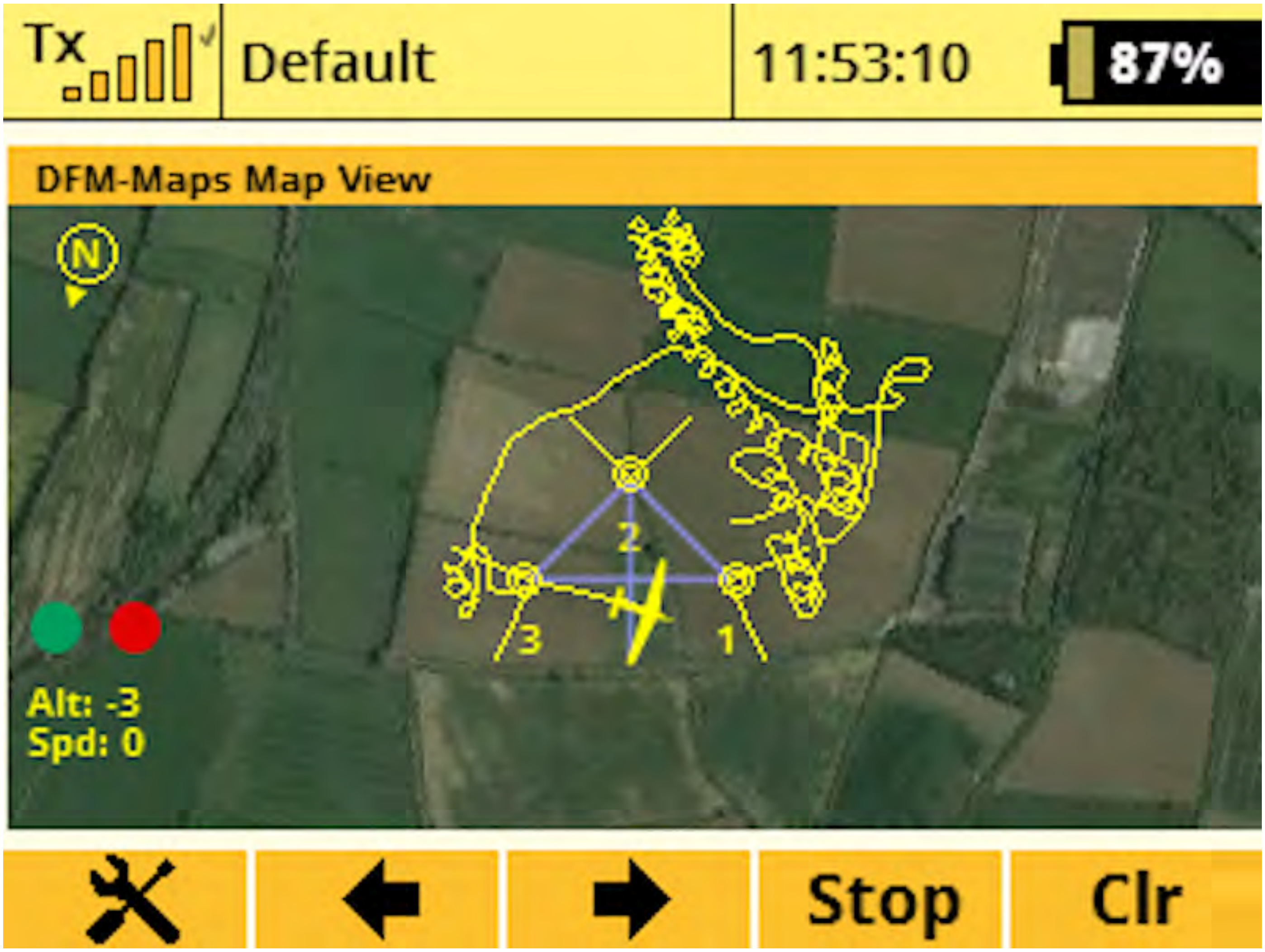
The app is free and only requires that the model has a GPS sensor that works with Jeti radio. Most of my testing was done with a homemade GPS using the rc-thoughts.com design, which cost me around US$15 for the parts, so it allows pilots to enjoy triangle racing for very little cost. The triangle racecourse can be modified to any size and length of time, making it possible to race against yourself with even a small foamy glider.

If your flying sites have no-fly zones, these are easily programmed into the maps. The app then gives you spoken warnings about approaching the zones, entering the zone and leaving the zone. The zones are also shown with a red line on the map display so that the position of the model in relation to the zone can be very clearly seen.

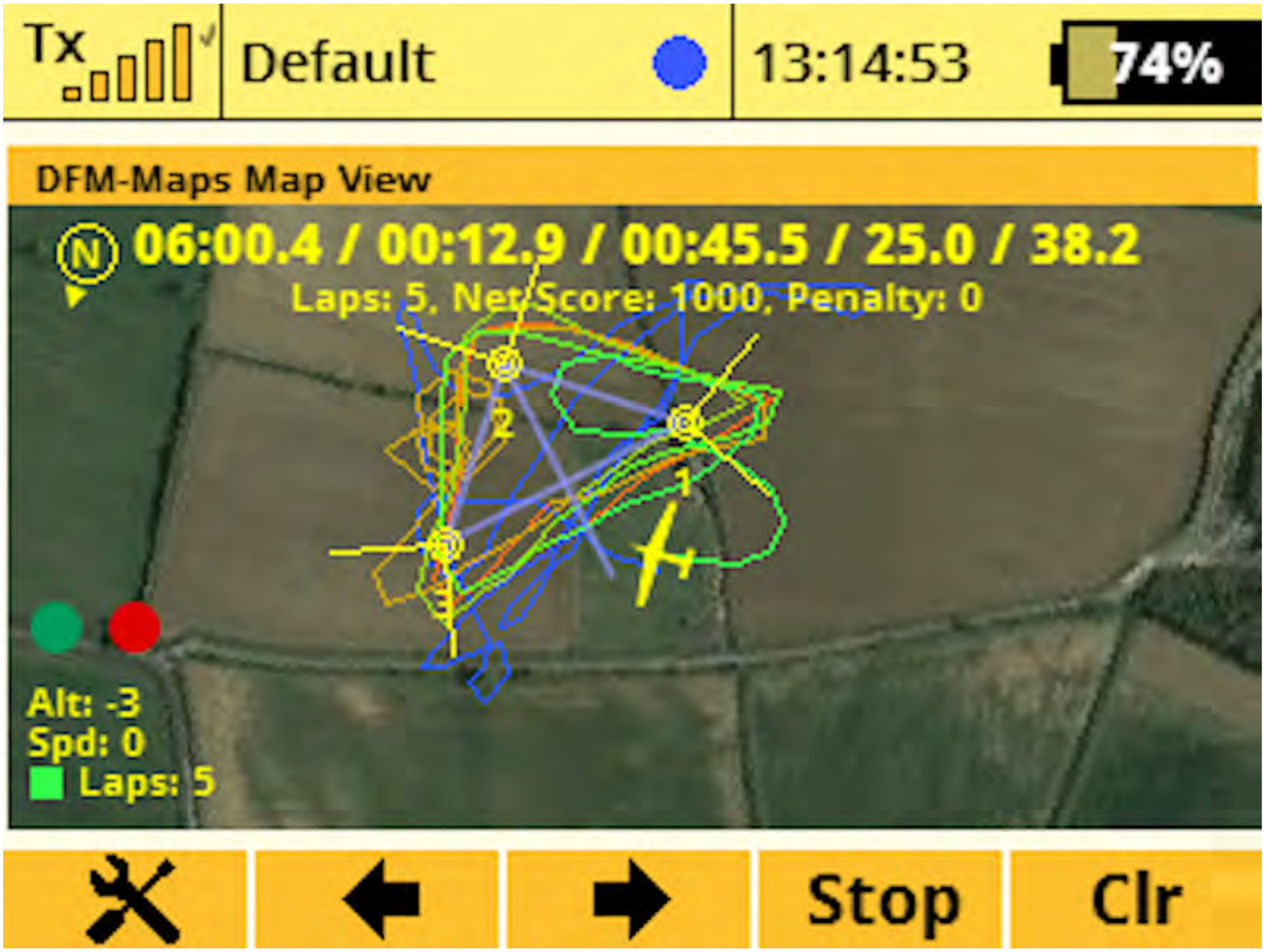
This photo shows the transmitter screen as I sit with a model in my back garden. The screen displays a Google Map in satellite view with an aeroplane icon right where the model is!



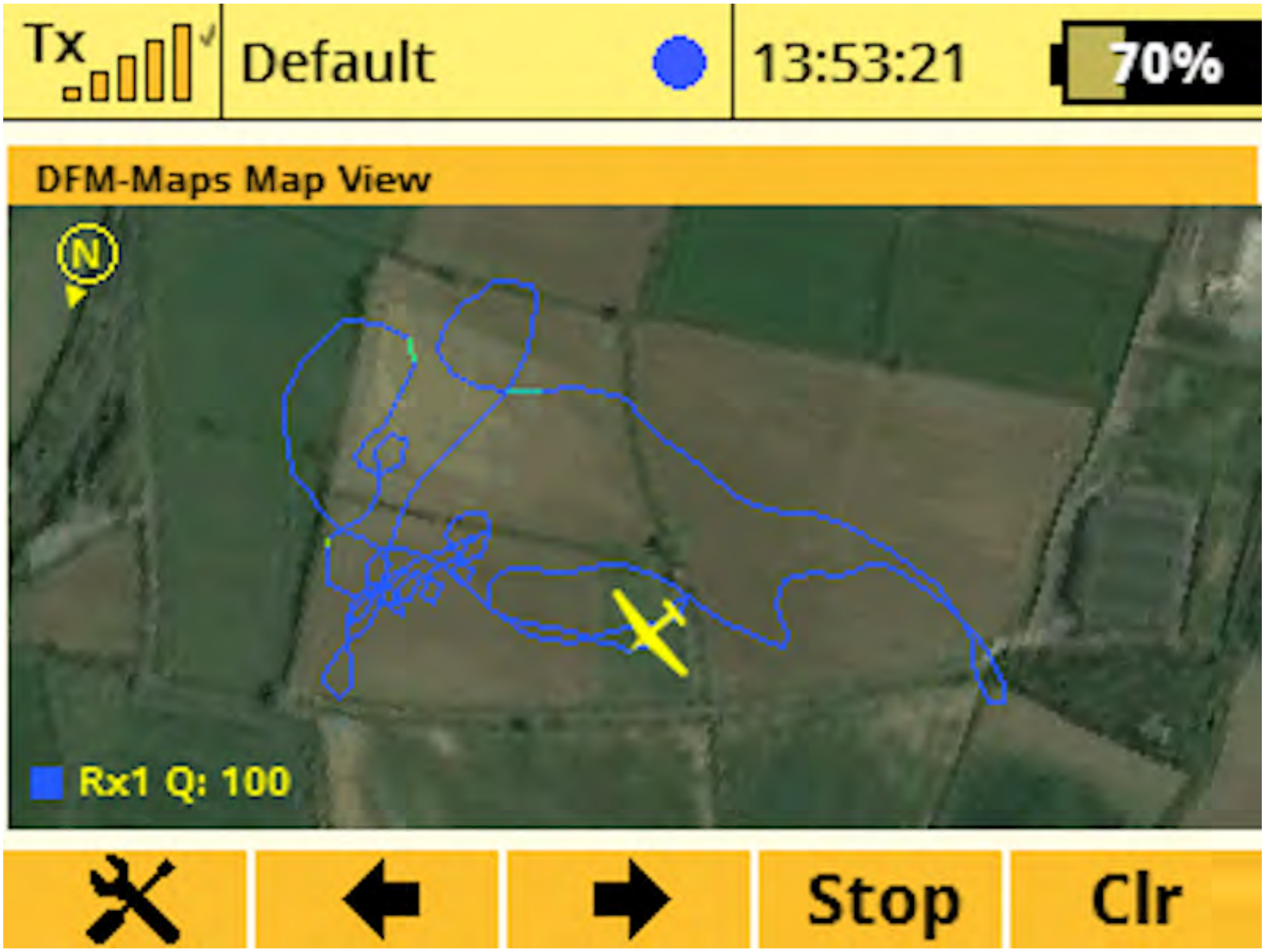
The next photo shows the transmitter screen after a short flight of my Multiplex Cularis glider from a grass airfield. The corkscrew path of the model while following a thermal down wind is very clearly seen.



This photo shows the result at the end of a short six minute GPS triangle race using a foam glider. Each lap is a different colour of track making it easier to follow each one. The app displays data about lap times and speeds, scores and penalties. Flying the race does not require the pilot to look at the screen at any time. Spoken information is given about height and speed before crossing the start line, any penalty due to height or speed is spoken as the start is crossed, and then steering and distance directions are spoken to each pylon in turn. Spoken instructions can be turned off by a switch while you go thermalling, and then switched back on when the race is resumed.



