
Radio C■ntrolled
Soaring Digest
April 2023
Vol. 38, No. 4

The New RC Soaring Digest

April, 2023
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In The Air

The view from Muller Windsports looking southwest over Cochrane, Alberta and out toward the Canadian Rockies. Note the absolute absence of any manner of aircraft in this photo, and hope that it doesn't foreshadow things to come.

The trouble with Canada.

This is another one of those 'rambles around the houses' which, for those who just want to get on with the RC glider stuff, here's the express elevator down to that. Otherwise, cinch up the five-point, it's going to be a helluva ride. Hopefully. — Ed.

It landed in my inbox ironically on *Wright-mas*, which regular readers of this column will know as December 17th. If email was capable of make the sickening thump of a dead-blow hammer, this incoming email would have made that sound. It was from our national model aviation organisation and there was once sentence fragment which leapt off the page, making the rest of the text fade into something like G-induced greyout:

> "made the difficult decision to temporarily suspend all outdoor flying activity, effective immediately"

I was immediately taken back to March 12, 2020 when the NBA teams for the game my wife and I were watching were frogmarched off the court in the middle of the game. My immediate, visceral reaction to that event, as with the recent *Wright-mas* calamity, was the same. A severe case of the runs along with “what the actual hell is going on?”

For the NBA and soon after the rest of all of us it was the beginning of the pandemic, and where things preceded from there — well — I’m absolutely sure **everybody** knows that story. In the case of the no-fly proclamation — well — it’s what the kids say these days: complicated.

After recovering from the immediate shock, my secondary reaction to the no-fly email was “have you *seen* the weather out there at the moment?” So far as model aviation is concerned, the weather in Canada in December — generally speaking — stinks. So, no-fly was kind of academic, at least for the time being.

All joking aside, though, the potential implications were indeed grave. For a long time, I have worried (and written) about the potential for the ‘drone revolution’ to render as roadkill traditional RC model aviation — the thing I have been doing in one form or another since I was six years old.

Turns out those fears were justified. In fact, *Where Did All Those Drones Come From?* which I originally published in 2016 was — setting all modesty aside and even if I do say so myself — downright prescient.

The Exemption

At stake was what I’ll refer to simply as the ‘exemption’. I think most know of what I speak in this regard: the short version of that is having your national model aviation organisation arrange, on behalf of all of us, for a free pass from all the regulations now coming into effect. So long as we abide by that organisations rules as to how and where to fly, we didn’t have to participate in the new drone-triggered licensing and registration regimes. We were ‘exempt’ from them.

I assume you were paying close attention when I said “abide by the organisations rules as to how and where to fly”, above, and therein lies the rub.

We now live in societies where no matter what you say, a substantial portion of the population will do the opposite—often for no better reason than they see whatever they’re being told to do (or not) as ‘yet another infringement on our freedom’. As such, it was really just a matter of time before somebody would **not** “abide by the organisations rules as to how and where to fly” and went ahead and flew wherever the heck they wanted and in a manner of their sole choosing. Shortly thereafter, the leadership of the national organisation was hauled up in front of the government regulatory agency to — and these are **my** words based on no first-hand knowledge whatsoever— show cause as to why the whole exemption shouldn’t be summarily cancelled.

If it was, anybody who wanted to fly anything, more-or-less, would have to plug into the regulatory framework put in place primarily to deal with the exploding and unprecedented growth of ‘uncrewed aerial systems’.

If that were to be the case, anybody flying anything weighing less than 250g (8.8oz) could more-or-less pursue the hobby as they always have. In Canada these are called ‘micro-drones’ and so long as you exercise reasonable care and attention, you’re good to go or something close to it. That’s the good news.

On the other hand, once you pass that weight tipping point — which is just about everybody, right? — you’re into Transport Canada’s Remotely Piloted Aircraft System (RPAS) licensing and registration and all that entails. RC gliders and their guiders would be lumped in with the 74,000+ drones and 79,000+ pilots already in the program as of this moment.

A bit more good news: despite the episode in the woodshed the exemption is still in place, with the national organisation tiptoeing through a recertification process. It, too, reminds me of how we all re-emerged back into something approaching normal as the pandemic began to wane. It's slow and painful, but all signs seems to indicate we'll get where we're going eventually.

Trouble in River City

There's a catch, though. For decades I have rarely — actually **never** — flown at a site designated for model aircraft by the national organization. Given the way my life and career has evolved, RC gliders are my personal counterpoint to the hubbub of the daily routine. The more remote the location and the greater the chance of **not** running into **anybody**, the happier I am. With one important exception: my wife, who is welcome anytime. She keeps the highs and lows in check.

As such, and assuming for the moment I'm flying over that 250g threshold, I'm technically in violation of civil aviation regulations which, to put it in the vernacular, are not to be fffff…ooled with. Hard landings I can handle. Hard time? Not so much. But the CARs are there for a very good reason — the safety of the flying public which, after all, is just about all of us.

All that righteous stuff said, I'm still suddenly and somewhat selfishly beginning to very slightly empathise (spoiler alert: you'll need an electron microscope to find it) with those who think government is trying to ruin all of our lives all the time.

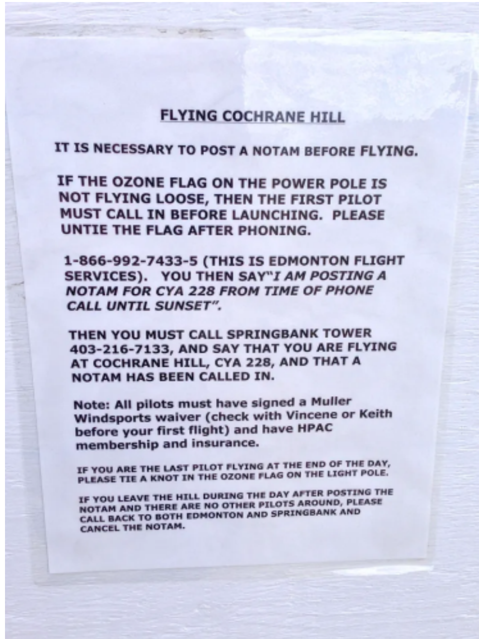
My choice, therefore and for the time being, is to fly sub-250g. No biggie. This humble journal keeps me very busy so the amount of flying time I'm actually going to have to give up is quite small. And when I finally get in the mood and have the time, I'll just go ahead and get the RPAS licensing and registration and all the foofaraw that goes along with it and carry on about my business. As someone who pays my taxes, holds a pilots' license and even a ham radio license, the towline broke a long time ago in terms of what the government knows about me. RPAS isn't going to make that any worse. Or better for that matter.

Paradigm Shift

I'll certainly understand if you looked at the key photo above — welcome to my neighbourhood, by the way! — but skipped the caption. I took that picture a couple of years ago around this time of year. Muller Windsports, sitting high above Cochrane, Alberta and topologically perfect for common wind patterns, is a great place to take a sandwich and watch the world go by.

Paragliding is Muller's focus, however, and RC gliders are verboten. Again, while that's a little disappointing, no biggie. It's private land and they can do whatever they want with it. It's not infringing on any rights that I actually possess. I'll keep asking, though, hoping that they eventually take Torrey Pines' lead and figure out a way that paragliding, hang gliding and RC soaring can co-exist safely and peacefully. Torrey has proved that's possible — but it's predicated on *everybody* behaving in a reasonable manner.

But there is something else which is worth a look when you finally make the trek to Muller:



I was one of those wide-eyed punks who drooled over the Rogallo-wing hang gliders made of bamboo and taped-together plastic sheet that somehow found their way onto the pages of *Popular Mechanics* in the early 1970s. Flying *totally outside* any regulatory framework was and is the dream of every kid who can't afford flying lessons. But even back then, if I had taken the time to really think it through, I probably could have figured out it was never going to last.

And it didn't. It took a couple of decades but hang gliding, paragliding and ultralights all eventually found their way into the broader aviation regulations. Aircraft of all types — fixed wing, balloons, paragliders and all the rest — all have highly visible registration numbers. Pilots are licensed, the prerequisite for which is some mandatory training, in order that the most obvious of hazards can be avoided and to make participation reasonably safe. I'm sure there are those who feel even this light regulatory regime is too much dang infringing, but I also think it's safe to say that most folks understand both the benefits and, of course, the drawbacks and lots still decide to go forward.

The placards at Muller don't say "don't fly". Paraphrasing, they say fairly clearly "if you're going to fly, here's how you're going to do it." It's not a democracy or a debate. It's just the way it is. Everybody gets it. Don't let it spoil your day.

So I think we should start to assume it will be the same for model aviation and RC soaring in the not-too-distant future. The vast majority of us will plug into the system and understand that like a lot of things it's not quite the way it used to be in the almost-entirely-fictional 'good old days'. We'll make the necessary adjustments and simply go about our business pretty much the way we always have.

Resources

- *Muller Windsports* of Cochrane, Alberta, Canada. — "We offer sales for Ozone Kites and Boards, Ozone accessories and other hang gliding and paragliding products. Our instructional programs are focused on…"
- *Where Did All Those Drones Come From?* by Terence C. Gannon in the New RC Soaring Digest. — "One of my earliest memories — I must have been five or six at the time — was when my father decided it was time to pass along his lifelong love of all things that fly, and bought us a Guillow's *Javelin*…"

Cover Photo

This month our cover comes to us by way of Uroš Šoštarič, who captured this gorgeous 5m *DG–1000* at Mangert in the Julian Alps of his native Slovenia. We'll turn it over to Uroš for the rest of the story about the slope at Mangert:

> "It's accessed via a beautiful alpine route and is the highest slope where you can fly with models in Slovenia, and lies at an altitude of 2000m ASL (above sea level). It enables slope soaring with beautiful views and thermal conditions. Furthermore, Mangart lies

> at the intersection of three countries: Slovenia, Italy and Austria. So at this location you are likely meet people who love slope soaring from all three countries."

Well, we don't know about anybody else, but we're prepared to book flights immediately to what sounds like a little bit of heaven on Earth. Thanks for the opportunity to use your beautiful photo, Uroš!

You are welcome to download the April 2023 cover in a resolution suitable for computer monitor wallpaper. (2560x1440).

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*All photos by the author. Here's the **first article** in the April, 2023 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

Another month, another Letters to the Editor and, yes, one more stamp in the New RCSD Glider Stamp Montage — can you spot it? Also, do you have a glider-related stamp you'd like to add? By all means, please let us know!

Intellectual property, flight simulators and Daylight Saving Time — the letters we received are eclectic, to say the least.

Glider Patents

It comes as a surprise that the single-most commented series we run is this one! Here's a representitive sample of what we've received in response to last month's Folding Wing Glider *patent which we've linked below. — Ed.*

This should have never been granted. I published an article in *Model Rocketry Magazine* about this type of folding wing in 1970, and I was not the originator. Someone had previously done it for F1C free flight piston powered models.

Patent examiners have a really tough job, and this patent was issued pre-internet and pre-Google. It is really unlikely the examiner would have found the published prior art.

Normally, if there was actually money to be made with this, it would get sorted.

Bob Parks
(via Medium Responses)

Does it matter that I was building and flying a version of this concept in the 70s? Interesting that someone was able to patent it.

It is indeed interesting what ends up being patented. I work in another technical field involving marine design and frequently run into patents for concepts that are reasonably obvious to a skilled practitioner.

Having a patent is really only license to litigate the idea.

Craig Funston
(via Facebook Comments)

I built a model with this system in the mid 1980s. It was produced commercially, called the *Tantrum*. Outer panels of the polyhedral wing were spring loaded with a mechanical release connected to the elevator. It worked OK, but occasionally one panel wouldn't deploy, and the resulting asymmetrical wing didn't fly so well! The build was heavier than a normal build as well, so the negatives of this design exceeded the positives.

Andrew DiMizio
(via Instagram Comments)

Condor Club

There's an active *Condor* club in the UK — although it's not geographically limited! It's called the *UK Virtual Soaring Club* and we fly tasks at 1400 / 2000 (local time in the UK) on Tuesdays, Thursdays and Sundays. Details via the Discord channel (linked in *Resources*, below).

Pop by and say hi and join in. We fly a variety of tasks: ridge, thermal, mixed as well as a mix of glider classes.

Marc Panton (PRV)
Windsor, Berkshire, UK
(via Medium Responses)

Swan Song for Daily Saving Time?

This received in response to the March edition of the In The Air *editorial which, oddly, focused on this twice annual ritual. — Ed.*

Oh that was a nice walk down memory lane for you! Thanks for sharing! My wife just informed me this might be the last time we experience the time shift. The powers that be are trying end this outdated practice. We just need the States to get on board. It's amazing to me how one little hour change can really mess me up. Well, for a couple of days at any rate!

Lyle Jeakins
Hamilton, Ontario
(via Medium Responses)

You're one of our biggest fans, Lyle, and for that we are truly thankful. So far as DST is concerned, you're right, we're pretty sure it's a thing of the past, too. We think The Ed *is the last person on Earth who will actually be sad to see it go. — Ed.*

Resources

- *The UK Virtual Soaring Club* on Discord. — General glider and aviation chat, as described in Marc Panton's letter above.
- *Glider Patents | US 4759736 A: Folding Wing Glider* in the March, 2023 edition of the New RC Soaring Digest. — "A folding wing hand launch glider having two modes of operation is disclosed. In one mode of operation a portion of the wings are retracted…"
- *In The Air | Spring forward* by Managing Editor Terence C. Gannon in the March, 2023 edition of the New RC Soaring Digest. — "For the record, I'm firmly in favour of retaining [DST] as-is. But for a very selfish and some would say silly and sentimental reason…"

Send your letter via email to NewRCSoaringDigest@gmail.com with the subject "Letters to the Editor". Alternatively, you can leave a reply in the Responses *section below (that's the little 💬). 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.*

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Spencer Lisenby Shatters Own Record, Pushes Transonic DP to 907km/h

With his Transonic DP ballasted to 9.2kg safely back on the ground, Spencer Lisenby and Bruce Tebo celebrate the historic moment. (credit: Steven Welsh)

The dynamic soaring ace extends his dominance of the outright model aircraft speed record extending back over a decade.

BIRD SPRING PASS, California, February 21, 2023 — Flying a *Transonic DP* ballasted to 9.2kg (325oz) Spencer Lisenby rocketed past his own dynamic soaring (DS) speed record to clock a run of 907km/h (564mph). As the New RC Soaring Digest reported back in January of 2021, Lisenby's previous record was 882km/h (548mph) set at Parker Mountain. This makes the new record nearly a 3% improvement over the previous one.

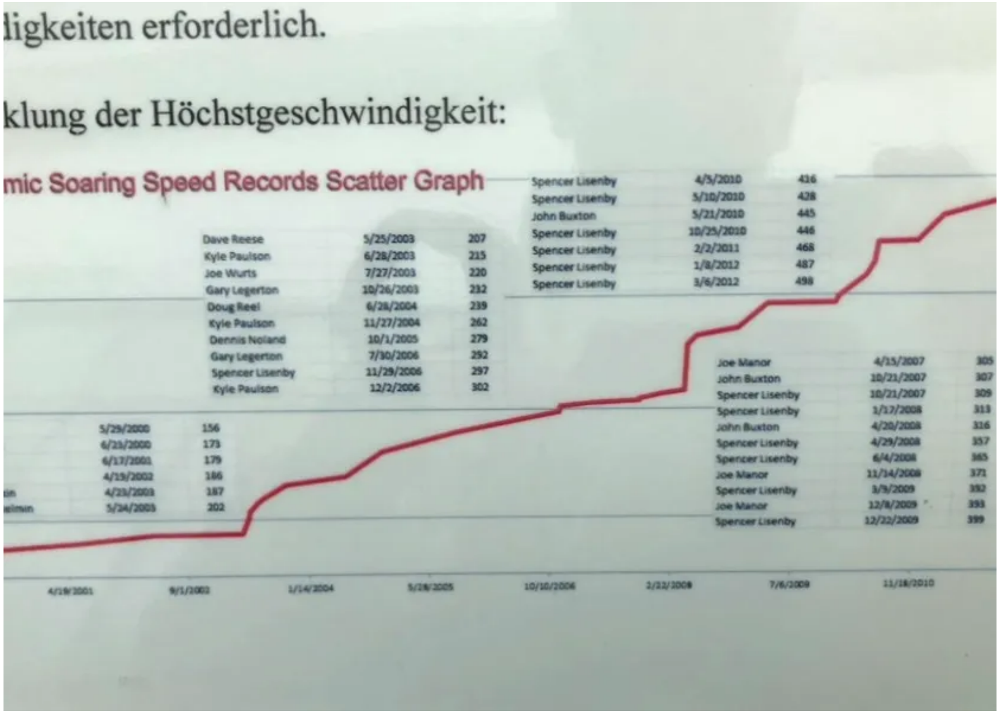
It what amounted to near perfect conditions at Bird Spring Pass—30m/s (108km/h or 67mph) winds gusting higher, sunny and cool—Lisenby also flew his smaller 2m *Kinetic DP* to 847km/h (526mph) making it the second fastest DS plane in the world despite its smaller span. Also on that day, Bruce Tebo flew his own *Transonic DP* to 874km/h (543mph) making the Californians currently without equal in the field.

Left: Spencer Lisenby and the Transonic DP at Bird Spring Pass, California on February 21, 2023. (credit: Spencer Lisenby) | Right: The documentary evidence from the radar gun operated by Bruce Tebo. (credit: Steven Welsh)

In conversation with the New RC Soaring Digest subsequent to setting the record, Lisenby provided this additional interesting detail:

“As a matter of convenience, when DSing, we measure speeds at a slower part of the circuit. Had we measured on the down leg rather than the up leg, we would have measured a ground speed in excess of 600mph and perhaps as high as 630mph! That makes the peak mach number in the order of 0.84.”

When asked what was next, Spencer commented that: “The *Transonic DP* was landed safely, felt great at these speeds, and seems to have more left in it.”



The dynamic soaring record graphic at the Flugwerft Schleißheim Museum in Oberschleißheim, Germany needs to be updated! (credit: Patrick Gannon)

We’ll continue to track the interesting and important flights of Lisenby and Tebo, and will provide updates as they are available.

Resources

- ***Spencer Lisenby Clocks Record-Breaking 882 km/h at Parker Mountain*** in the January, 2021 issue of the New RC Soaring Digest. — “In a remarkable advancement of the state-of-the-art Spencer Lisenby, the renowned practitioner of the dynamic soaring (DS) flight regime, has broken the outright speed record for a model aircraft…”
- ***New World Record! 564 mph by Spencer Lisenby*** video by Steven Welsh on YouTube. — The complete, nearly five minute video from which the six second clip above was extracted.

*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****.*

Cool New Stuff

Two exciting new contest ships, a better way of burnishing your balsa and what all the cool kids will soon be wearing.

Falcon F5K

Revamped construction methods means this popular, high-performance design is now available at a more reasonable price.

Currently most state-of-the-art F5K gliders feature carbon construction. This is because they are basically revamped designs based on their motorless predecessors. It dictates great performance, just like the original DLGs, but with a steep price tag to go with it.

However, the Flyinger team (formerly HighQuality) and FlightPoint are collaborating on a fresh approach to drop the price of a moulded F5K glider: the well-known *Falcon* now has a **fibreglass** layup which not only decreases the price but also refreshes the old designs with its crisp white base color.

Notably, this more economical construction does not come with a significant weight penalty — the AUW (all up weight) of a complete glider is around 250g and with a built-in ballast tube pilots can take it to over 300g.

There are also numerous convenience features: the airframe can quickly be disassembled, including the vertical fin, so it can be packed in a compact case for transportation and storage. It utilises a proven method of splitting the wing at the centerline, with only a simple and foolproof strip of tape to secure the two halves for flight.

(credit: FlightPoint)

The fuselage is available in colour-keyed white paint over a standard *Falcon* fuse, constructed with carbon and fibreglass to enable your receiver antennas to remain fully internal. For those looking to squeeze the last bit of performance out of the *Falcon F5K* a bare-carbon, unpainted fuse is also available. The fibreglass layup of the tail surfaces are shown painted blue but there a variety of other colours to personalise the glider while also helping with orientation while the glider spirals away in a thermal.

So now there is another option for F5K glider pilots to join the movement and start competition flying at a fair price. It is the great 'old' *Falcon* with *Synergy2*-family airfoil, outstanding production quality and great handling. But at a lower price tag. Complete information available directly from FlightPoint.

Stick Sanders

Builders of all stripes will find these a handy and durable addition to their shops.

When shaping either traditional wood construction or the latest composite layup, there can never be too many shapes and sizes of sanding blocks. Lee Valley Tools has this great option available at a very reasonable price.

What we like particularly is the replaceable belt usually found in power tools has been scaled down and adapted to this application. So forget forever the fiddly cutting of strips of sandpaper — that blunts your X-acto! — and the mess of gluing them to spruce sticks to get that long, narrow sander you need.

The sanding belts themselves are durable, cloth-backed units. They can be rotated or replaced by simply pushing the spring tip. Available in both 1/4" x 6 1/2" and 1/2" x 8" models with six belts in a variety of grits. You'll likely want both! Complete information available directly from Lee Valley Tools.

TT-Eclipse

Composite RC Gliders makes an impressive debut in the F5J class with this 3.8m supership.

(credit: Composite RC Gliders)

With the *TT-Eclipse,* this highly-regarded German firm makes its debut in the F5J competition class with this most recent addition to their *Thermal Taker* series. With a wingspan of 3.8m and an area of 88dm², it's obvious the name is inspired by the *TT-Eclipse's* ability to cast a very big shadow.

Available in *Standard*, *Full Build* (glider and electro), *Ready-to-Fly* and *Ready-to-Fly Premium* kit configurations, there are a range of price points to bring the *TT-Eclipse* within reach for a broad audience in this class. All kits feature premium components from name-brand suppliers.

The TT-Eclipse features premium build quality. (credit: Composite RC Gliders)

Similar to the *TT-Aurora* DLG (discus launch glider), this model also features beautifully shaped visible carbon paired with a filigree and simple design. As with all in the *Thermal Taker* series the manufacturing quality and surface finish is no-expense-spared premium quality.

In contrast to the *TT-Echoes*, which has very dynamic cross-country flight characteristics, the *TT-Eclipse* is optimised for the lowest possible sink rate. That said, by de-cambering the flaps and ailerons minimally the *TT-Eclipse* will pick up speed to cover ground and get out of sink at a prodigious rate. Once it reaches the lift again, lightly cambered flaps and ailerons optimise the rate of climb.

Composite RC Gliders' Sebastian Franken puts the TT-Eclipse through its paces. (credit: Composite RC Gliders)

If you're contemplating a serious run at F5J, the *TT-Eclipse* is well worth your attention. Complete information available directly from Composite RC Gliders.