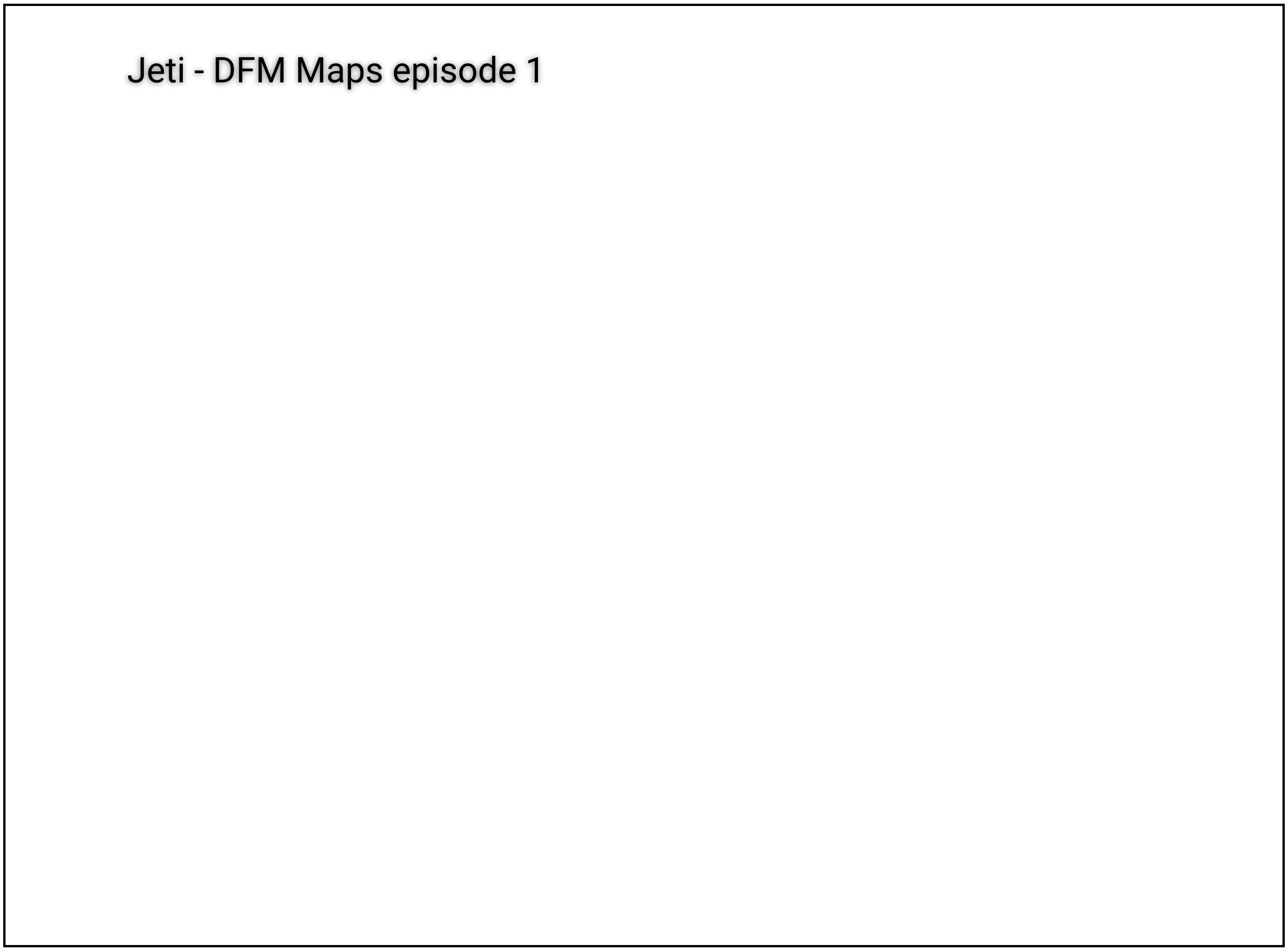
The picture below shows a short flight with the track colour coded for reception data quality. Almost all of the track is blue, indicating 100% of packets were received and acknowledged. Three short sections at random locations are changed to green showing a slight reduction in data packets acknowledged. In this case the reduction is well within acceptable limits but such a visual presentation of data can be used rapidly at the field to pinpoint any areas where there are thought to be recurring interference problems.



Putting a Google Map on a transmitter screen is not a matter of just installing a simple app, so we have full training videos on YouTube about how to get the maps and how to use all the settings to get what each pilot needs for each model. The training comes in three episodes: Episode 1 deals with the basics, Episode 2 the no-fly zones and Episode 3 covers GPS triangle racing. Now that the app has been published for a short time, feedback from other pilots who have used it has allowed Dave to make even more improvements to it, particularly the screen presentation of triangle racing, so by the time that you read this there may be an Episode 4 to explain the upgraded functions.

Resources

- In-Flight Setting of a Multi-Point Trim Curve for Crow Brakes from the July, 2021 issue of RCSD
- Jeti — DFM Maps Episode 1:

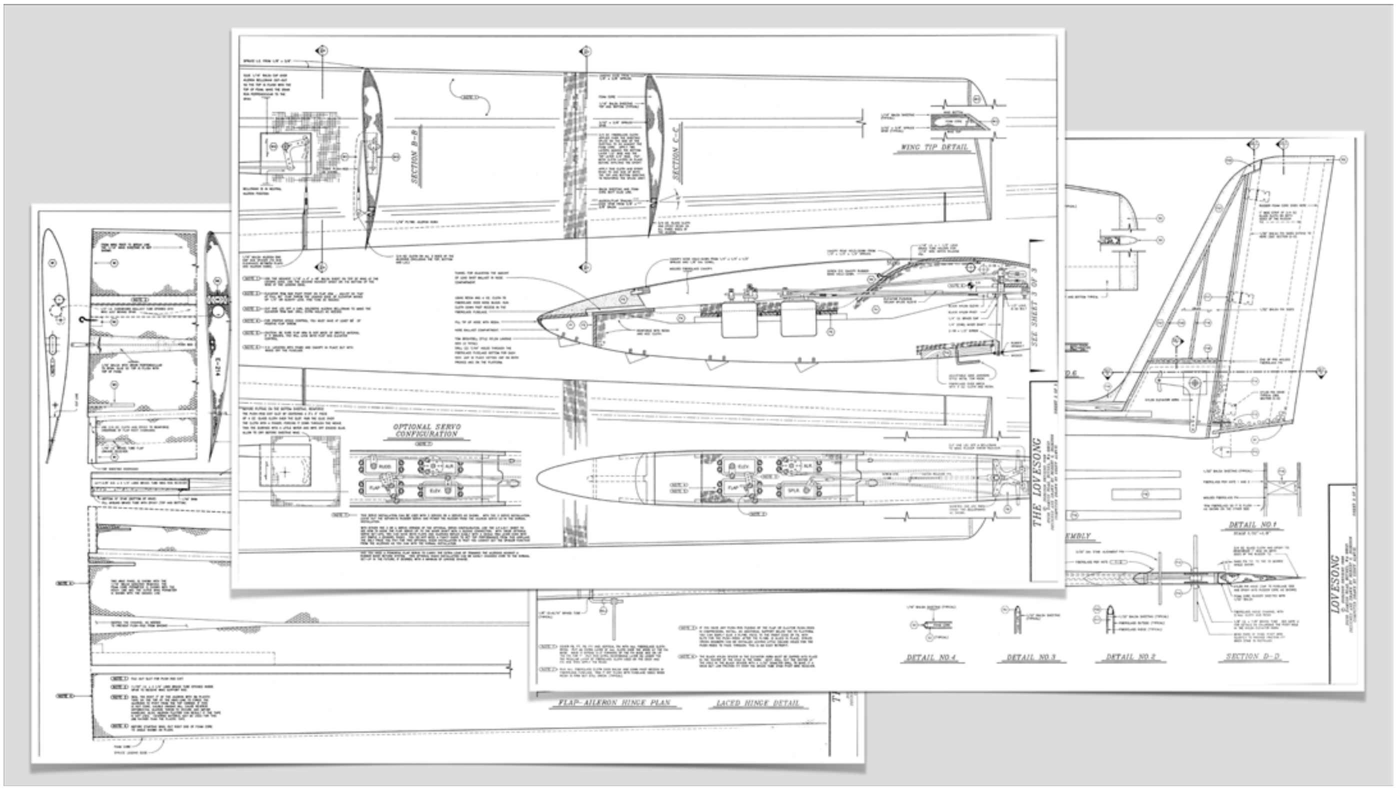


All images and video by the author. Read the ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

The Harley-Davidson Lesson

A phenomenon that still persists to this day.

[Bob Dodgson](#)



Funny story: RCSD put out a call for photos which included any one of my designs and a Harley. Zilch! There was even one reader who commented “I somehow think Bob’s designs wouldn’t share the same stage with a Harley. They’re opposite ends of the spectrum.” Unless and until the illusive Harley/Dodgson photo shows up, here’s an equally germane headline image. (image: Dodgson Designs via Outerzone)

A while back I was at a meeting of the Seattle Area Soaring Society. The featured speaker was the new ‘high-tech’ glider kit manufacturer of the month. We were told all about the amazing materials that his glider kit utilized. One thing that the starry-eyed manufacturer said that stuck with me was that there were even more tantalizing materials in the pipelines that would momentarily become available. When we had these materials, then we could really build great gliders!

This boundless faith in the 'Holy Grail' of technology reminded me of stories I had heard about doctors telling families of terminal cancer patients that "… there is no known cure right now. However, I am in contact with the latest research developments and so if a breakthrough occurs, I will immediately utilize this new treatment on the patient."

After mulling over the mad dash for 'me-too' high-tech glider kit production that has taken place over the past couple of years, I began to realize that soaring is changing so profoundly in its emphasis, its goals and its philosophy that it is paralleling what happened in motorcycle manufacturing in the 1970s and early 1980s.

The Japanese caught US manufacturers off guard by producing lightweight, inexpensive and reliable motorcycles that took over an ever larger market share. Before they knew what had hit them, US companies were going out of business. Soon, Harley-Davidson was the only US manufacturer left and they were just hanging on by a prayer. In the meantime, the Japanese were becoming ever more obsessed with performance technology. They added cylinders and increased compression ratios. They even seated the drivers in the most aerodynamic positions. You still see some motorcycle drivers zipping along curled up in a near fetal position. As technology took over and performance-to-weight became the driving force, something very basic was lost. What was lost was the main reason that had made motorcycling popular in the first place.

Somehow, the people at Harley-Davidson figured this out just in time. They went to work to improve the quality of their machines while maintaining the human appeal of the old Harley motorcycles. You see, it was learned that people like motorcycles for the personal freedom it gives them. They like the throaty sound of the large cylinders, they like a machine that lets the human body relax and enjoy the ride.

The resurgence of Harley-Davidson was so dramatic that the industry knew it had veered way off course and had lost sight of why people enjoy the hobby/sport of motorcycling. Now, the Japanese motorcycles look more like Harley-Davidsons than genuine Harley-Davidsons do and motorcycling has once again discovered its soul.

A common theme that I am hearing from people is that soaring is not as much fun now as it used to be. Some people have come back to flying my gliders because they say that they have never had as much fun soaring before or since. What attracted most of us to soaring was the simple joy of being able to put a heavy sculpture into the air and watch the miracle of it remain airborne with no motor. We cheered as better designs and control systems appeared because we could stay up longer in less favorable conditions and cheat Mother Nature even farther. Many believe that this performance curve hit its zenith in 1982 with the advent of the Windsong. Nothing new or significant in surface controls, maximum L/D or minimum sinking speed has occurred since to help the hapless pilot achieve better air times.

In the headlong dash for the most 'bullshitically correct' (BC) glider, the soaring pilot has become the big loser. The market has become a cookie cutter of sameness. To be BC, the glider wings must have a Schumann planform, the fuselage must have a strip of kevlar in it somewhere and the wings must be pre-built. To carry BC to even new levels of absurdity, in a recent soaring column in Model Aviation, the soaring editor was defining the 'new breed' (read bullshitically correct) as having four servos in the wings and a wing span of between, 112" and 118".

What dribble! As long as the control surfaces are moving properly, the glider does not care where the servos are. Why 112" to 118" span? Perhaps for F3B, the launching device restrictions makes this size optimal — but for thermal duration flying — come on! In short, there is nothing new about this breed, from the controls they use to the swept wing planforms. People like Dwight Holley, Dick Pike and Bob Bougher were putting servos in the wings of swept-wing Maestros in the 1970s for gosh sake.