RC Soaring Is Not A Crime

It took skateboarding from outlaw to Olympic sport, so why not RC soaring?

The *In The Air* editorial in this issue is subtitled *The trouble with Canada,* and in it *The Ed* comments on the dramatic changes in the regulatory landscape for RC soaring. Things are sure not what they used to be. Hence the *RC Soaring Is Not a Crime* t-shirt.

Given the way things are going up in the Frozen North — and sadly where things may be headed in other parts of the world — we may all need to look down and remind ourselves of this fact every once in a while. It's also a great way to cheekily comment on all these draconian regulations coming down the pipe. Depending on where you think things are going, you can order in either optimistic white or pessimistic black. Group (grumpy mob?) discounts available.

Complete information available directly from The RCSD Shop.

Say you saw it in the New RC Soaring Digest.

The Fine Print *All product descriptions in* Cool New Stuff *are prepared in collaboration with the product's manufacturer and/or distributor which is/are entirely responsible for ensuring the accuracy of their product's descriptive text and images contained herein. Note also the* New *in* Cool New Stuff *can sometimes mean 'new to us' — the French* nouvelle *as opposed to* neuf.

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It’s Time to Raise the 250g Limit

A retro shot of a classic DLG launch at 60 Acres Park near Seattle, Washington. This is what is at stake. (credit: Phil Pearson)

A 1kg limit proposed by FAA-recognized, community-based organizations strikes a better balance.

*It has become increasingly apparent there are subjects of sufficient importance that they warrant long-form, guest editorials. To that end, we welcome Adam Weston as our first contributor in this regard. He writes eloquently in support of this issue of direct and immediate impact to the 31% of our readers who are based in the United States. It’s also of great interest to **all** readers, given many of you are facing similar challenges of your own in your home countries. — Ed.*

FAA regulations requiring Remote ID (RID) and registration for both aircraft and pilot have exclusions for aircraft weighing less than 250g (8.8 oz). Two model aircraft organizations who recently joined the AMA as FAA-recognized Community Based Organizations (CBO) — the *First Person View Freedom Coalition* (FPVFC) and the *Flite Test*

Community Association (FTCA) — have proposed raising the limit from 250g to 1kg (35.2oz / 2.2lbs).

These CBOs — links are provided in *Resources*, below — have suggested their members and anyone else who flies RC aircraft in this weight class join a letter-writing campaign to Congress. They feel **now** is the time to make this move as the current FAA authorization expires in 2023 — **this year!**

Some of you in the New RCSD readership will immediately appreciate why this campaign should be of interest. For the benefit of others, I'll identify some of the reasons:

- As FAA regulations stand now, anyone flying an aircraft heavier than 250g after September 2023 will require full RID-compliance and registration of both aircraft and pilot to fly anywhere outside of an FAA Recognized Identification Area (FRIA).
- The FAA has recently disclosed their plans for FRIAs are very limited. They will likely only capture existing AMA model aircraft flying fields with ~20 or more members and will not include parks, school yards or people's backyards.
- When it comes to pure RC sailplanes or electric-assist gliders there are very few aircraft we typically fly that will meet this 250g limit. If and when we move to a 1kg maximum a much broader range of aircraft will be available to pilots.
- For most of the aircraft we would want to fly in an uncontrolled park or schoolyard a 1kg limit is likely a good match. This should cover any 1.5m DLG's and electric launch 1.5m as well as many aircraft in the 2m sailplane class while maintaining a reasonable margin of safety.
- This could also cover some of the slope planes we enjoy as well as many slopes aren't AMA fields either. As we move into larger aircraft, RID and registration become more practical (once those systems become available).

Many of you are likely wondering why you are just hearing about this now and from some organizations you may have never heard of and not from the AMA. We've had several conversations with the AMA about raising the limit and their response is they think this would benefit model aviation, and they are supportive of less regulation in general and raising the limit specifically, but they **don't** believe the time is right to write your Congress person.

Some more of what we stand to lose in the absence of a 1kg limit. (credit: Phil Pearson)

From past experience, the AMA believes they have one chance to ask their membership to contact Congress. They believe if they ask their members to do so too often it loses its impact, and fewer and fewer members actually respond. The AMA has stated they are in constant contact with Congress and are still figuring out which points they will want to focus a letter-writing campaign on for the FAA reauthorization. It may be some items are clearly going to be in the bill but some others they'll need some help with. It's also possible that the current FAA reauthorization will get extended into 2024 or beyond as has happened in the past when reauthorization has come up and its just too early now.

So, where does that leave you? If you are excited about the prospect of raising the limit before RID and registration kick in, there are very few reasons **not** to go to the website noted in *Resources* below and chip in. The FPVFC has provided a form letter you can copy and paste, and instructions on finding your Congress person.

Yet more of what makes the 1kg limit a for which it's worth fighting. (credit: Phil Pearson)

Often a personal letter can be more impactful than a form letter, as the staff may have to actually read your letter to see what issue you are corresponding about, but sometimes its the shear volume of interest in this topic and the form letter is just fine. If you think you'll get fatigued by writing two letters to Congress, then you'll want to wait and see if you agree with the AMA's points they will be campaigning for, seemingly in the coming months.

Personally, I'm willing to write more than one letter to protect as much of this hobby as possible. I might even make a phone call or two or write more guest editorials for the New RCSD. *(We would welcome them, Adam! — Ed.)*

So what do you think? Please leave your thoughts in the *Responses* section — you get there by clicking the little 💬 below. Thanks for reading and please join me in helping to get this done!

Resources

- *FAA-Recognized Community Based Organizations* — are those "that meet the statutory definition in Section 44809(h) of the Exception for Limited Recreational Operations of Unmanned Aircraft, may apply for FAA recognition…"
- *First Person View Freedom Coalition* (FPVFC) — "The culture of recreational First Person View (FPV) flight has and will continue to inspire a new generation of model aviation pilots…"
- *FPVFC Congressional Outreach* — "We encourage all of you to reach out to your representative with the below memo to encourage them to make the following changes for the FAA Reauthorization Act of 2023…"
- *Flite Test Community Association* (FTCA) — "designed to be the hub where the people identifying with the community can rally together to promote the future of model aviation. Our vision is simple, we want to bring hope for the future…"

Note that the author of this guest editorial is solely responsible for its content. If you would like to contribute your own guest editorial, please ***contact us*** *for further details.*

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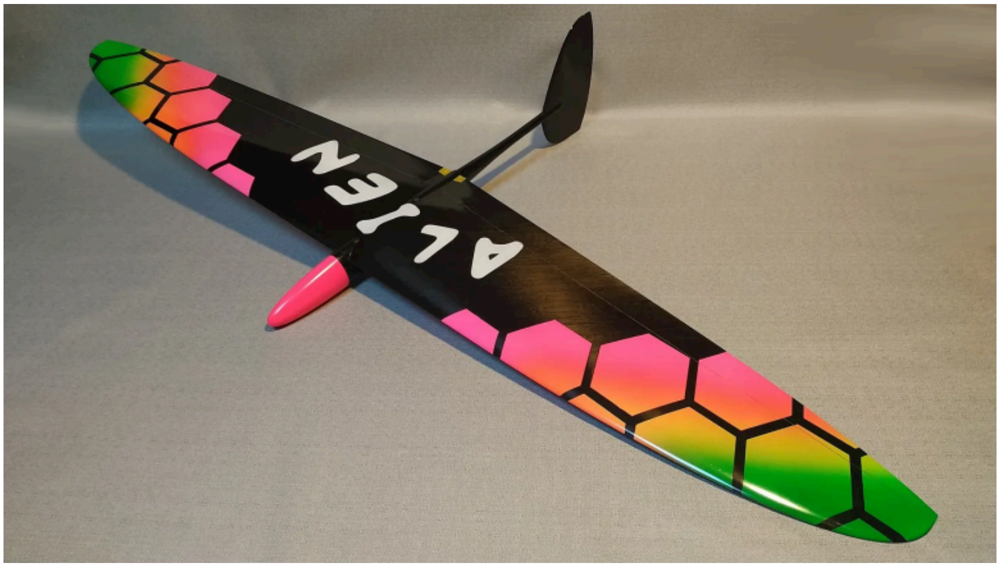
Alien

The Alien posing for the photographer set against a backdrop of the exquisite French Alps in early Spring.

A Carbon Encounter of the Bird Kind

Introduction

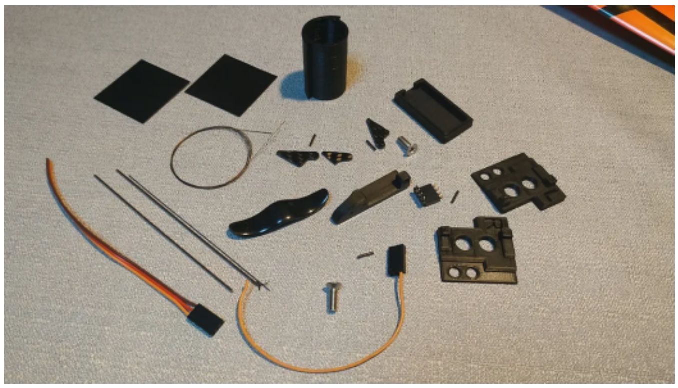
The new flying wing designed by Christophe Bourdon and manufactured in Ukraine by Anton Ovcharenko (OA Composites) is aptly named as the concept goes off the usual track. It is a hybrid flying machine borrowing both from the world of the flying wings but also from F3K, intended rather for the slope in light conditions, capable of carrying a lot of ballast and being able to be discus launched. After other best-sellers such as the *NRJ*, the *Strike*, and of course the *MicroMax* reviewed previously on these pages (see *Resources*, below), we will see if this new flying wing follows the same successfull path!

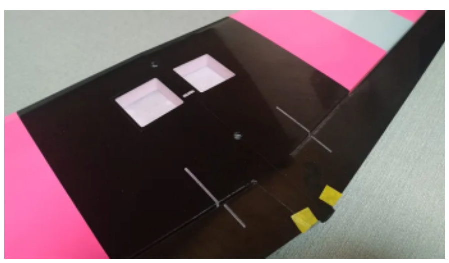


A nice looking and original model to fly.

An Original Design and a Complete Kit

The *Alien* is a flying wing of 1.20m wingspan with a fairly pronounced forward sweep and a particularly thin airfoil of 6%. It has a short nose, a relatively long rear boom with atotal fuselage length of 590mm. The fin is of the hand-launched type with a sub-fin using a cable control and piano wire spring. The structure of the wing uses the most common technology in F3K competition models: it consists of a core — not Rohacell® as on the *MicroMax*, but extruded this time — and a spar and a skin made of 40g/dm² bi-axial carbon fabric. The fin is also made of a core with bi-axial fabric. The fuselage is made of carbon fabric, the front of the fuselage and the nose cone being fiberglass so it's 2.4Ghz compatible. The kit is complete: wing and fuselage, 3D-printed servo frames, 3D-printed ballast tube, carbon plate horns, piano wires and cable for the rudder control. A small, four-pin 90° connector is also provided for the fuselage/wing connection. All the housings of the horns and servos are machined in the wing.

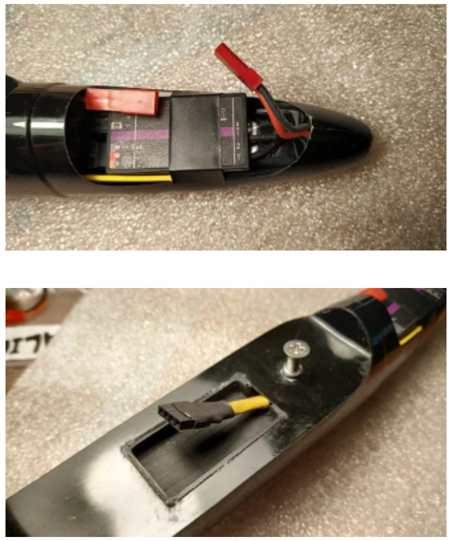




The kit composition, very complete with all accessories.

A Demanding Radio Installation

Let's start with the wing assembly. Flying wings in general, and performance flying wings like the *Alien* in particular, are not 'approximate' radio installations with residual slop here and there. Precision controls and accurate neutral positions are crucial. F3K competition micro-servos are therefore highly recommended. For my part, I opted for the excellent MKS HV75-R in its flat mounting version. The servo housing cut out of the foam offers quite a bit of space, so I was able to create and 3D-print servo frames specific to my model of servos — the frames supplied were not suitable — which avoids gluing the servos directly onto the carbon skin. But before gluing the servo frames into the housing, it is first necessary to prepare the servos arms and the controls of fins with 1.2mm piano wire.



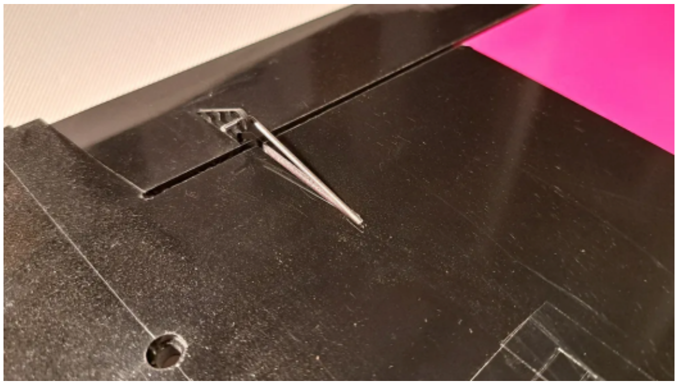
The radio installation, with 3D-printed servo frames, single cable rudder command, and the short nose.

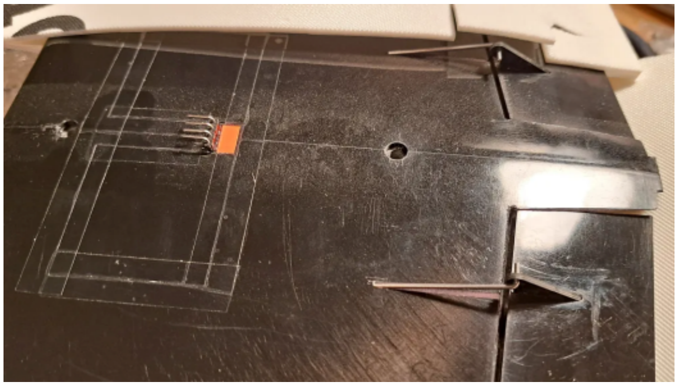
By means of small file I drilled through the foam core gently to allow the control rod to reach the aileron. With a first blank mounting, the exact length between the rudder hole and that of the fin is measured, then the custom bend of the control rod is made, in a ‘Z’ on the servo side and simply bent on the control surface side.

I then installed the wiring to the central angled connector, with removable connectors on the servo side. This takes up more space for sure — when compared to the size of a JR/Futaba connector with the size of the servo itself — but I wanted to keep the possibility of removing the servos if necessary.

The servo’s arm is reworked to have the hole as close as possible to the axis while allowing the necessary travel, but being as short as possible knowing that it is oriented on the skin side.

Once all the elements were ready, I proceeded to glue the servo frame, with the servo in place, screwed on its frame and with control rod connected. Once dry, I glued the control horn connected to the piano wire. Servo covers are made of carbon fabric and they are simply taped with a thin, transparent adhesive tape.





The ailerons control rods and servos in place, with the 90° connector.

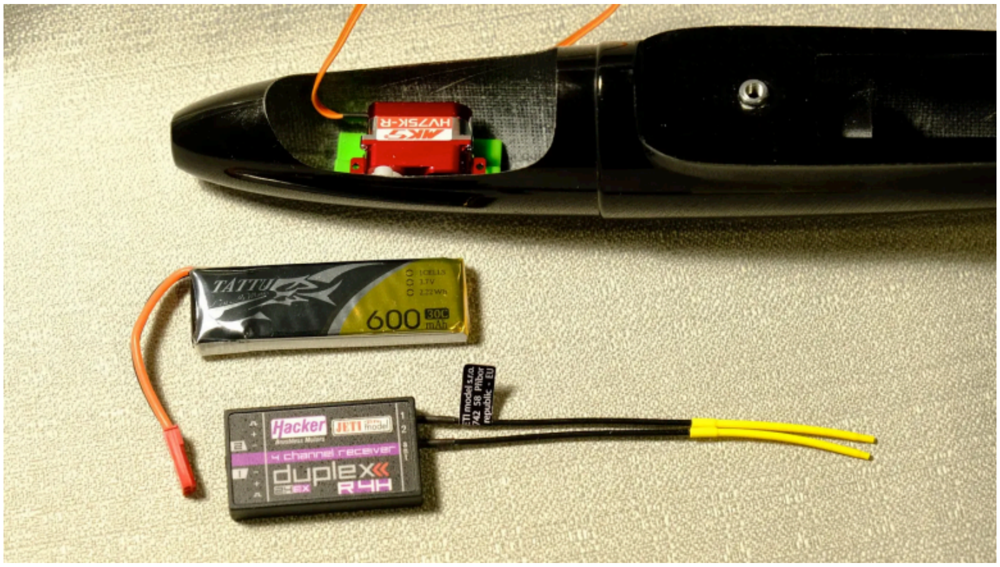
The installation of the DLG-style throwing peg is very classic, on the left wing if you are right-handed and vice versa. Both wings are reinforced on this area of the wing tip. The instructions recommend an angle between 2° and 5°, the gluing being done for my part with some epoxy.

The throwing peg being prepared for installation.

Let's continue with the fuselage: as with the wing, the servo frame delivered did not correspond to the brand of servos I use, so I took the opportunity to change at the same time the assembly by preferring a flat mount at the bottom of the fuselage rather than on the side. I created and printed the appropriate servo frame for the MKS *HV75-R*. Being 3D-printed with PLA (polylactic acid) filament—only cyanoacrylate glue works. Epoxy glue, especially, does not stick and will let go at the first shock.

The fin is glued in place with some epoxy, ditto for the rudder carbon horn. Then I installed the piano wire acting as a spring, within the thickness of the hinge. Finally, I gently drilled the hole of the rear boom to let out the control cable, with a crimped cable loop on the rudder control horn side and the same on the servo side. However, I first added a few centimetres of plastic sheath to protect the cable in the first centimetres in the fuselage. Perfectionists may prefer on the servos side a system to adjust the tension, but it is a few extra grams that are added so for my part, I did the simplest.

The ballast tube — if it can be called that! — is sanded and then glued in place with some cyanoacrylate, taking care to centre it on the theoretical CG. A second 3D-printed part, glued to cyanoacrylate glue, closes the wing seat, leaving a hole at the front to route the connector from the receiver. The receiver battery is a 600mA 1S LiPo which allows a good flight time, the servos used will need to be compatible with the use of low voltage — it is necessary to check beforehand when choosing servos.



The four channel receiver and the 1S 600mAh battery providing a long flying time.

For the balancing lead, I first moulded an inner nose impression using a hot thermoformable plastic: simply soak this plastic in boiling water so that it softens, then place it in the nose and let it cool. Once the nose print is finished just put aluminum foil around it, then 'plant' everything in a pot of sand, remove the nose print leaving the aluminum foil in the ground and pour the right amount of lead, a little below the necessary weight. This will then leave you the possibility to adjust the balancing lead to the nearest gram. I needed about 50g to obtain the recommended CG, this is due to the short nose of the *Alien*. Finally, the scale indicates 290g empty flying weight. Let's take the direction of the slope to test all this!

No Less than Three Flying Modes!

What differentiates the *Alien* from other flying wings is that it has been designed to offer no less than three flight modes to widen its flight range and therefore its versatility. On the other hand, this also means the need for more fine tuning for each flight phase as we will see later.

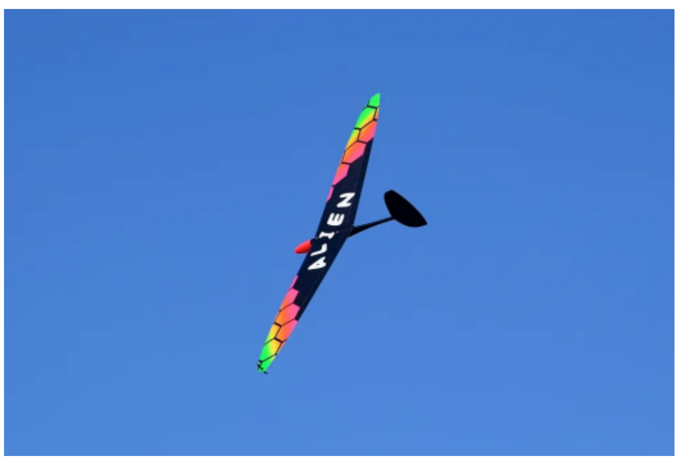
Ready for the maiden flight?

But first let's talk about the throw: the launch by the wing tip will not cause any problem for the DLG-initiated but will remain more problematic for the beginner (that I am and remain). Because the configuration without stabiliser makes that the *Alien* is very sensitive to the exit angle of the gesture and corrections to the elevator. One time, the angle is too 'closed' and the *Alien* leaves almost horizontal and another time, the angle is too 'open' and the *Alien* leaves too vertically. This type of throw, however, makes it possible to reach comfortable altitudes allowing to consider more serenely the search for thermals, without however reaching the height of throwing of a competition model.

The *Alien* requires a little habituation because each phase corresponds to a certain incidence of flight. In the thermal position, and therefore at low speed, the wing flies with increased incidence. The wing remains very healthy and demonstrative while 'wrapped in a pocket handkerchief', and yet the controls remain hyper-effective.

In the cruising speed position, the control surfaces are inclined slightly upwards. In this position the *Alien* favours finesse, transits endlessly and can cover a lot of ground, allowing the exploration of a wide area compared to other models of this size.


ALIEN

ALIEN

ALIEN

ALIEN

The Alien provide lots of satisfaction and fun in flight!

The smooth position — aligned control surfaces — corresponds to the speed position. It will be reserved for conditions of stronger wind, ballasted wing, aerobatics or dynamic soaring. In this position the speed increases again and the flight becomes more aggressive and the efficiency of the control surfaces increased.

In aerobatics, the aileron differential setting is crucial. For the roll to be axial it is necessary to have an inverse differential (more downward travel) which is unusual. So, on the cruising flight mode, which also allows to do aerobatics in light air, the dilemma of the reverse differential — or not — arises. A fourth phase of flight can easily be conceived.

Flying the Alien in video.

But let's go back to the *Alien*'s aerobatic capabilities: once correctly set up, single or four point rolls go through without a hitch, loops are ample even in light air, reversals thanks to the efficiency of the fin are very straightforward and inverted flight is easy.

The use of ballast adds even more dynamism and inertia in the trajectories and helps greatly to fight against the wind. I was able to fly in 8m/s to 10m/s of wind without any problem.