Most recently, when the Saber was about to be the first competition glider kit to use the officially ignored and even denigrated SD7037 airfoil, I was advised not to use it based on writings of Michael Selig, himself, and in a personal admonition from Harley Machalis who built the wind tunnel prototype. Based upon the wind tunnel test results and upon my own prototype evaluations, the Saber came out with the SD7037 rather than the Selig recommended SD7032. The result of the Saber's success opened the floodgates for the SD7037 which is now the most popular airfoil in thermal soaring.

My 25 years of experience in the hobby has taught me to do my own homework and to not blithely take the accepted truisms of the day as fact. Interestingly, in a recent magazine soaring column, even Michael Selig conceded that 'tips up' contributes to increased tip stall problems in slow speed turns. Tell me this is not so! I thought that every BC glider design from 'here to eternity' would have to be tips up!

A few days ago, I was amazed while at the flying field, to hear a flyer extolling the virtues of an original set of wings that he had designed. These wings used the BC (Schumann) planform but they even had the trailing edge of the tips swept. With a knowing look, I was informed that Martin Simons had said that swept tips provided a dihedral effect. I was blown away with this earth-shattering crumb of knowledge. I guess that with BC design, even the most basic knowledge has taken on a 'mystical-techno' quality. I told this well researched flyer that any wing sweep provides a dihedral effect He was dumbfounded to hear that even normal sweep, including sweep of the inboard section, contributed to the dihedral effect. Whatever happened to the dispensing of knowledge without mysteriously shrouding it within our favorite theories of BC aerodynamics?

It may even surprise you to know that BC gliders have not taken over areas of the country by outperforming the gliders that are designed to fly the farthest and stay up in the lightest lift. They have taken over areas because the best flyers started flying them — so the BC gliders started winning contests. Had the less skilled pilots kept flying the better performing designs, they would have improved their chances against the 'top dawgs' but alas, they too fell off the tree of wisdom like overripe fruits. With no respectable flyers in an area flying the better performing gliders, the BC gliders look good. No one is aware that they are hotshots in a sea of mediocrity.

Humorously, in parts of the country where all the good flyers did not abandon the great thermal ships like the Saber, Anthem and Lovesong, the ones who did change over to the BC gliders amidst great hoopla and fanfare have been soundly getting their fannies fairly well trounced this contest season. None of the new gliders is as good in light air as is a Lovesong, saber or Anthem. None of them appears to have an advantage in maximum L/D at reasonable thermal searching speeds. What is most significant is that the new ships, with the high-speed compromise airfoils, zoom right through light lift, giving the pilot no indication, in air that a Saber, Anthem or Lovesong would sense and could even climb out in. Getting air times is not about jetting aimlessly around the sky listening to your glider whistle. Getting your air times is about having a glider that is adroitly feeling its way through the medium of air and is faithfully telegraphing back even the most subtle information to the pilot.

I guess the real question is: "what is glider flying really about and what is it about glider flying that originally captured our imaginations and that has held us transfixed for months and even years?" For most of us, the art, the mystery, the outdoors, the freedom, the challenge and the oneness with nature are some of the captivating forces. However, if soaring continues down the path toward 'new breed, bullshitically correct, copycat sameness' and the dubious pursuit of technology as an end in itself, soaring will end up like the motorcycle industry of 1978. For our sport to continue to evolve, to grow and to bring the maximum pleasure to its participants, we need to have the Hogs and the Choppers — not just the wound-up-tight Kawasakis.

This article originally appeared in the 93–1 edition of Second Wind*, the Dodgson Designs in-house newsletter. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

1/3rd Scale Mita Type 3 Production Notes

The eighth part of a twelve part series.

Norimichi Kawakami

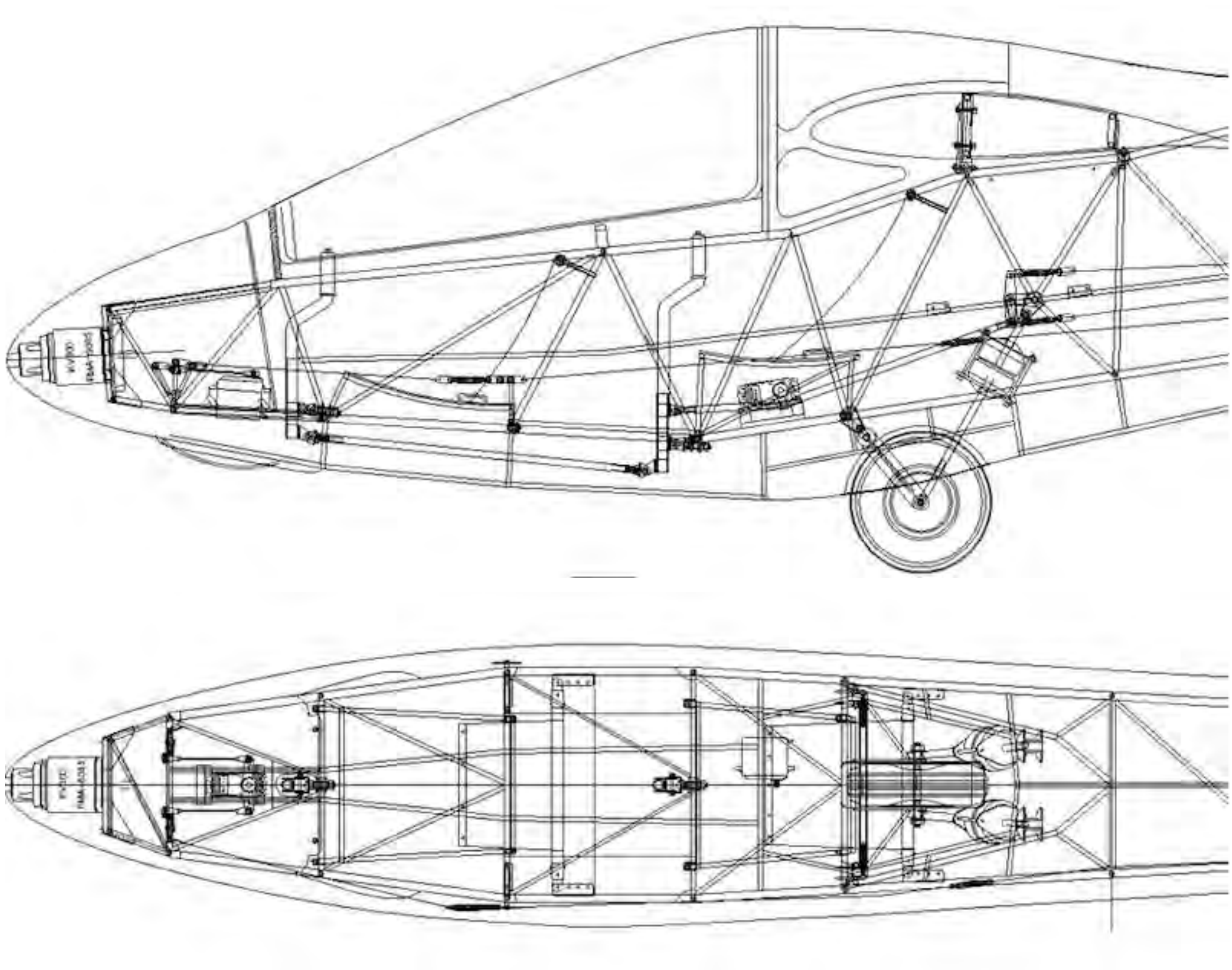
You may want to read the seventh part of this series before proceeding to this article. Also if you prefer, you can read this article in its original Japanese.

Fabrication Part 32: Seat Back and Shoulder Harness — Seats Completed

Making a wooden mold for FRP parts is a very time-consuming work. For a change of pace, I completed the seats by making the 'backs' that attach to the ‘seats’ previously made.

The ‘Back’ of the Mita

The ‘backs’ of the Mita seats are made of cloth. Their lower ends are attached to the seats, and the upper ends are wrapped around aluminum horizontal bars and inserted into two parallel slots in the upper fuselage as shown in drawing 45.



Drawing 45: Seats of Mita Type 3 Revision 1

There are four holes in the slots that allow you to change the reclining angle by changing the position of the horizontal bars on the backs. Widths of the back cloths are trapezoidal with the lower parts slightly narrower than the upper parts. The back clothes are attached to the seats by a thin aluminum plate. I don't know why, but the back of the rear seat is attached to it far forward than the front seat, and as a result, the back angle of the rear seat is looser than that of the front seat. Also, the front seat has four screws and the rear seat has five.

The Completed Seats

The seats were completed by attaching the "backs" made according to the drawing with the "seats" already made on the fuselage (Photo 161). For the horizontal bars, I attached short aluminum tubes to the ends of balsa rods, and attached acrylic tips to the ends of the tubes. I hammered brass nail heads into the aluminum tubes to give the appearance of rivets. The slots are aluminum channels that I found at a Home Depot.

Photo 161: Finished seats. Bottom left = front seats, bottom right = rear seats.

Shoulder Harness of Mita

Naturally, the Mita gliders are equipped with shoulder harnesses, but the one on display at the Shizuoka Aviation Museum is not, as it was already missing when the aircraft was donated to the museum. Therefore, I don't know what kind of shoulder harnesses were actually attached to the aircraft, but I could know how they were attached as Mr. Kimura, who was the original owner of the aircraft, drew me a diagram of how it was worn. Therefore, I decided to pursue the atmosphere of the harnesses, not the shape.

The Shoulder Harnesses I Made

The most troublesome part of making a harness is the buckle. I decided to buy ready-made buckles and ransacked the handicraft stores, but I couldn't find any 1/3 scale harness buckles, so I decided to substitute the plastic parts that hang the belt on the case and close it. I dyed parts of these in silver to give them the feel of metal parts. For the belts, I got a strip of string that looks like that.

In Photo 162, you can see how the harnesses are threaded through both the front and rear seats. Namely, the belt passes through the U-shaped bracket at the rear of the seat while holding the left and right shoulders, then passes the brackets right and left at the rear edges of the seats and closes with a buckle in front of the belly. When the shoulder harnesses are attached, they look like real aircraft seats.

Photo 162: Seats with shoulder harnesses.

Fabrication Part 33: Covering the feet around the rear seat rudder pedals

Rear Seat Pedal Foot Cover

The Mita glider has a foot cover around the rear seat rudder pedals, which adds an accent to the cockpit. If you are not familiar with the Mita, you may not imagine what I mean by “a pedal foot cover”. So I show you the finished product first, although the order is reversed.

Photo 163: Rear seat rudder pedal foot cover.

The rudder pedals of the rear seat (instructor’s seat) are mounted on both sides of the front seat (student’s seat). In other words, the instructor puts his feet on the pedals with his legs open and the front seat between them. To cover these rear seat rudder pedals, both sides of the front seats are covered with foot covers. These covers give the cockpit a sense of presence and accent the Mita cockpit. Therefore, I could not omit them in the model. The foot covers of the actual aircraft are supposed to be made of aluminum (presumably), but in the 1/3 model they are made of FRP to reduce radio interference.

Making a Wooden Mold

Since the cover is curved, a mold is needed to make it in FRP. The mold was made by cutting a block of thick paulownia wood and pasting it together.

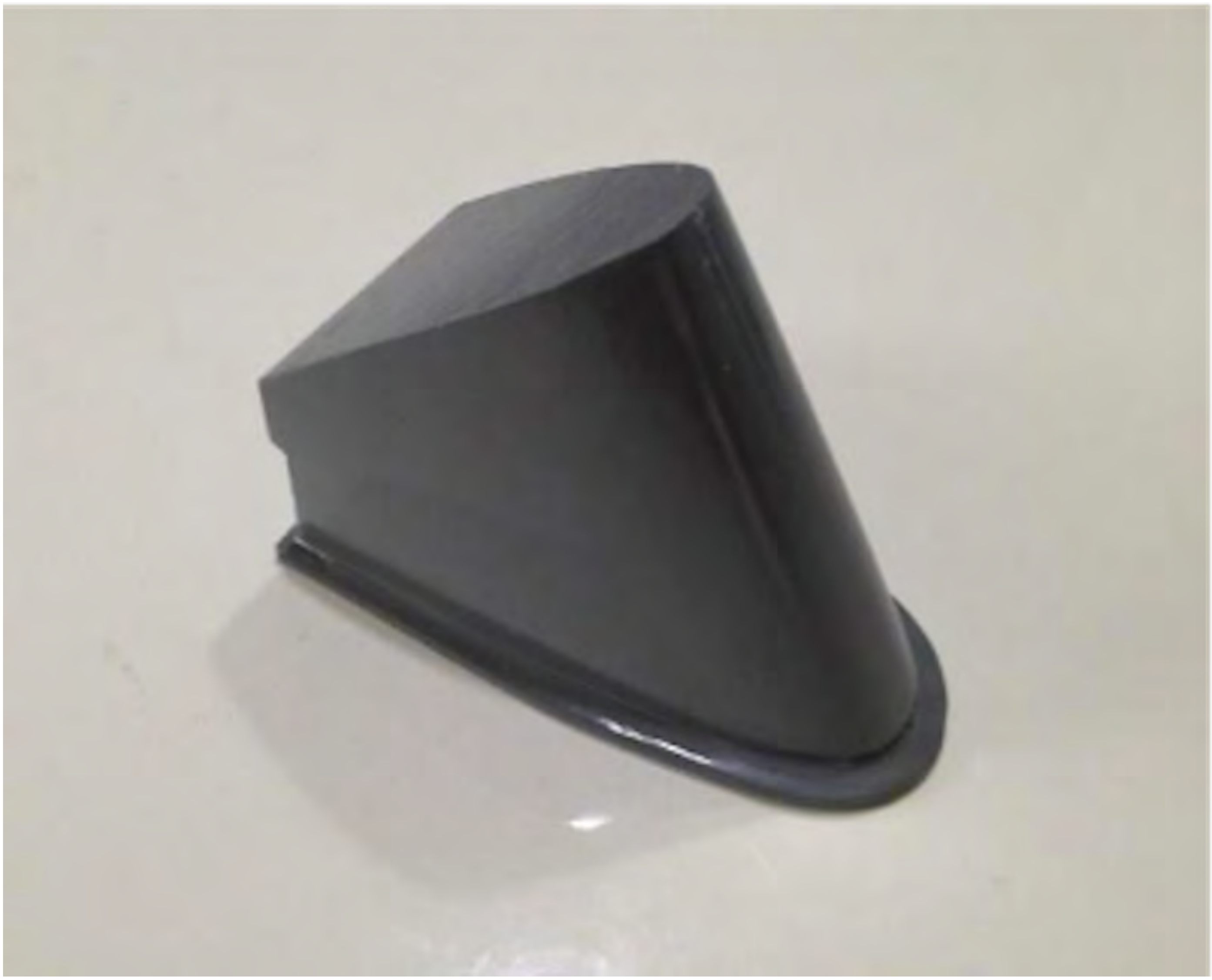


Photo 164: Wooden mold for making the foot cover.

Using this as a male mold, I made a shape out of cardboard and impregnated it with epoxy resin to make the covering.

Making Shapes with Cardboard

I softened the cardboard by wetting it with water and stuck it to the wooden mold. Leave it to dry for a day.

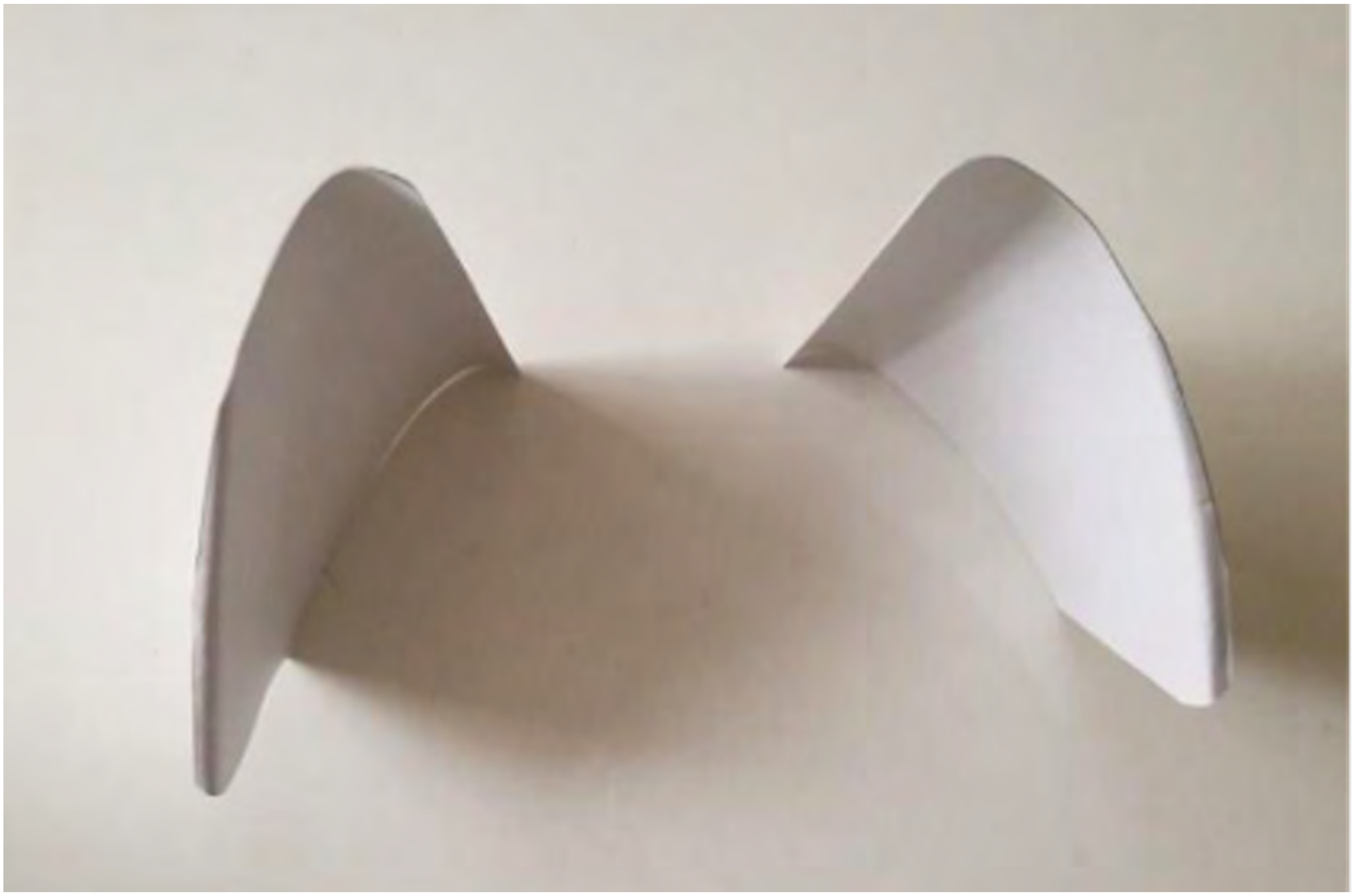


Photo 165: Making a shape with cardboard.

Resin Impregnation

Then I applied epoxy resin to both sides of the finished paper form, attached it to the wooden mold again, put it in a "Futon (Comforter) compression bag", and vacuumed out the air. Then, the epoxy resin permeated the paper and impregnated it well. I left it for a day to let the resin harden before taking it out, but it was difficult to peel it off, even though I had applied many coats of release wax to the wooden mold. When I finally peeled it off, the resin layer on the surface was partially left on the mold and the surface was not clean. The side that touches the mold is not visible because it is inside, which is good, but it is not thick enough, so I applied resin to both sides again. However, because the resin was applied by brush, the surface was not very smooth after hardening. I had no choice but to polish it up with water-resistant paper.

This is how the foot covers were completed.

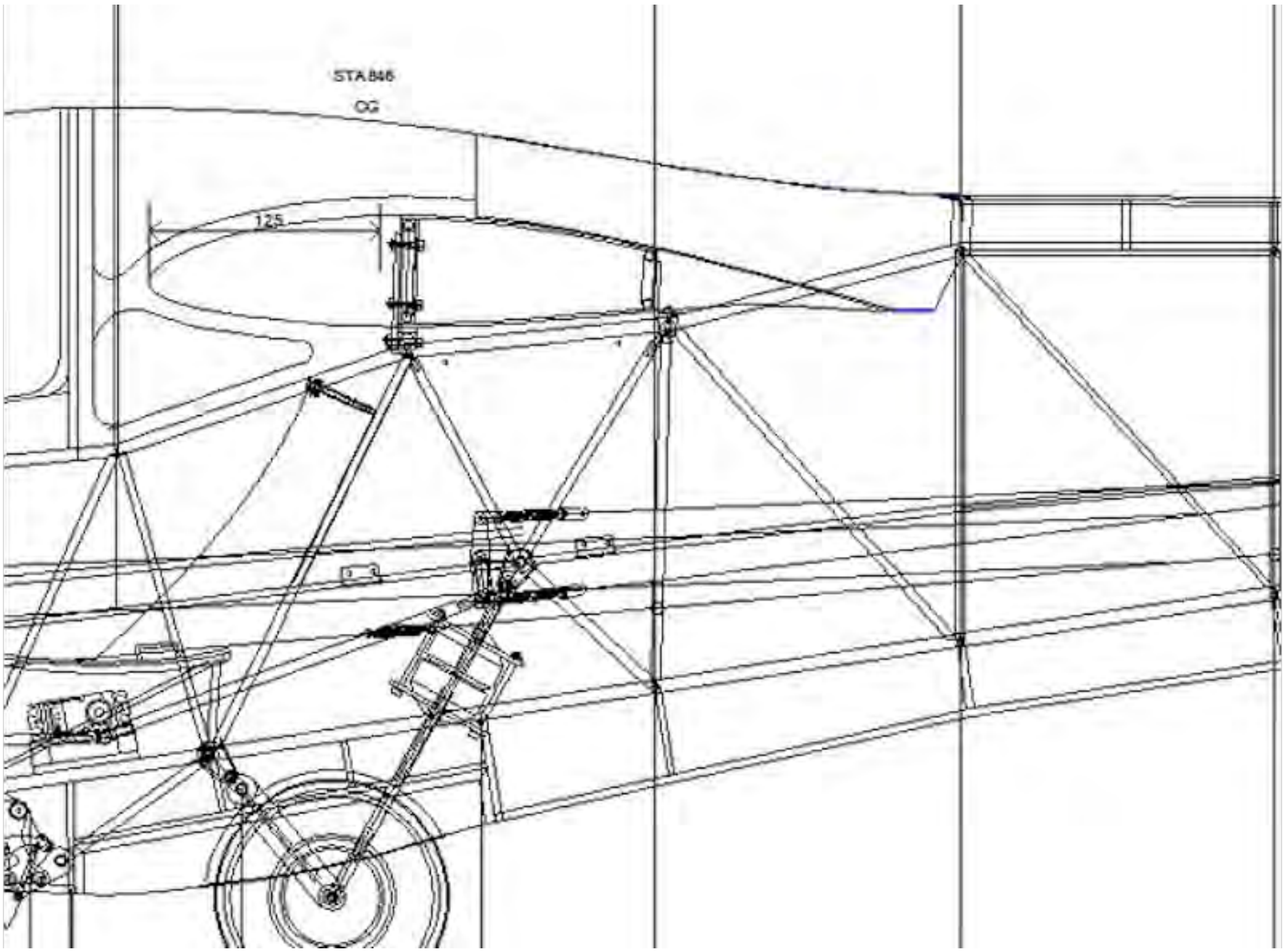
Photo 166: Completion of the foot cover around the rear seat rudder pedals.

But there remains one question of what is the need for this foot cover? I don’t understand the need for it. I don’t want to think it’s to prevent scary instructors from kicking students with their feet.