Small conditions but the Alien performs great!

On the other hand, in use, I found the ballast system not very convenient: the short nose is quickly filled by the rudder servo, the receiver and the battery. And even if everything fits without too much difficulty, the access to the ballast located under the wing is done by the front and forces in my case to take out the receiver, put or remove the ballast, and put the receiver back.

The Alien in good company, the MicroMax already reviewed in the New RC Soaring Digest.

On the *MicroMax*, though much less roomy, the ballast is inserted through the wing seat. Of course, the wing must be disassembled, but it is easier and quicker in use. A similar solution on the *Alien* would have been more convenient.

Overall, the flight envelope is very wide, but it is in light air or light breeze that the *Alien* outperforms, offering a real pleasure to fly and have great fun.

The Alien even can save your afternoon if the conditions are weak.

My Conclusions

Not quite a DLG, but not *just* a flying wing in the usual sense of the term, the *Alien* both intrigues and amazes with its outstanding flight performance. The quality of the manufacture is there, but the *Alien* is nevertheless demanding both during the assembly and during the settings, not accepting any approximations. This is the only way to ensure that the *Alien* will offer you a wide range of flying possibilities and give you entire satisfaction.

Summary

I Liked	I Liked Less
The concept and the very original look	The ballast system not convenient
The manufacturing quality of the kit	The small amount of room at the front
Flight performance	

Specifications

Wingspan	1,200mm
Length	590mm
Root chord	190mm
Airfoil	Proprietary, 6% thickness
Wing Area	17.1dm²
Wing loading	17.4g/dm² (and up)
Empty Flying Weight	290g
Manufacturer	OA-Composites (Ukraine)
Price	In the range of €390

Settings

Flight Phase	Normal	Thermal	Speed Acro
Neutral position	+1.5mm	+3mm	0 to +0.5mm
Ailerons	+11 / -7mm low, expo 20%	+11 / -7mm low, expo 20%	+6 / -10mm, without expo
Elevator	±3.5mm, no expo	±3.5mm, expo 20%	±3.5mm, no expo
Rudder	±16mm	±16mm	±16mm

(Note "+" is upward, "-" is downward. CG 30mm from leading edge.)

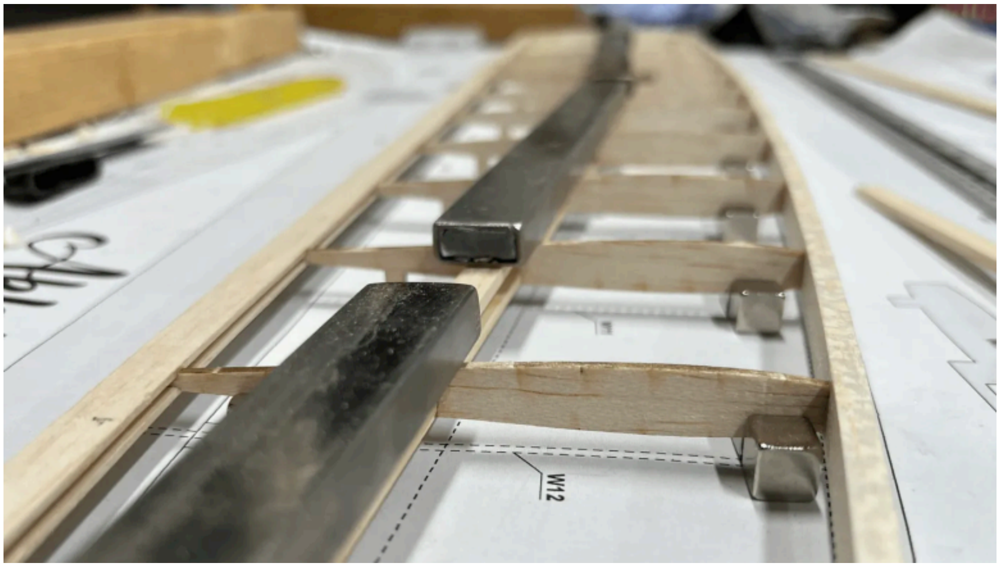
Finally, this flying wing lives up to its name as it seems to come from another planet — good flights and happy landings to all!

Resources

- *The Rondel Anthology* — The complete works of Pierre Rondel as they have appeared on the pages of the New RC Soaring Digest.
- *MicroMAX, the Pocket F3F!* by Pierre Rondel. — "The MicroMAX is a project initiated by Henning Schmidt, designed by Christophe Bourdon and manufactured by Anton Ovcharenko (OA Composites)…"
- *HV75-R* from MKS Servo. — "founded [in] 1999, we specialize in research, design and development of RC model servos, all kinds of gear boxes and electronic control equipment…"

All images and videos by Joël Marin and Pierre Rondel. 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.

Magnetic Building Board



A built-up wing on a magnetic build board.

An attractive project for a Sunday afternoon.

Like many of you, I have a backlog of kits to build. At least three of them are ‘built up’ wings and one or two are even built up fuselages too. My workbench is pretty solid and mostly flat with a monolithic (and sacrificial) slab of 18mm (3/4") MDF (medium-density fibreboard) on top. It’s fine for day to day model work and other DIY tasks, but its not really smooth enough or flat enough for building a +1500mm (60") wing panel for a scale glider where a few millimetres of difference between each end could mean five degrees of wash out or in. Add to that: MDF is a hard material, so pushing modelling pins into it is near impossible. The end result is that the workbench isn’t ideal to build traditional wings on.

> Thus, I have been putting off and actively avoiding a few builds that I really should JFDI (AKA just do it already).

Requirements Gathering

In the build queue, there's the 3.6m (142") Pat Teakle *Salto* (~1/4 scale):

- ***Requirement #1:*** A board that will take an 1800mm (70") span wing panel.

There's also a little 2m VTPR glider from Silence Model with very small and fine tips needing accuracy to maintain the correct span-wise section:

- ***Requirement #2:*** A board that's flat.

My current build bench is in the garage / shed that's watertight but unheated and the existing workbench is dual-use between modelling and other DIY activities:

- ***Requirements #3 and #4:*** A moveable / portable board *and* a board that's dimensionally stable in varying conditions.

The final consideration is practicality; this is a hobby, not a business:

- ***Requirement #5:*** Quick and easy to source and build using 'off the shelf' components wherever possible.

Imitation is the Greatest Form Of Flattery

The idea of magnetic build boards has been around for years. A quick Google returns dozens of forum threads and posts as well as a few retail offerings.

> The concept is pretty straightforward: a sheet of steel on a flat base and some magnets.

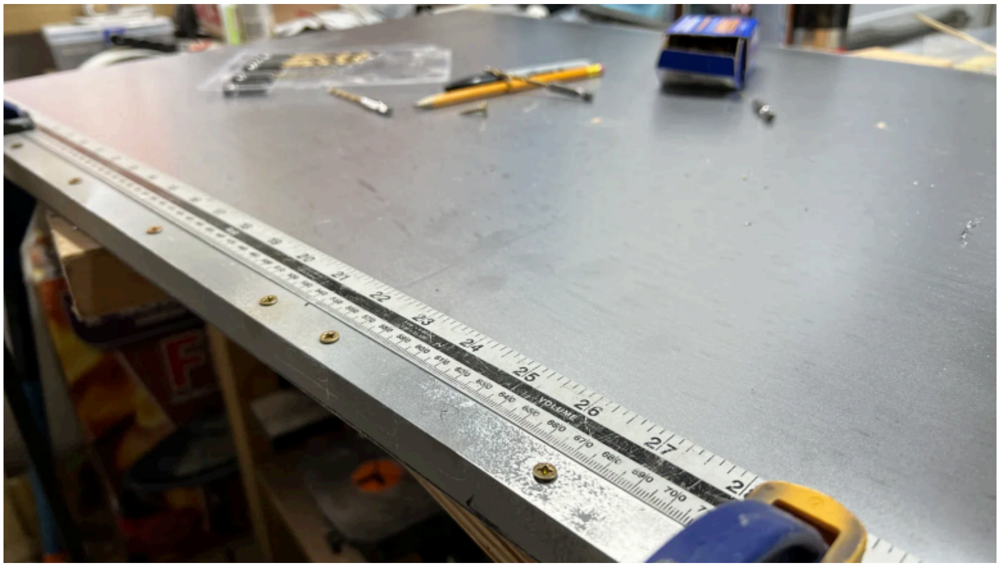
Where there is some variation is the type of base and thickness of the steel.

My Version

Following *Requirement #5*, I wanted to build mine 'in a day' with parts from the local hardware stores. A limiting factor was the steel sheet: I could only find sheets in 1000mm x 600mm (39" x 26"), so there was always going to be a join. I picked 0.75mm (20 AWG / 1/32").

Meeting multiple *Requirements* (*#3*, *#4* and *#5*) using MDF sheet as the base board was an obvious choice. At 18mm x 1800mm x 600mm (3/4" x 71" x 26") it's a pre-cut size that's well stocked in the UK and is pretty stable in most conditions — especially with a coat of paint to seal it.

I wasn't keen on using glue to attach the sheet to the base board as a didn't want to introduce any thickness variation caused by high or low points in the adhesive (*Requirement #2*). However, because the steel sheet was in two parts (to meet *Requirement #1* and *#5*) the solution was to use some aluminium angle along the edge to clamp the sheet in place, sandwiching the sheet between the angle and the MDF. The angle section would serve and additional purpose in helping to keep the edges neat when stored elsewhere. (*Requirement #3*)



Angle section holds one edge of the steel sheet.

The top edge received a similar treatment, though in that case, it was a full-width wood strip as I'd run out of the angle section!

As the sheets were a pair of 1000mm (39") wide panels whereas the base board was 1800mm (71") wide, there was an excess to trim off one end.

It may look curved, but it is not!

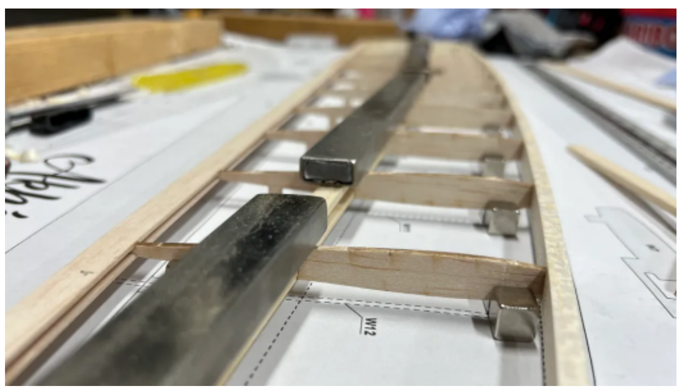
Finally, the selection of magnets proved a little tricky: most of the forum posts and other ‘how to’ articles suggest using square ‘ceramic’ (also known as ‘ferrite’) magnets with links to US suppliers. In the UK however, it's quite hard to find square or smaller rectangular ferrite magnets. There are lots of circular, but very few others. The next choice was ‘rare earth’ (also known as neodymium) magnets which are readily available from Amazon and other retailers online or otherwise.

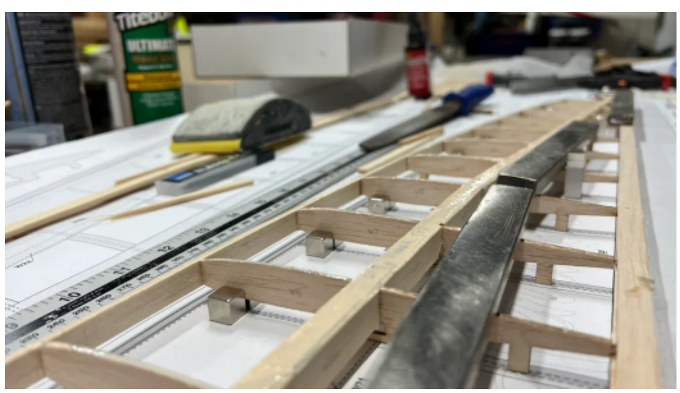
A drawback of these small but very powerful magnets can be they crush the delicate balsa we often use (and skin!) as the ‘snap’ into place or together, so care needs to be taken! Having explored options and read many posts, I settled on two shapes:

1. **Rectangles** — a pack of 10 sized: 20mm x 10mm x 5mm (0.78" x 0.39" x 0.2")
2. **Cubes** — a pack of 25 sized: 10mm x 10mm x 10mm (0.39" x 0.39" x 0.39")

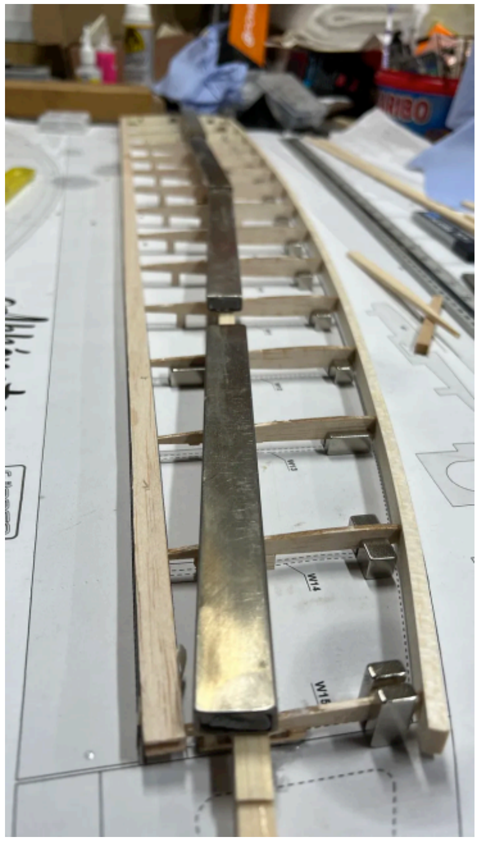
In Use

The first project to land on the board is the starboard wing of my 2m VTPR project from Silence Models of France, the *Akhénaton V².* The range of magnets on hand were ideally suited to keeping the ribs both upright and secure on the board during gluing and initial layup. I also used a few ballast weights to ensure things were snug to the board across the span.



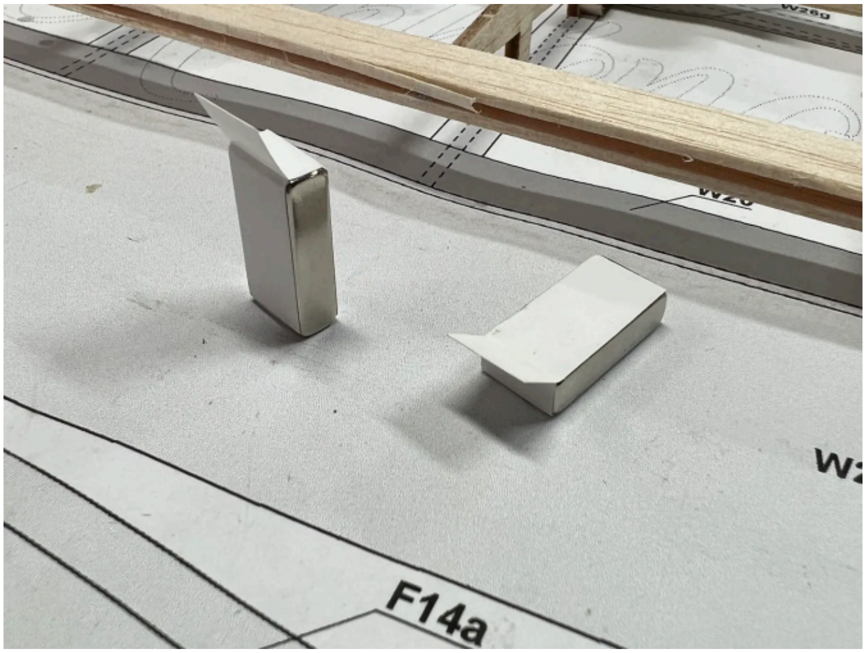


Cube magnets hold the rib stand-offs/legs square.


W14
W15

Cube and rectangle magnets offer options. Ballast bars for weighting down.

One thing that was clear however, was separating the magnets from the base board could be tricky at times. Add some ‘tails’ to them with the label printer. It was an easy fix and doesn’t seem to impact their attraction or alignment. I may do some more experiments as time progresses.



Left: Looking along the span of the Akhénaton V². | Right: Small ‘tags’ help to separate the magnets

Time and Costs

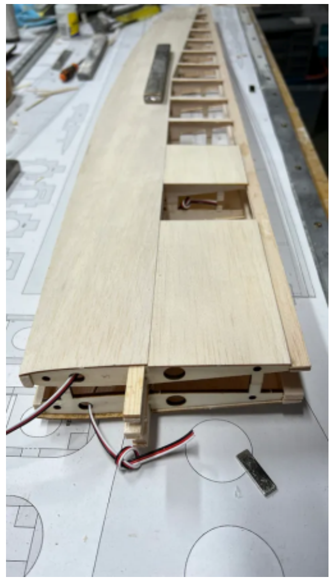
Remembering *Requirement #5*, the only ‘custom’ part of the project was trimming the steel sheet down from 2000mm — both sheets combined — to 1800mm. Other than that, all the other materials such as screws, angle section, tools and the like were off the shelf or on-hand anyway.

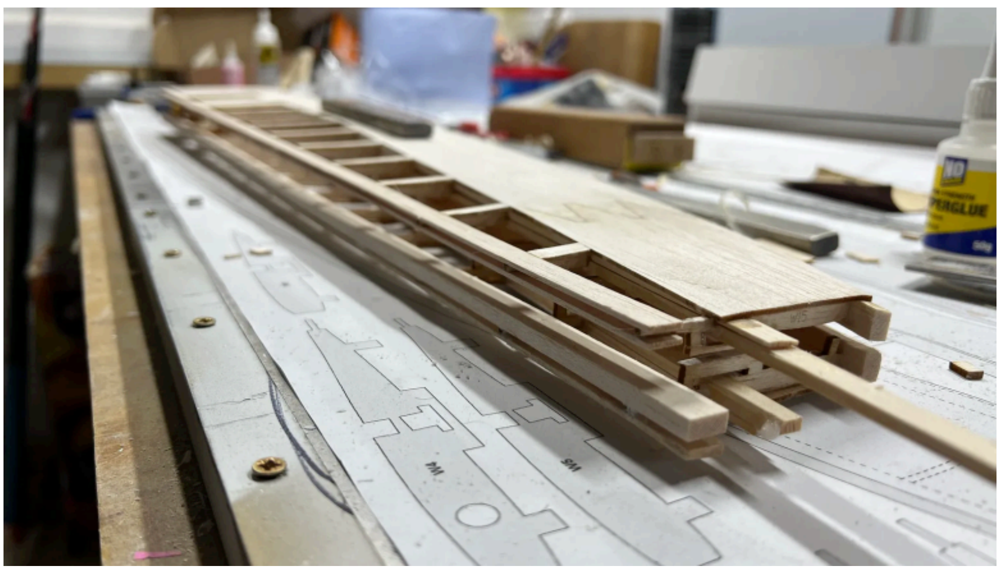
The whole build took less than two hours (excluding travel) and all in, ~£100 ($120 USD, €113) including the magnets. The costs could probably be reduced with more efficient materials sourcing, but I bought the MDF and steel off the shelf from retail hardware stores as a Sunday afternoon project.

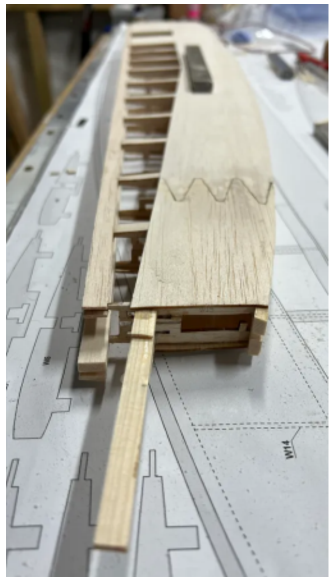
> So was the magnetic building board project worth it? I’d say “**yes!**”

The Proof

Here’s the first pair of wings off the table. Lining up their leading edges, trailing edges and 1st, and last ribs, there’s barely any perceptible variation; further, both are still flat after building and skinning the top surfaces.







Both wings are true and dimentionally mirrored.

Next Steps

As mentioned, I may revise the magnet tails once I have used them a bit more and see how they last. I will also probably expand the number of magnets I have. The current stock was sufficient for this wing, but a larger wing would likely need more.

My current focus for the board is wings, but many of the source articles also show fuselages being built. There are several plans for 45 and 90 degree templates, with magnets attached, to aid such builds. With time, I may build a few of those too.

And finally, the steel is 'raw', so that will need some paint or other maintenance to prevent it rusting. On the whole, the other tools in the workshop fair pretty well as it's not inherently damp, but prevention is preferable to fix! Another option would have been galvanised sheet steel, but none was available off the shelf locally.

If you have any questions feel free to add them in the *Responses* section — you get there by clicking the little 💬 below. Thanks for reading and good luck!

Resources

- *The Panton Anthology* — The complete works of Marc Panton as they have appeared on the pages of the New RC Soaring Digest.
- *H–101 Salto Short Kit* from Pat Teakle. — "The return of the H101 *Salto* is a welcome return with a new fuselage mould and new wing section (HQW 2.5/12) now with scale trailing edge air brakes…"
- *Akhénaton V² 1975 MM* par Silence Model. — "Nouvelle version du célèbre planeur de voltige acrobatique dessiné par Ludovic Clavier. Un kit plus poussé pour des vols extrêmes…"
- *Magnetic Building Board-a-palooza* — A pre-configured Google search for all things magnetic building boards. Go wild.
- *Realth Bar Magnets Magnets: 20mm x 10mm x 5mm* from Amazon. — "Helpful to shower door" or for magnetic building boards.
- *Wukong Magnets: 10 x 10 x10mm* from Amazon. — "Powerful enough to meet your daily needs" or for magnetic building boards.

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Flying Back in Time

Dave Pullinger with his magnificent if not star-crossed half-scale Spalinger S.10.

A fond recollection of an event where the star of the show burned bright but not long.

Back in 2015 the Ghost Squadron were hosting their away-day events in a field near the town of Cheddar — yes, home of the cheese — situated down in the lower right corner of England. Well-known for the generous size of their models, you could always rely on seeing stuff at a GS event that verged on the spectacular. — CW

Every year the Ghost Squadron goes off for its holidays, usually for a week, and often in different locations. For the last couple of years, one of those locations has been near the landmark of Cheddar Gorge, in Somerset and this year, after careful scrutiny of the weather forecasts, I opted to go down there on the Sunday, the day with the lightest winds, to see what was occurring. The first thing to greet my eyes upon arrival, was the wonderful sight of Dave Pullinger's massive half-scale Spalinger S.10 being painstakingly rigged in the next parking bay.

The Spalinger S.10 in action.