Fabrication Part 34: Wooden Mold for the Center Wing Fairing

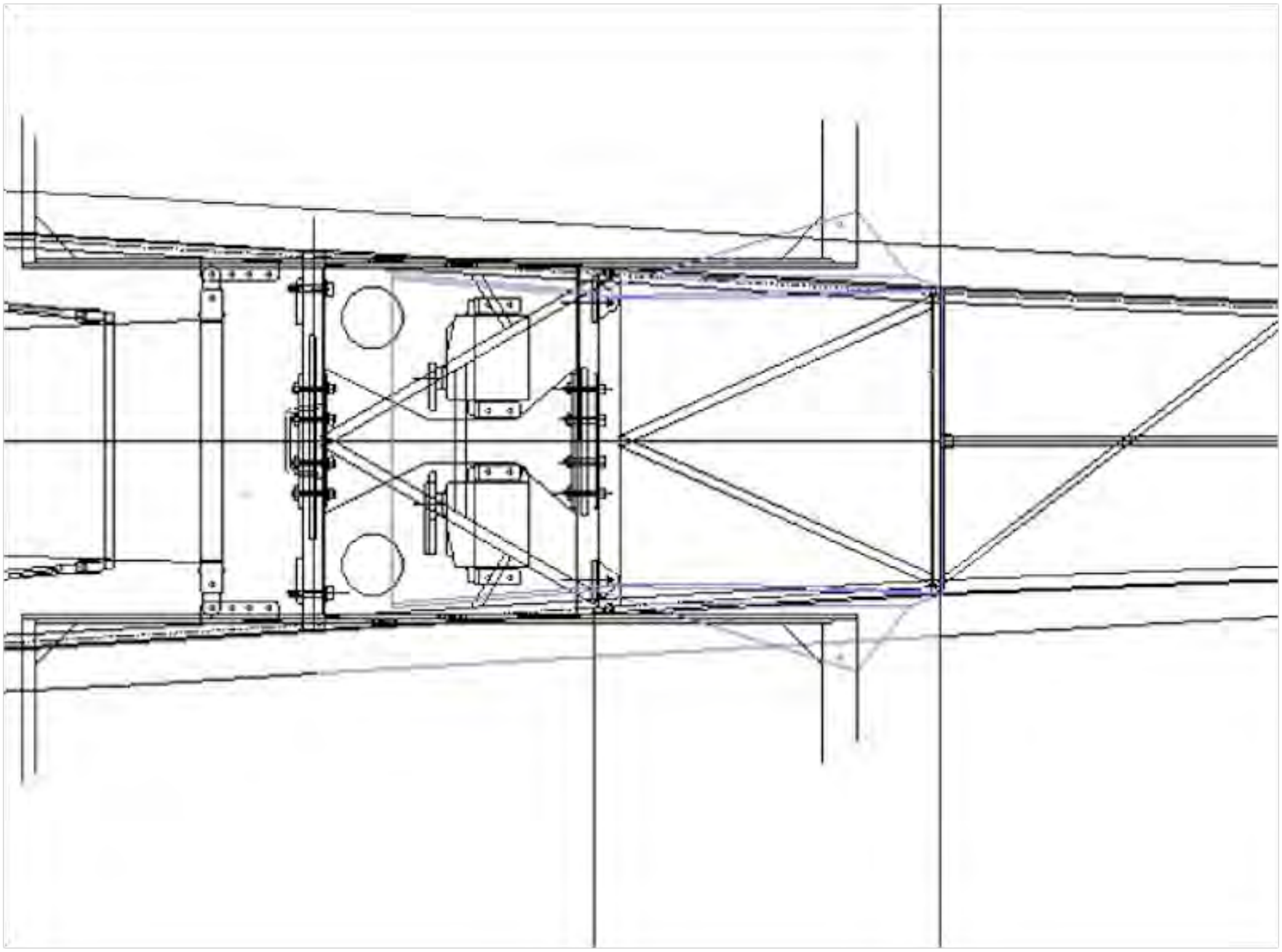
Fairing for Center Wing of Mita

There is a fairing made of FRP on the upper part of the center wing of Mita Type 3. The fairing connects the rear end of the cockpit canopy and the upper overhang structure of the rear fuselage, and covers the upper half of the center wing. The side view is as shown in drawing 46.



Drawing 46: Side view of center wing fairing.

The blue area in the drawing is the fairing. In the plan view, it looks like drawing 47.



Drawing 47: Plan view of the center wing fairing.

The cross-sectional shape of the fairing is semicircular at the tip because it is connected to the canopy, and the trailing edge is the shape of loof because it covers the upper overhang structure of the rear fuselage. The lower surface of the fairing touches the upper surface of the center wing, so it has an airfoil shape. In other words, it is a structure with a very complex three-dimensional shape change. A wooden mold was made in preparation for the fabrication of this fairing.

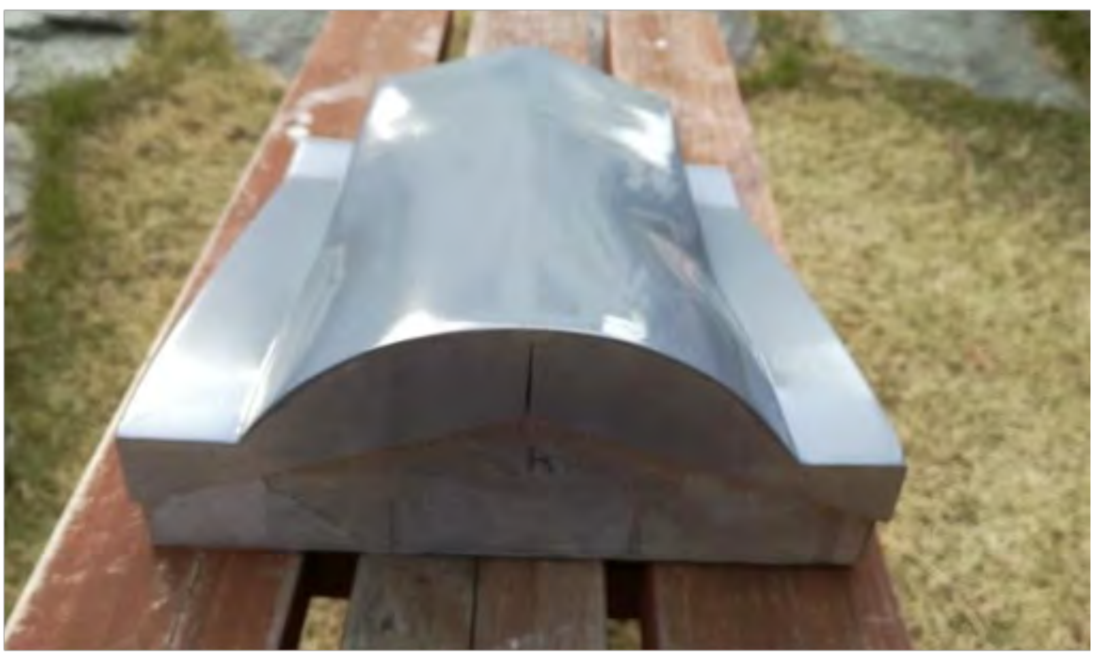
The Wooden Mold I Made

The wooden mold was made from balsa following the same process as the mold for the nose cowling. I drew a drawing of the three-dimensional shape, cut out several ribs, assembled them, and then filled the space between them with thick balsa boards before shaping.

Photo 167 shows the finished wooden mold. The sides are wider and straighter than the actual dimensions because of the need to make plaster molds. I planned to cut out this part after the FRP molded part was made.

Photo 167: The completed wooden mold for the center wing fairing.

The front side that connects to the canopy and the rear side that covers the top of the rear fuselage are shaped as shown in photo 168.



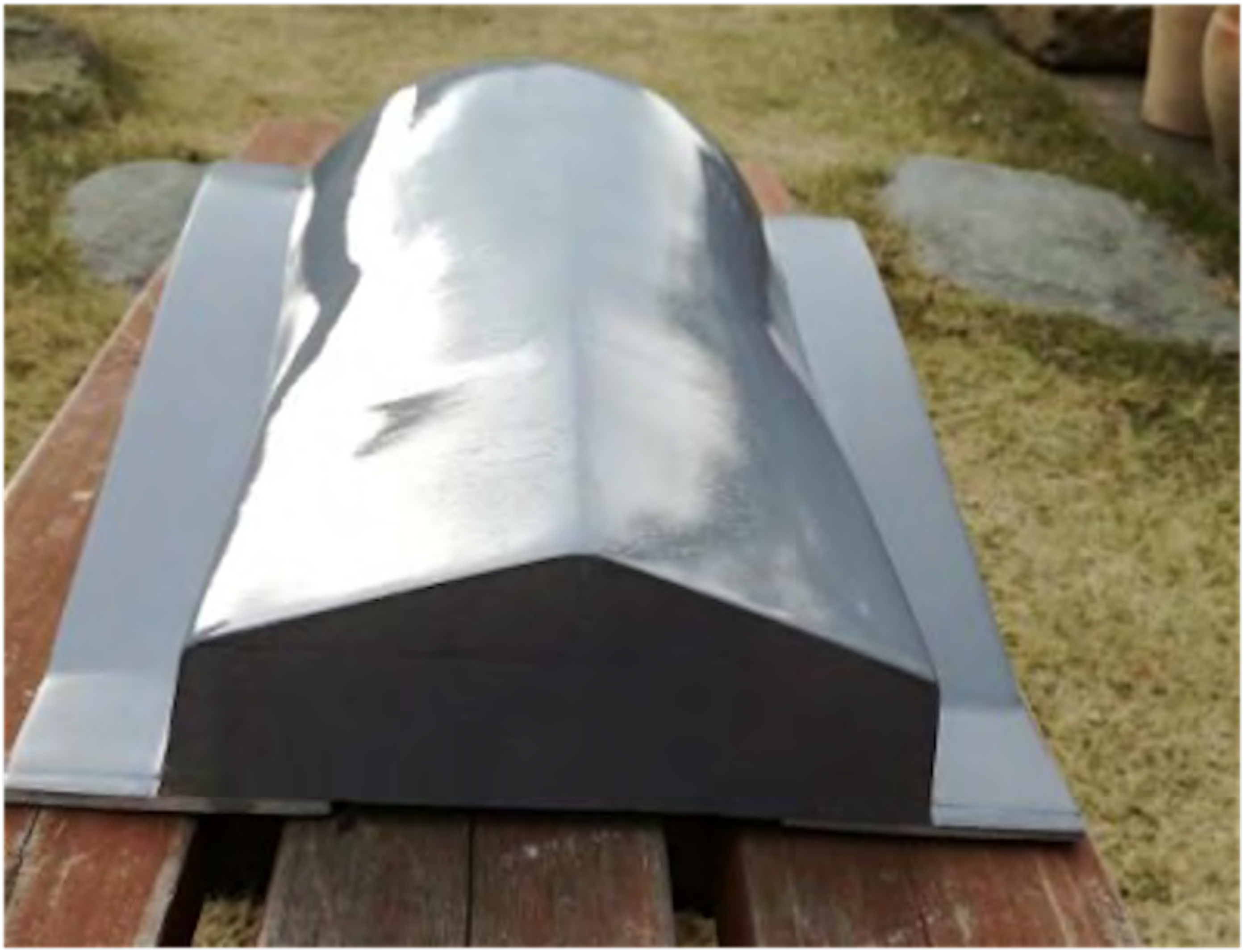


Photo 168: Front side shape (left) and rear side shape (right).

It took a lot of time to shape and kill the grain, but I managed to create the shape.

By using this wooden mold to make the center wing fairing before making the nose cowling, I hoped to acquire the know-how of making plaster molds and FRP parts, which was my first experience. However, after some research, I found out that in order to use it as a wooden mold, it is necessary to apply fine water-resistant paper up to about 2000 grit and polish it with compound before applying release wax to improve the release of the plaster mold. In addition, if it was the first time you use the mold, you need to apply the release wax about 8 times, so it was a long way to go.

Fabrication Part 35: Plaster Mold for the Center Wing Fairing

Waxing the Wooden Molds

I smoothed the completed wooden molds for the nose cowling and center wing fairing with 2000-grade water-resistant paper and polished them with compound. After that, I applied 8 coats of the Bonlease Wax for release. Photo 169 is a photo of the waxing process.

Photo 169: Waxing the wood molds.

There is another mold in the picture along with the cowling and fairing. This is the mold for making the foot covers around the rear seat pedals as described in Part 31. Waxing each of these three molds eight times was a tough job.

Applying PVA

When the waxing was finished, the next was to apply PVA (polyvinyl alcohol), a liquid for releasing the plaster, on top of it. I applied the blue PVA on the sponge by stroking it in one direction as per the instructions. I was afraid that the liquid would pop off when applied on top of the wax, but my fears were unfounded. A thin film of PVA was formed.