This model is a tour-de-force of the modelling arts, and a very challenging subject to boot. As well as being a biplane glider, it has no ailerons, roll control being activated by the warping of the upper wings. Six years in the making, this model is a follow-on from Dave's original 1/4-scale design, published so long ago that Fred Flintstone was still wearing shorts at the time. No expense had been spared in the making of this masterpiece including the installation of two half-scale pilots and the use of a sign writer to complete the finishing touches.

So keen was your reporter to see this beast in action, that he refused to fly himself, lest the great moment be missed. This meant that the first attempt didn't take place until near lunchtime, whereupon proceedings ground to a halt, as no one else wanted to miss it either.

It takes a lot of help to get the S.10 in motion.

Although the wind was forecast to be light, it was still blowing at right angles to the runway, and it became evident as the poor tug roared and trembled, and the Spalinger reluctantly moved at walking pace, that the wing warping was going to be unable to prevent the downwind wingtip from scraping on the grass, thus demolishing any hope of getting airborne. There was a deep irony to this situation, contingent to the rules and regs that apply to models over 20Kgs. Event organiser, John Greenfield, had brought along his new half scale Klemm, a model more than capable of towing up the Spalinger, but he was the only person on-site certified to fly both models! Eventually, after three attempts, the Spalinger became airborne, and after an agonisingly slow climb to altitude, we were treated to the re-creation of a small piece of history.

Left: John Greenfield (centre) readies the mighty Klemm. | Right: The Klemm in action at the Cheddar event.

This model was indeed an impressive sight in the air, and three or four more flights were embarked upon during the course of the day. Sadly, and for reasons unknown, on the last flight the S.10 went into a dive from which it didn't recover, and this little piece of history became history itself.

An iconic view of history-in-flight.

Later, the Klemm went on to tow up Tony Hazlehurst's half-scale Slingsby *Falcon*, an impressive and scale-like sight indeed.

Like me, many others must have clocked the favourable forecast, because there were plenty of gliders in attendance, waiting for a tow. One to catch my eye was Ian Stromberg's 1/3-scale SZD-8 *Jaskółka*, scaled up from the John Watkins plan. Weighing in at just under the

20kg limit, this was an impressive model, and it looked pretty impressive in the air too.

Ian Stromberg's 1/3-scale Jaskółka in action.

Equally as impressive was Ian's realisation of the Fowler Flaps that are a feature of this machine. I have long nurtured the idea of building a Letov LF-107 *Luňák*, but the problem of building in the Fowlers has always dented my enthusiasm somewhat. There are plenty of kits available for the *Luňák*, but they all seem to have conventionally hinged flaps.

Chris Garrod's mighty ASH 25Mi in action at Cheddar.

Despite the crosswind, it was a good day for aerotowing, and the tug pilots put in their usual sterling performance, whilst the gliders circled in the sometimes very abundant lift. As this seems to be a fixture in the event calendar, it can only be hoped that next year's weather will also include a day as good as this one!

Left: Happy scene at the Ghost Squadron event. | Right: Author's 1:3.5 scale Rhonadler ready to go.

Thanks for reading and if you have any questions, please do not hesitate to add them in the *Responses* section below — you get there by clicking the little 💬 below — and I will do my best to answer them.

Resources

- *The Williams Anthology* — The collected works of Chris Williams as found in the pages of the New RC Soaring Digest.

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Published in The New RC Soaring Digest

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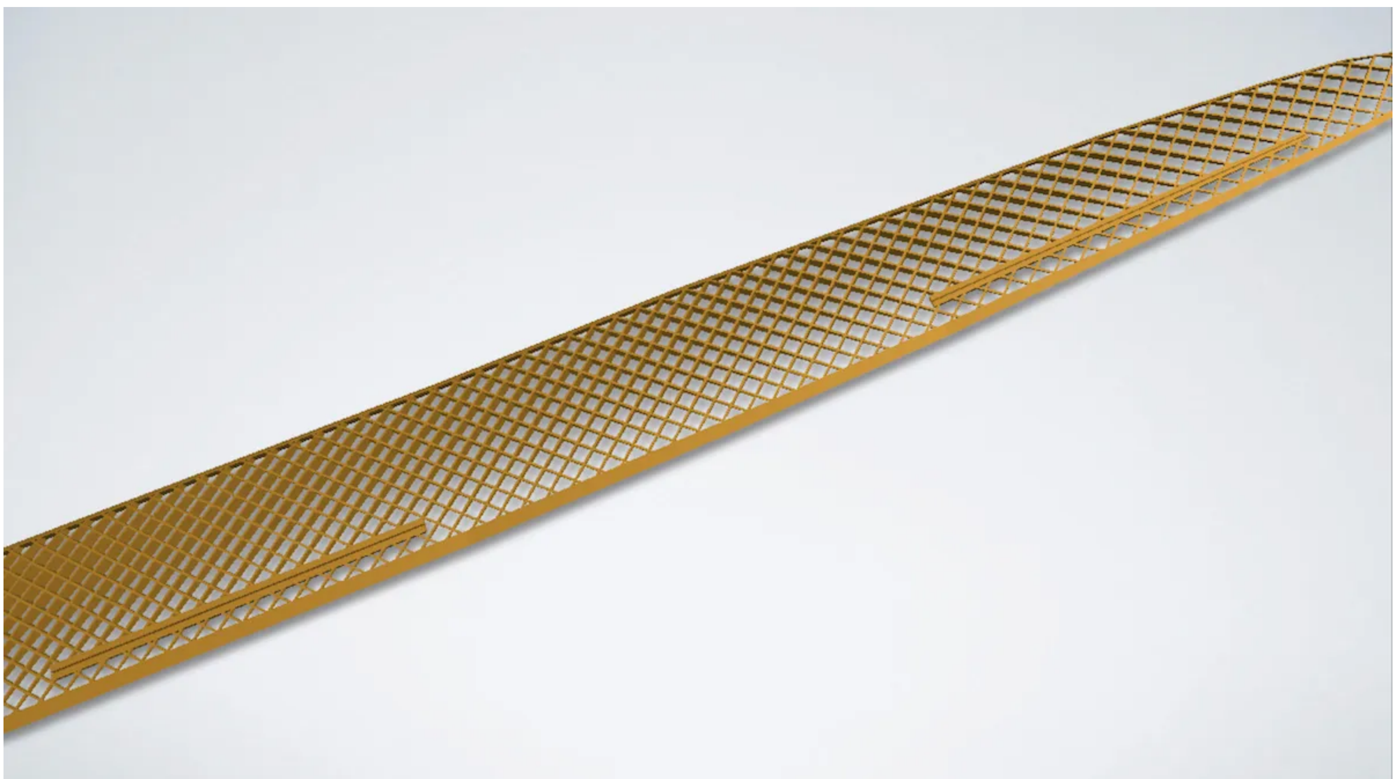


Geodetic wing structure.

Project ALTius

Part III: Working within weight and financial constraints.

*In **Parts I and II of this series** the author described performance glider projects as complex with a lot of repetitive and complex operations. He went on to explain how CAD software can be automated in standalone separate SAD (software assisted design) apps and homemade*

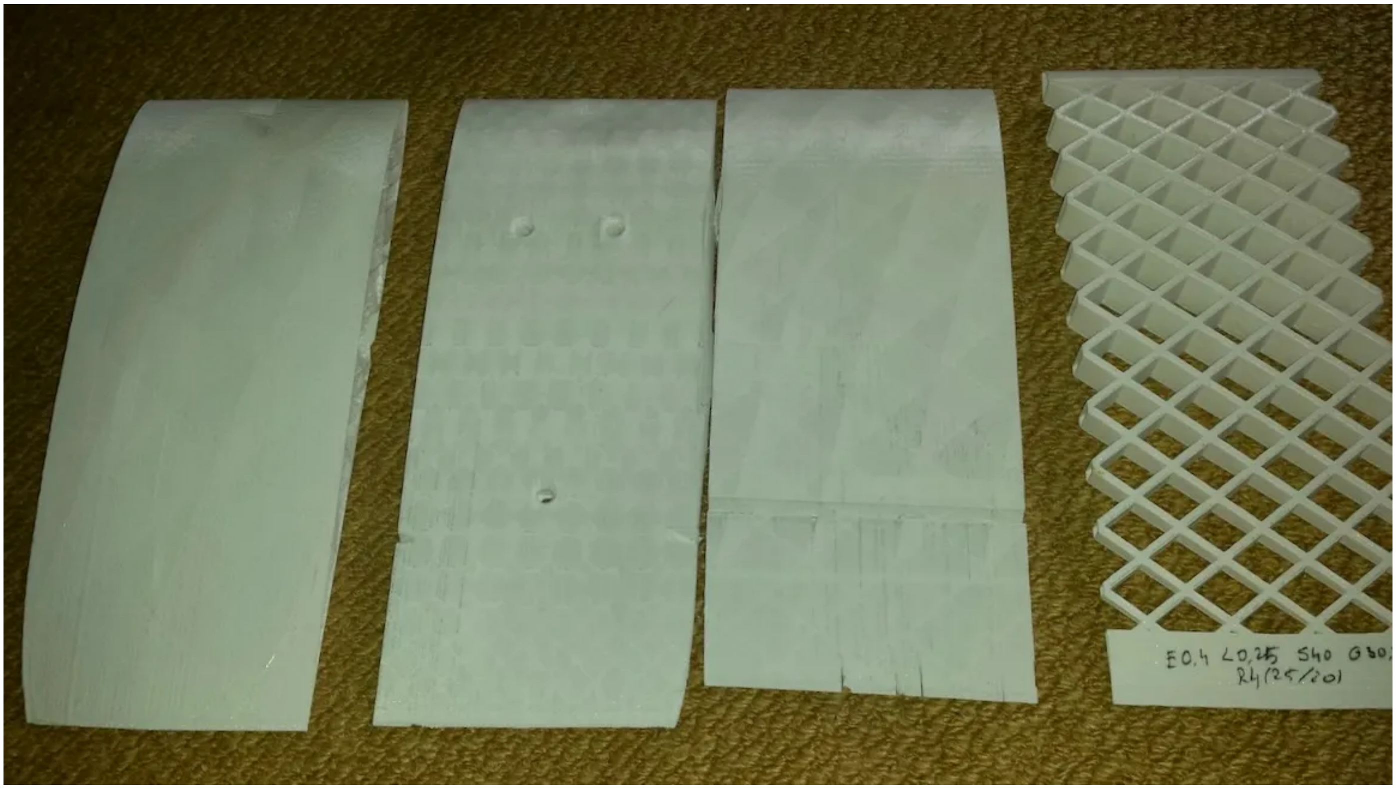
HAM (hardware assisted manufacturing) devices and then presented some same workflows to illustrate their use. — Ed.

With the information from the RCGroups discussion (see *Resources*, below, for this and all links reference in this article) and the hints from the previous articles you should have a good idea of what can be done with `xflrwing` and what needs to be done in *NetFabb* and *OpenSCAD*. Also, It's very important to have a good assesment of your manufacturing tools and skills. If you own or have access to CNC equipment you can use the wing, mold and plug 3D models and start working. That said I still recommend starting with some sacrificial stock like XPS (extruded polystyrene foam) first which you'll likely know this as 'pink insulation foam'.