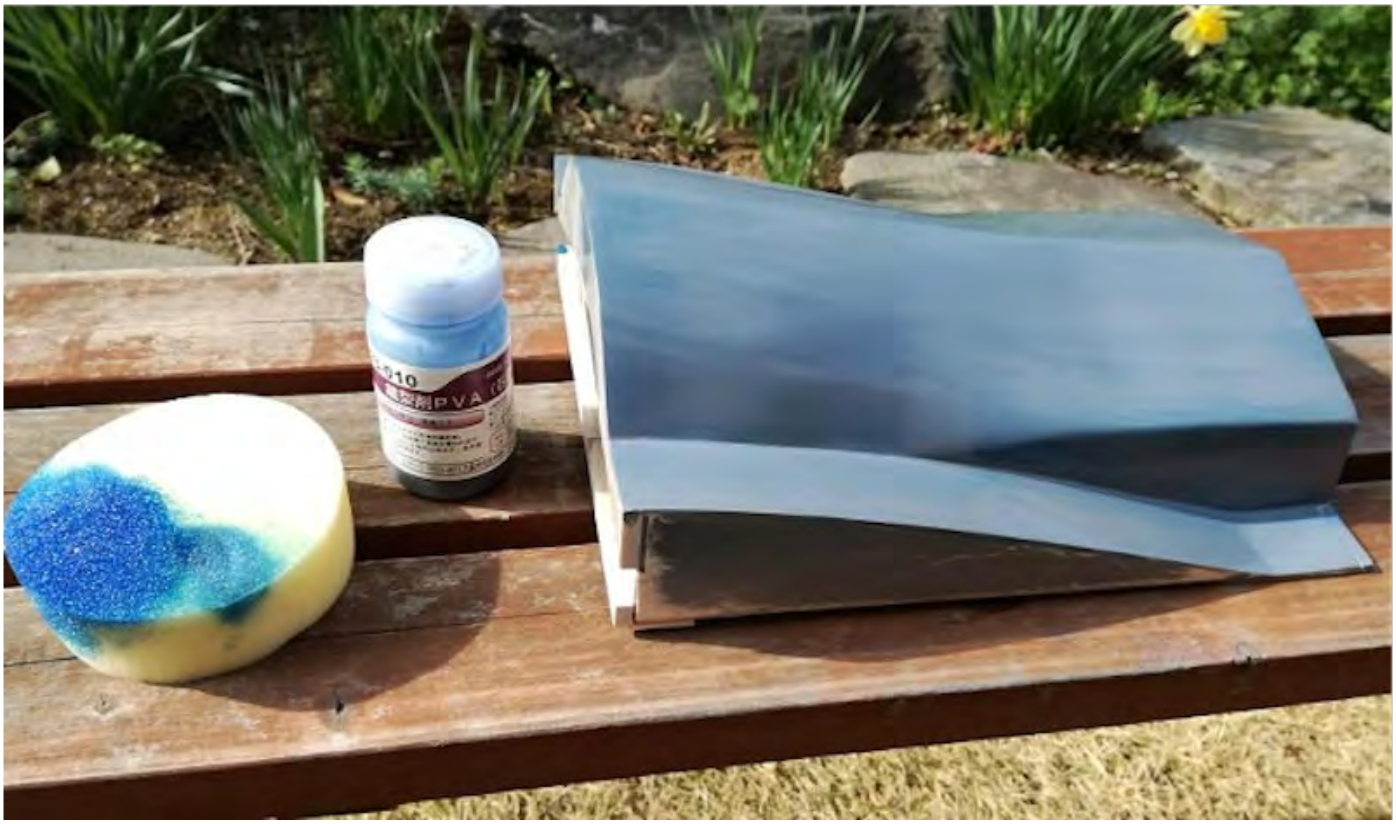


Photo 170: PVA applied to the wooden mold.

Plastering

Finally, it was the phase of the real plastering. To prevent the plaster from flowing out, I covered the wooden mold with a wooden frame. A thin sheet of plastic was attached to the inside of the wooden frame with double-sided tape to prevent the plaster from sticking.

Photo 171 shows the plaster I used. It is the SAKURA mark Class A of

Yoshino Gypsum.

Photo 171: Plaster used.

I prepared 720cc of water to 1kg of plaster as per the instructions. I didn’t know what amount was appropriate, so I tempolary used 1 kg for the first time. Sift the gypsum into the water in the bucket, leave it for about a minute, and then slowly stir it with a round wooden stick. Be careful not to let air get in. After 200 times of stirring, the mixture became a little sticky, so I scooped it up with a ladle and poured it onto the wooden mold. By the time I finished pouring the entire 1 kg of plaster, the remaining plaster in the bucket started to harden. It seems that 1 kg of plaster is the maximum for me to work with at one time, and I should work a little faster.

When I finished pouring 1 kg of plaster, it seemed a little insufficient, so I dissolved another 500 g of plaster in water and poured it on. At this time, I was worried about the strength of the plaster, so I put some gauze in between as reinforcement. When I finished pouring 500g of plaster, I was worried that the thickness of the leading and trailing high parts of the fairing might be a little insufficient, so I poured another 500g of plaster over those areas. In the end, I used a total of 2 kg of plaster. This is what the plaster looked like after it was applied.

Photo 172: Wooden mold with plaster applied.

Removing the Wooden Frame

Plaster begins to harden quickly as it generates heat. It seems to be a good idea to remove the wooden mold when the heat reaches the maximum temperature, so I immediately removed the wooden frame. It was easy to remove the wooden frame because it has plastic plates on the inside.

Photo 173: Wooden mold with the wooden frame removed.

Wooden Mold Removal

The climax was the removal of the wooden mold, which came off easily, either because of the shape or the preparation. I was very worried about it, but it was a relief. Photo 174 is a plaster mold with the wooden mold removed.

Photo 174: The plaster mold removed from the wooden mold.

PVA is easy to dissolve in water, so it dissolves in the moisture of the plaster, giving it a blue color. There was no “soot”, which I was worried about, and the mold came out very clean. The edge surface is also beautiful. After this, it will take at least a week to dry, so it will still be a while before I can apply the FRP.

Fabrication Part 36: Plaster Mold for the Nose Cowling

Making a wooden frame for pouring plaster

Now that the wooden mold for the nose cowling has been coated with release wax, it's time to pour the plaster over it. The first step was to make a frame out of 4 mm plywood so that the wooden mold would stand vertically and plaster would not flow out even if it was poured from above. Photo 175 shows the finished wooden frame and the wooden mold that has been coated with PVA and is ready for plastering.

Photo 175: Wooden frame and mold for nose cowling plastering.

Plastic plates are attached to the inside of the wooden frame to prevent the plaster from sticking. The bottom of the wooden frame is bent into a folding screen in two places to match the bottom of the wooden mold. The mold is placed on the crate like this. Plaster is then poured over the top.

Photo 176: The nose cowling mold installed on the wooden frame.

Plastering is Finished

A total of 4kg of plaster was poured. I dissolved 1kg of plaster in 720cc of water and poured it four times. Since I had experience with the center wing fairing, this time the work went smoothly.

Photo 177: Wooden mold after plastering.

I wrapped gauze around the second and third coat to reinforce them, and after four coats, the first coat of plaster had already hardened enough, so I immediately removed the wooden frame.

Removing the Wooden Frame

The sides of the wooden frame are screwed to the bottom. When the screws were removed, the plaster came off easily without sticking due to the effect of the plastic plates inside of the sides. After that, when I lifted up the plaster, the bottom surface also came off easily.

Photo 178: Plaster mold with the wooden frame removed.

However, the plaster soaked through the gap between the wooden mold and the bottom of the wooden frame, and the plaster stuck a little to the periphery of the bottom of the wooden mold.

Removing the Wooden Mold

The next step is to remove the wooden mold. The first step is to attach a "handle" to the bottom of the mold for pulling. I held the handle and pulled, but it was not easy to pull out because of the plaster stuck around the bottom of the mold. You can see the plaster stuck around the bottom of the mold in picture 179. After removing the plaster from the bottom of the mold, it was easy to remove the mold.

Photo 179: Wood mold removal.

Completion of the Plaster Mold

Photo 180 shows the finished plaster mold. The inside corner is a little dirty because it was scraped off when the plaster was peeled off, but there is no problem because the regular border is located 2mm from the bottom of the mold. There is no “soot” inside, so I can say it’s a good job. The large plaster mold that I was worried about is now complete!

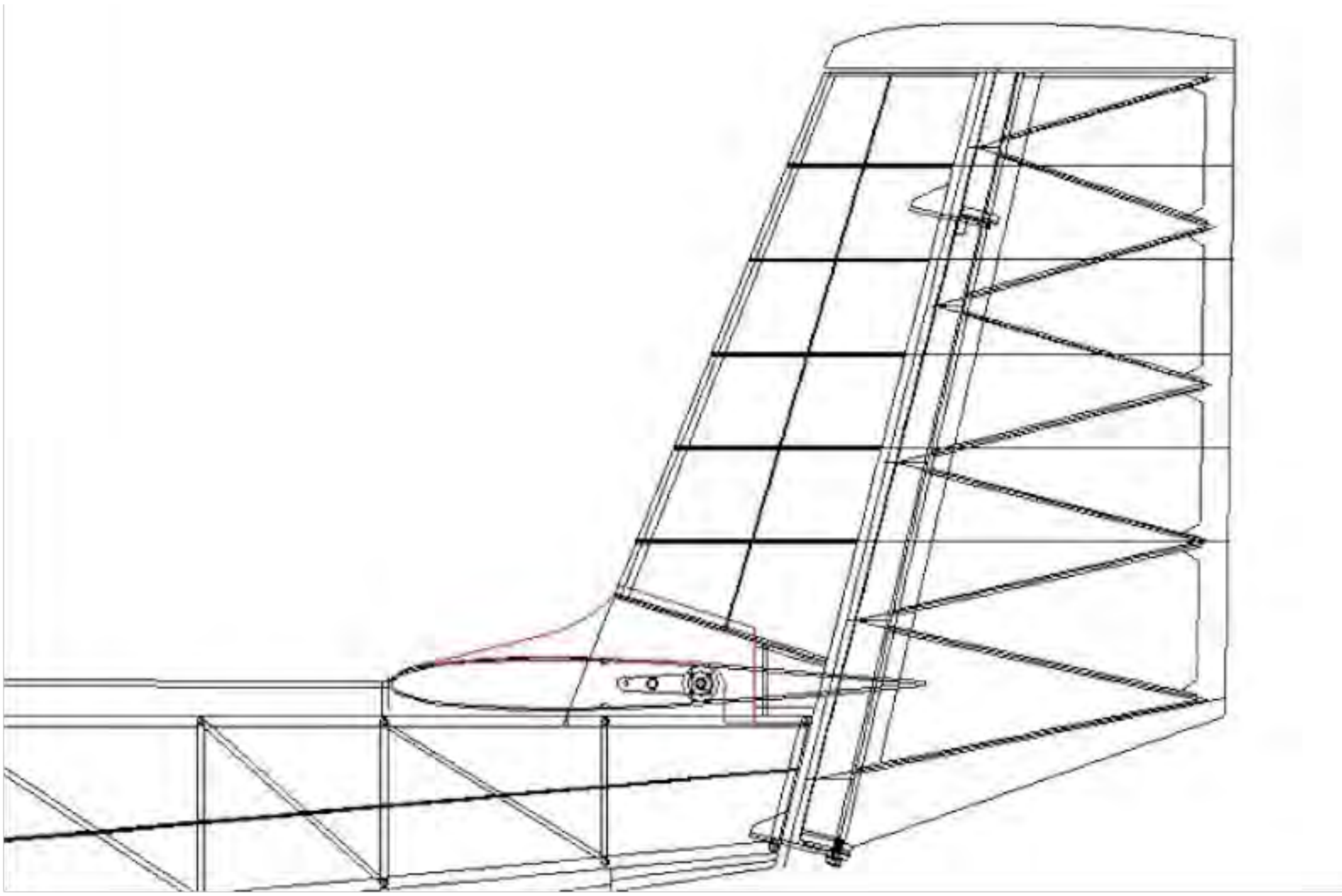
Photo 180: Completed plaster mold for the nose cowling.

Fabrication Part 37: Failure of the Plaster Mold for the Vertical Tail Fairing

The plaster mold making has been going relatively smoothly so far, but this time I made a mistake in making the plaster mold for the vertical tail fairing.

Vertical Tail Fin Fairing

The bottom of the leading edge of the vertical tail fin of the Mita is notched in a V-shape for installation and removal of the horizontal tail. The fairing made of FRP is attached there. The red line in drawing 48 shows the fairing.



Drawing 48: Vertical tail fin fairing.

It covers the notched portion of the vertical tail fin and most of the lower surface covers the upper surface of the horizontal tail fin. The rear part goes through the inside of the elevator and sandwiches the fuselage. I tried to make a plaster mold from a wooden mold to make this model, but failed.

Wooden Mold

The first step was to make a wooden mold. Photo 181 is the finished wooden mold.

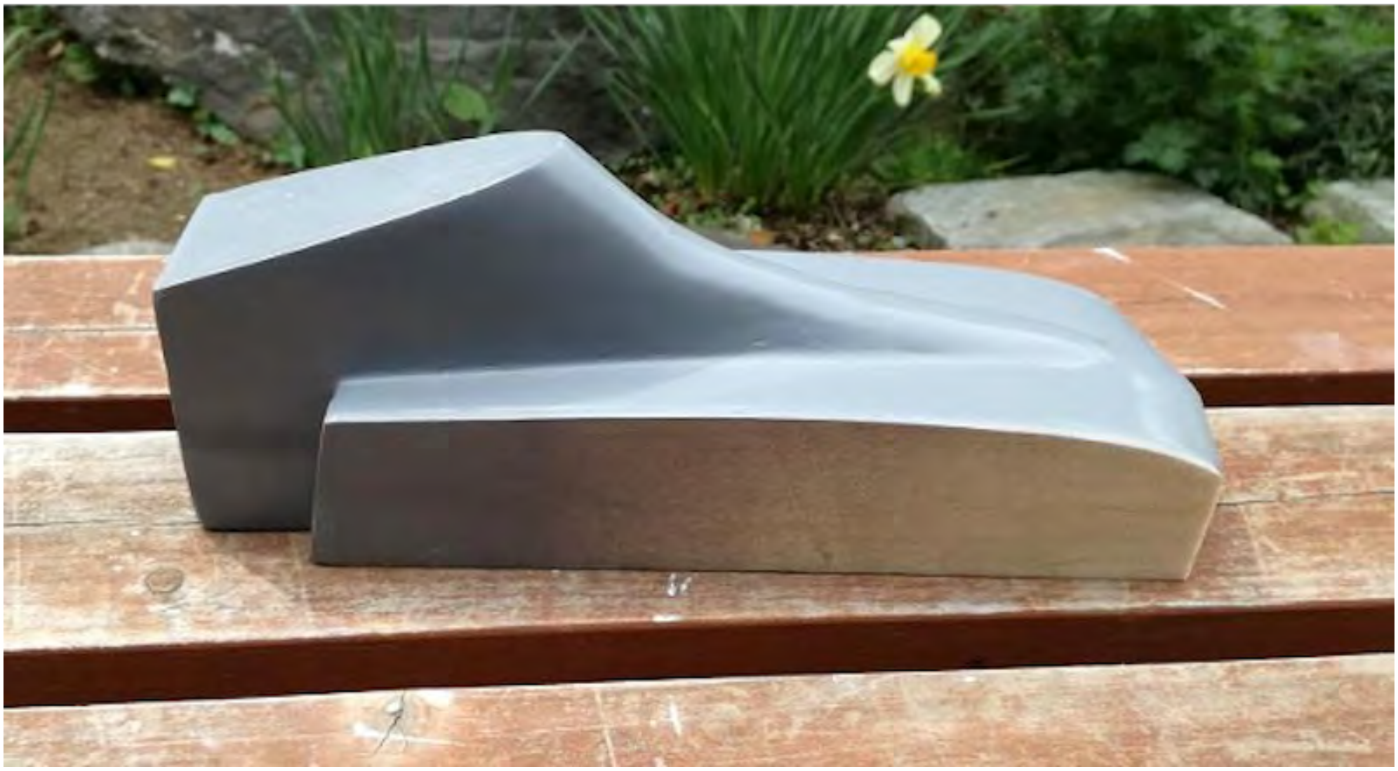


Photo 181: Wooden mold of the vertical tail fin fairing.

I was actually working on this mold at the same time as the center wing fairing mold, but it took a lot of time and effort and the completion was delayed. For the first time, I filled the balsa skeleton with clay and shaped it. When I thought the clay was dry, I polished the surface with sandpaper and put lacquer surfacer on it, and when I was correcting the small parts, I found a gap between the balsa skeleton and the clay. As I filled the gap with poly putty, the same phenomenon appeared in other parts.

I repeated this several times, but I wondered if the clay, which I thought was dry, hadn't dried out completely. And when I pressed hard on the nicely shaped area, it dented. It turned out that the clay that was covered by the balsa skeleton would only dry on the surface that appeared on the outside, but would not dry on the inside because it was blocked from the air. I had no choice but to dig out the clay I had shaped and reshape it by filling it with balsa boards. However, the thin clay in the front part was already dry and could not be removed, so I left it as it was. That was also the source of the problem.

After shaping the balsa, I sprayed lacquer surfacer on it and polished it with water-resistant paper, but the surface skin of the clay part was partially missing. I had no choice but to fill the area with poly putty and start over again. However, the same thing happened every time I polished it with water-resistant paper. It seemed to be an endless process, but I managed to complete the work as shown in photo 181

Initially, I thought I would make the wooden mold of the nose cowling by filling it with clay, and even bought clay, but I was worried about its unknown characteristics, so I changed to balsa. In hindsight, this change was the right one. I learned that clay is unsuitable for molds that are not easily exposed to air.

> ***Lessons Learned 6**: Don't use clay for shaping wooden molds. The parts that are not exposed to air will not harden forever.*

Making the Plaster Mold

I covered the wooden mold with a frame and poured the plaster. This time I omitted the gauze for reinforcement because it was a small item, but I think that was the main reason for the failure. Unfortunately, I forgot to take a picture of the plaster being poured.

As the plaster began to harden, I removed the wooden frame.

Photo 182: Plaster mold with the wooden frame removed.

Next, I tried to remove the wooden mold, but the back of the mold would not come off. This is because the plaster oozed out from the gap between the mold and the wooden frame, and hardened to cover the mold. The back of the mold has a lot of contact with the wooden frame, so it inevitably becomes like that. When I tried to remove the mold from the front, which is easier to remove, the plaster broke from the center when I put a little force on it. When I tried to remove the rear part, it broke into two pieces. That’s three disassemblies in total. In the end, it ended up in the state shown in photo 183.

Photo 183: The broken plaster mold.

This was the third time I made a plaster mold, and since it was a relatively small one, I underestimated the risks. I'm now wondering whether I should repair the broken plaster mold, remake it, or give up on the female mold and make an FRP product using the wooden mold as the male mold.

Plaster Mold Making Know-How

Through making three plaster molds, one for the center wing fairing, one for the nose cowling, and one for the vertical tail fairing, I have a vague idea of the procedure. I want to summarize the know-how for the future.

1. **Can the mold be pulled out?** If the shape is upward open, most of the molds can be pulled out if the pre-treatment of the mold and the production of the wooden frame are done properly.
2. **Treatment**: The wooden mold should be sanded neatly and finally polished with water-resistant paper of about 2000 grit, and then with compound. Then rub with Bonlease wax about 8 times, and finally apply PVA.
3. **Wooden frame**: A thin sheet of plastic should be attached to the inside of the wooden frame with double-sided tape to prevent the plaster from sticking.
4. **Notes on setting the mold on the wooden frame**: The most important thing is to eliminate the gap where the mold meets the wooden frame. If there is a gap, plaster will soak in and harden around the wooden mold, which is the biggest hindrance to mold removal. It may be a good idea to use double-sided tape to prevent gaps where the two sides meet.
5. **Plaster handling**: Do not handle too much at once. The plaster hardens too quickly, and it will harden before all the work is done. In my case, the upper limit is about 1kg at a time.
6. **Reinforcing the plaster**: Plaster is easily broken, so it’s a good idea to wrap a cloth around any areas of concern.
7. **Timing of mold removal**: Plaster hardens quickly, so remove the wooden frame immediately after pouring. It is best to remove the wooden mold while the plaster is still hot. At this point, any plaster that has seeped into the gaps between the wooden frame and the mold will break down relatively easily.

Fabrication Part 38: Control Sticks and Related Structure

While waiting for the plaster molds to dry, I made the control sticks, spoiler lever and tow rope release knobs.

Sticks and Related Structure of Mita

Mita is a tandem type double seater, so there are two control sticks, spoiler levers and tow rope release knobs. The control sticks are located in front of the center of the seats, and the spoiler levers and tow rope release knobs are located on the left side of the cockpit.

Finished Control Sticks and Related Structure

This is the completed control sticks and related structure.

Photo 184: Control sticks and related struture.

The upper part of the control sticks are bent like a crank and the grips are close to the pilot. The control sticks are inserted into the aluminum tubes of the gimbal mechanisms. The gimbal mechanisms are driven by the elevator servo and the dummy servo for the aileron, so the control sticks will fall back and forth, left and right, as they are steered.

The spoiler is connected to the steel tube on the left side of the fuselage via a link. In the 1/3 model, the spoiler is moved in and out by a servo located in the center wing, so this lever is a dummy. The other levers in front of the levers are the brake levers for the main wheel. The brake levers have a wire attached to them, and pulling the lever applies the brake connected to the wire. In this model, the wire is not yet attached. Of course, the brake levers are also dummy.

When the yellow ball is pulled, the wire connected to it opens the hook of the release mechanism, and the tow rope is released. The 1/3 model uses the servo for the rope release to open the hook, and the wire extending from these knobs were connected to the servo through a pulley. A weak spring is installed in the middle of the wire so that the knob moves as if it is pulled backward when unlocked.

This is an enlarged photo of the front seat. The orange ball is the towline release knob.

Photo 185: Around the front seat.

This is the rear seat. The two dark blue levers standing on the left side are the spoiler (rear) and brake (front) levers.

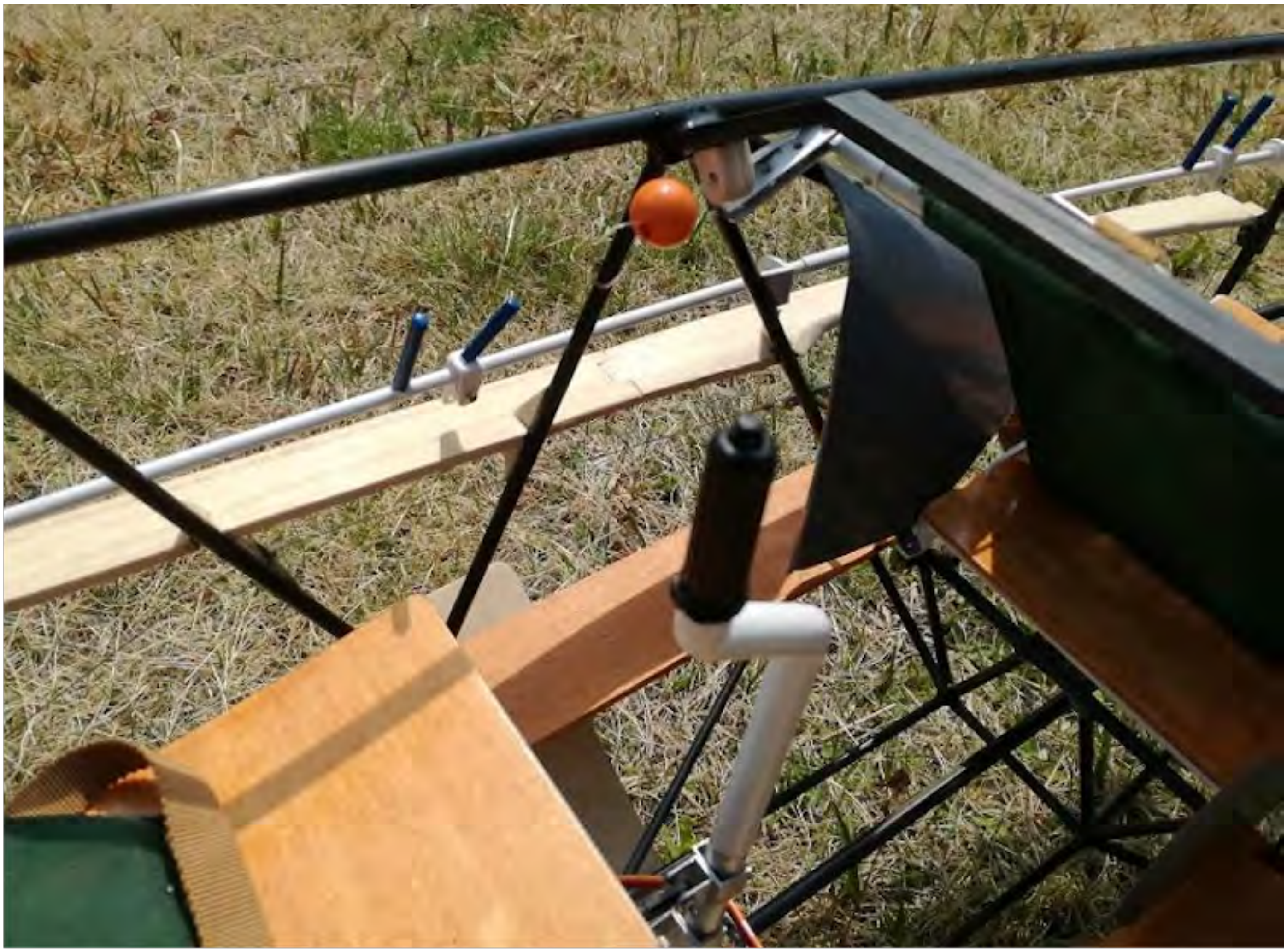


Photo 186: Rear seat area.

The grip of the real machine has a rubber cover with vertical stripes to prevent slipping. In order to create that feeling, the grip is made by attaching several thin wires vertically.

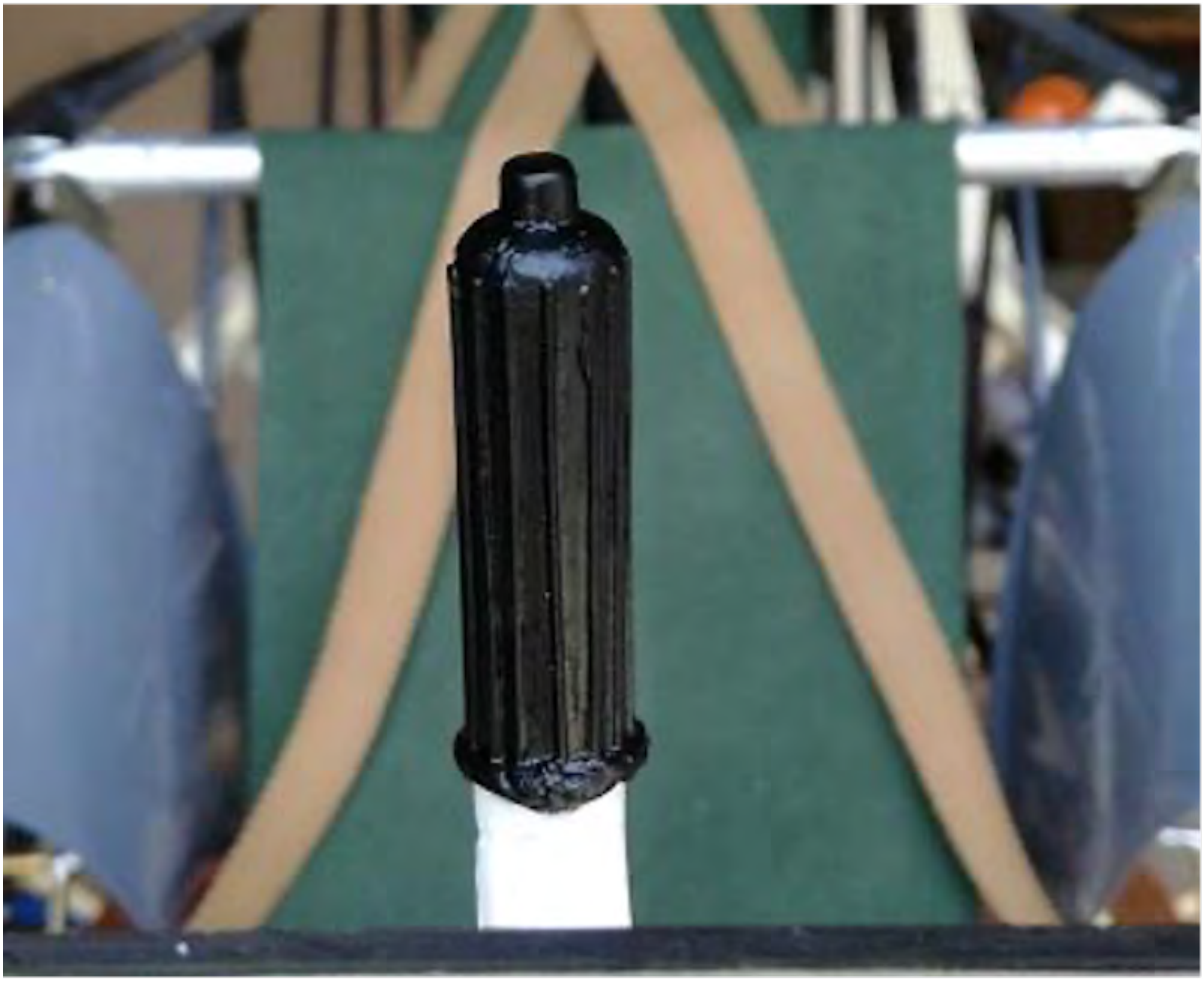


Photo 187: Control stick grip.

This is a photo of the spoiler operating mechanism from the left side of the fuselage.

Photo 188: Spoiler operating mechanism.

The steel pipe is made of 4mm diameter bamboo string. The steel pipe is curved because the side of the body is curved. The steel tube is supported in three places. In the real model, the supports are screwed in place and can be removed, but in the 1/3 model, the supports are too small to be screwed in place, so the bamboo string is split in two at the center and connected with a short brass pipe. The brass pipe is attached in such a way that it can be pulled out and inserted, so the bamboo string can be removed from the fuselage.

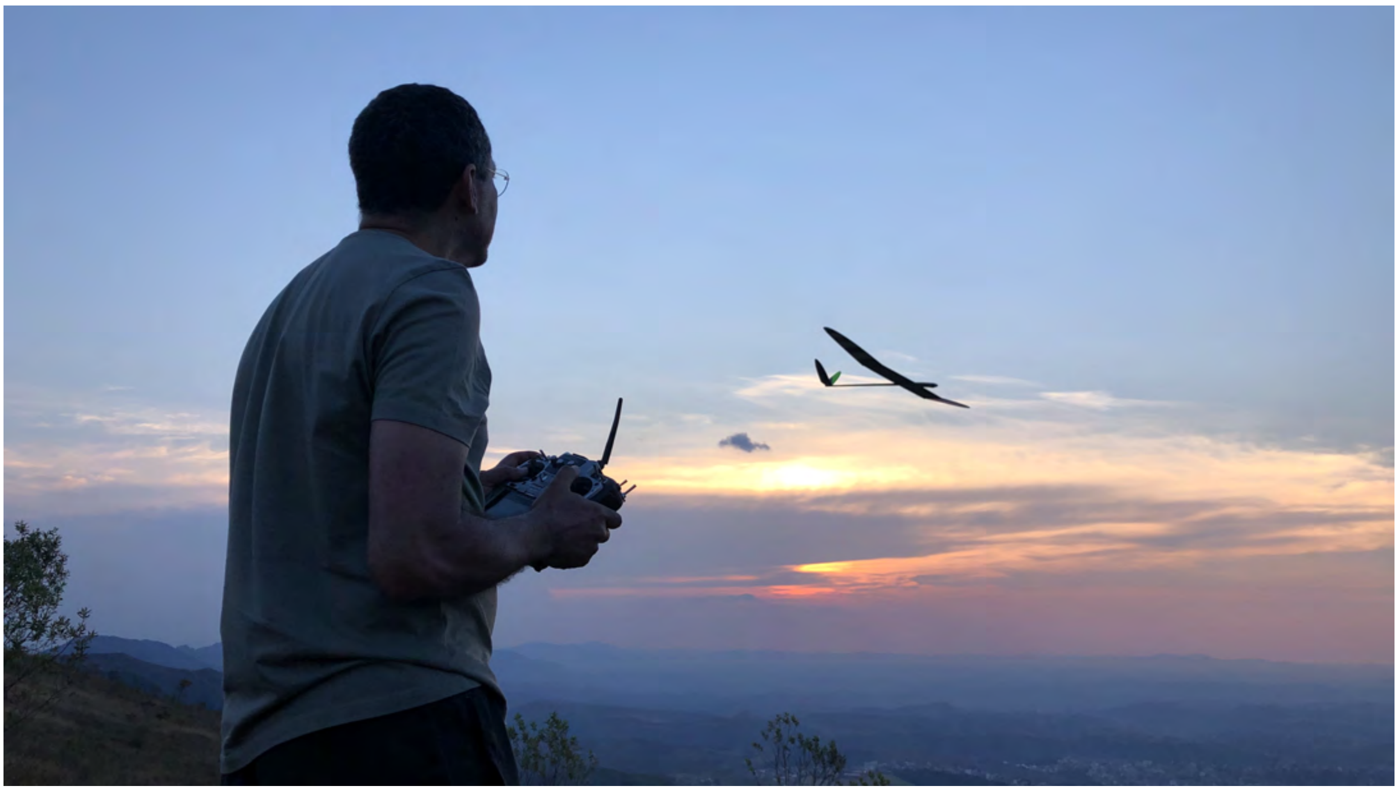
The white bar with a yellowish-green ball on the end of it in the back is the elevator trim lever. This is also a dummy. With these equipment installed, the inside of the cockpit is almost completed except for the instrument panel.

*This is the seventh part in this series. Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

The Trailing Edge

Bottoms up.

The NEW RC Soaring Digest Staff



In this beautiful shot by Leonardo Galvani, Marcio Beraldo guides his 'Dr Tarr' into the Brasilian sunset over Parque Rola Moça near Belo Horizonte in Minas Gerais. It was taken in October of this year. See 'The Illusive Sunset Photo', below, for more information.

We lamented in the last edition of *The Trailing Edge* the looming onslaught of holiday advertising which descends on the unsuspecting public at the stroke of midnight on November 1st. If we're lucky. On cue — actually, slightly before — the pumpkin spice was put away and the candy cane sprinkles were unboxed at Starbucks everywhere. Christmas music began to emenate from, well, every nook and cranny so far as we can tell. We have to admit that the first time we hear *Do They Know It's Christmas*, we still kinda like it. But by mid-month we're sure we'll be seeking an 'Xmas Free Zone' as we think Virgin Records used to call it. Back in The Before Times, in the days when we went to a downtown office, at least there was offically sanctioned during-working-hours consumption of alcohol, even if it was only a small tot of rum in the morning coffee. Bottoms up.

That cheery salute (the social equivalent of "drivers, start your engines!") made us think of something we think is worthy of closer inspection. That is what lies at the **bottom** of each article in a typical edition of the New RC Soaring Digest. There are a few things there of which you will want to avail yourself, if you haven't already:

- **Resources** In pursuit of a pristine, undistracted reading experience, we consciously avoid hyperlinks in the text of articles we present on our pages. There were considerable time and effort allocated to getting readers to the article in the first place, so we're in no hurry to see them leave down some hyperlink, never to return. That said, there is almost always something to reference. That's the role of *Resources*. You're almost guaranteed to find some nuggets in there.
- **The Standard Footer** To make a digital-first publication like RCSD more magazine-like, we put links at the bottom of each article which take you forward one article, backward one article or back to the table of contents. For those who read RCSD cover-to-cover in a linear fashion the moment it arrives, these links are particularly handy.
- **Responses** Every article has an opportunity for you to comment, ask questions or generally kibbitz about the subject matter. Take advantage of it by using *Responses.* We think you'll find most authors are *delighted* to hear from readers. Or give them a few *Claps* to let them know you care.

If you weren't aware of these features, problem solved. Yet another good reason you'll want to scroll to the bottom of each article in each issue of RCSD.

The Illusive Sunset Photo

As you now likely know, the key photo (the one above the title) in each edition of the *The Trailing Edge* features a sunset or some sort of end-of-the-flying-day photo. Turns out they're not as plentiful as you might think. So you can imagine our delight when we were contacted by Leo Horta who hails from Belo Horizonte, Minas Gerais, Brasil. Leo has a treasure trove of such photos! With certainty, we'll will be featuring them in future TTE rambles. Leo is the point man for a very active flying group there and we hope to bring additional coverage of their activities in future issues. We'll admit to being woefully ignorant of this part of the world — Leo's photos reveal its breathtaking beauty. And, get this, some of their flying sites are so remote as to require a hank of climbing rope in the toolkit. Truly another place on our must-see-and-fly list for the future.

Of course, if like Leo you have a magnificent flying-at-sunset photo you would like to headline *The Trailing Edge*, by all means, please let us know!

New in the RCSD Shop

The Dodgson Designs Licensed Logo T-Shirt

We are proud to announce that through an exclusive arrangement with Bob and Sandy Dodgson, we are now offering ***The Dodgson Designs Licensed Logo T-Shirt***. If you have ever built or flown one of Bob's classic designs, or even if you're just a fan of his work, this is one item you will want to add to your collection. It's through your support of the RCSD Shop that we manage to provide all this great, commercial-free content. We are so thankful to Bob and Sandy for their level of commitment to RCSD's success.

Of course, we still have our highly sought after ***RCSD Cover Photo T-Shirts***. This collection now includes July, 2021 which features the out-of-this-world (literally) cover photo is of Stratodynamics' F5J-based HiDRON™ high altitude research platform as it cruises around the New Mexico desert at over 80,000 feet. It's an amazing, unique photo.

We manufacture and ship worldwide. Be the first kid at the field or slope to have one. And, our comments above notwithstanding, it's never too early to order for the holidays!

Make Sure You Don't Miss the New Issue

If you want to be absolutely sure you don't miss the December issue of the *New RC Soaring Digest* make sure you subscribe to our **Groups.io mailing list** or connect with us on **Facebook**, **Instagram**, **Twitter** or **LinkedIn**.

That's it for this month. Thanks to all of our contributors in this issue and above all, thank you, the RCSD reader — without you, we're nothing.

Now get out there and fly!

*Read the **previous article** or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*