Subtractive manufacturing via CNCs is not my forte — I'm not a fan. You need a good machine — very rigid and accurate — and it's very messy. I had some ideas about carving plugs from XPS given its easy-to-machine properties and then topping with resin and mineral filler. However, the volume of work is quite large and involves a lot of elbow grease for polishing the molds and plugs. Also in order to machine solid cores from *Rohacell®* or XPS you definitely need some perforated molds and a vacuum table or at least double adhesive tape. So no CNC for me for the moment, just 'simple' 3D printing.

A good 3D-printer is affordable (and way less messy than) CNC.

In fact *Project ALTius* started as a ‘3D-printed F5J glider’ — in fact, the ALT in ALTius comes from ‘additive layer technology’. I created the wing 3D model and I started printing: first with a 0.4mm nozzle, then 0.3mm and finally 0.2mm. Then I started a different approach — perforating the wing in *OpenSCAD* similar to Kraga’s *Kodo* glider. None of these methods had satisfactory results. Why? It’s time for some numbers — that is, weight estimation.



Bad prints with a small nozzle and transition to a geodetic structure.

No Precision Scale Required — We'll Just Run Some Numbers

In `xflrwing` text output you may notice a small section with some numbers: projected area of the wing, total area, volume plus some estimations of the weight depending on the materials. There are also estimations of the weight of fuselage, tails and AUW (all up weight) and wing load.

Remember that *Project ALTius* is about a 'performance glider' which is to say an 'F5J competition glider'. Even if we don't have the wing load as in F3J we still need to have a resilient wing at a reasonable weight. That means AUW something between 1250 and 1500g for a 3.6 to 4m wingspan. Furthermore, this means a wing of 625-750g, a tail of 60-75g and a fuselage of 230-300g.

Have you noticed the pattern here? I've allocated from the 'weight budget': around 50% to the wing, 5% to the tail, 20% to the fuselage and 25% for the rest consisting of motor with or without reduction gearbox, spinner, folding propeller, ESC, servos, receiver and LiPo pack.

Did I just make up these numbers and percentages? Not really, there are an educated guess from what I've seen in my F5J gliders: *Viator* 3.16m, *Crozilla* 3.45m, *Ultima2* 3.6m, *Shadow* 3.65m, *Xplorer* 3.7-3.8m and *Ultima* 4.0m.

The wing weight has three different components:

1. **Surface** (W1) — the weight of the material used for the wing surface. Of course it is proportional to the total wing surface
2. **Volumetric** (W2) — the weight of the material used inside of the wing. It is proportional to the volume of the wing — there is a little 'overlap' between W1 and W2 but we will simplify the model.
3. **Structural** (W3) — the weight of the spar, joiners and other elements. It is **not** proportional to either surface or volume.

Right now there are three methods to build the wing:

1. **Balsa** (eg. *Pulsar*) — W1 (surface) is for *Oracover®* and carbon D-box, W2 (volumetric) is zero for air, structural weight W3 (structural) is spar, ribs and joiner.
2. **Hollow-wing** (eg. *Explorer)* W1 is for surface composite, W2 is zero, W3 is spar and joiners.
3. **Solid-core** (eg. *Ultima*) — W1 is for surface carbon, W2 is for *Rohacell®* and W3 is for spar and joiners.

One important remark about W1/W2/W3 in different technologies: in the latter years I have noticed a transition from hollow-wing — with W2 equal to zero — to solid-core with a significant W2. This was done of course at the attendant benefit of lower W1 and W3. The density of *Rohacell®* is 30kg/m^3 to 50kg/m^3 which is similar to XPS. However, this technology — taken from DLG designs — has so far limited application to F3J. To the best of my knowledge a 'heavy' 3.16m *Viator* was the only winch-launched, solid-core design in an F3J competition.

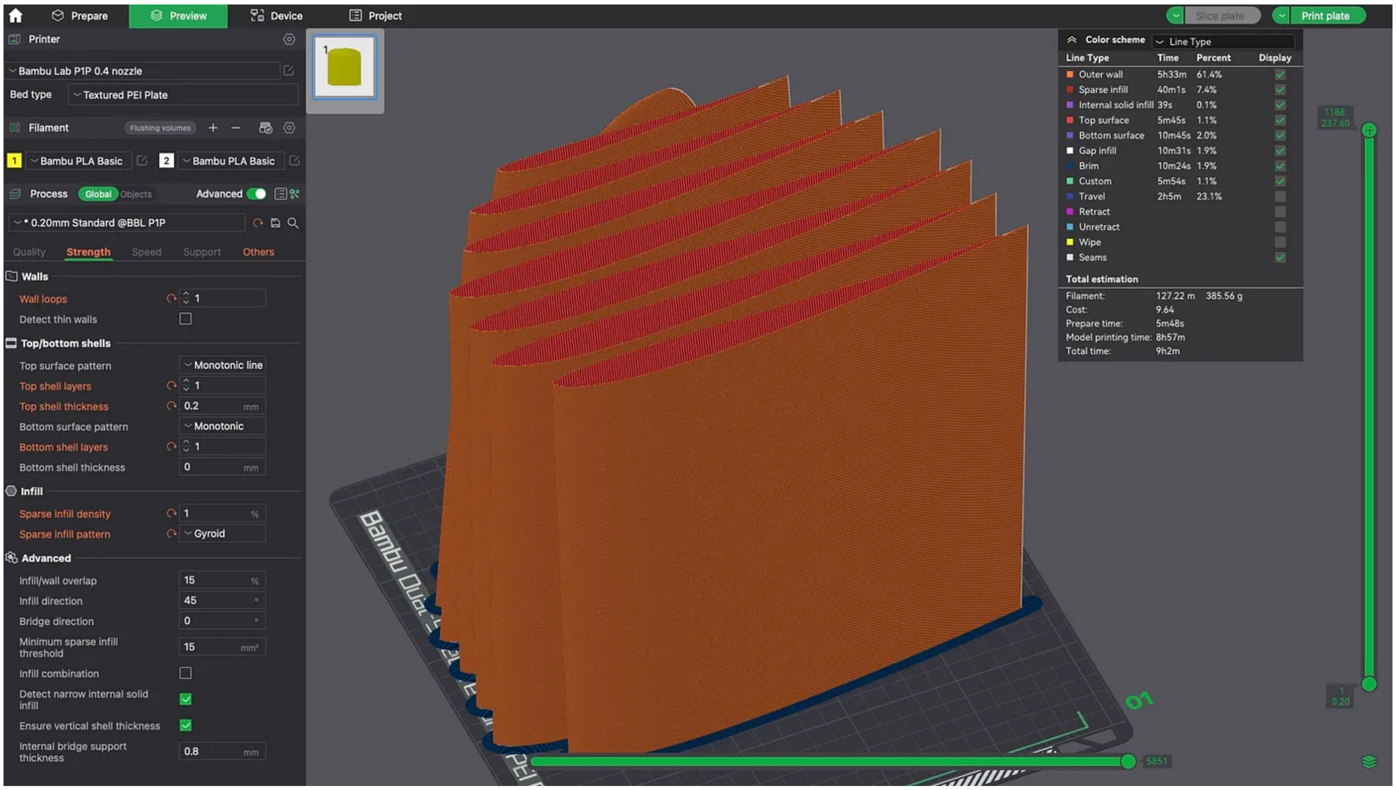
Is a 3D-Printed Wing within Our Weight Budget Constraints?

Let's try to estimate the weight of a 3D-printed wing of 75dm^2 projected area — 1.5 m^2 total area — and a volume of 6000cm^3. For a 0.4 mm nozzle the surface is made up of one or two 'walls'. One wall results in:

W1 = 1.5 m^2 x 100 x 100 (to convert from m^2 to cm^2) x 0.04 (the diameter of a 0.4 mm nozzle in cm) x 1.15 g/cm3 = 690g.

If we print the interior with a 1% infill we will have:

W2 = 6000cm^3 x 0.01 (1% infill) x 1.15g/cm^3 = 69 grams.



Segments for half wing prepared in slicer — our weight estimation was good.

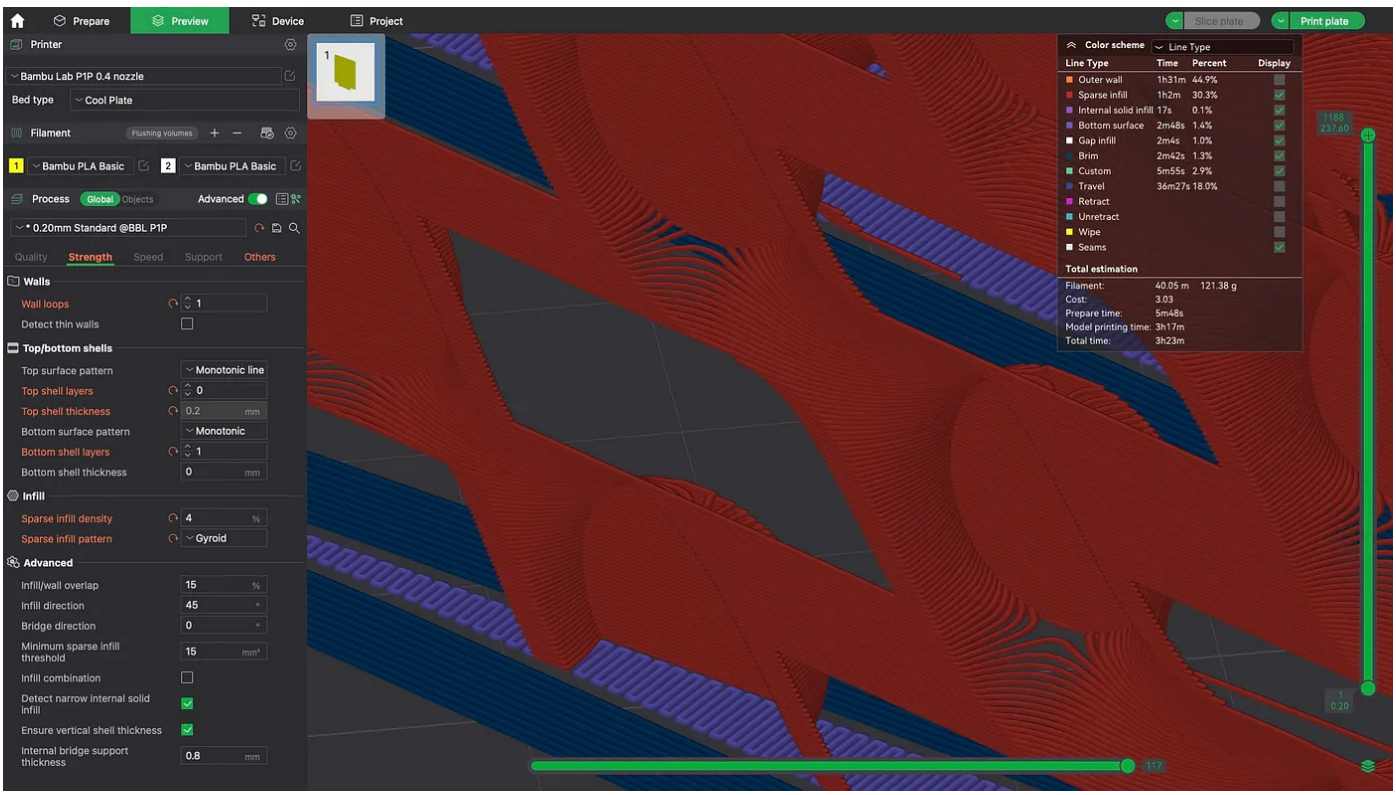
With *0.4mm nozzle / one wall / 1% infill* we are exceeding the weight budget even with a W3 of zero. That means no spars — a very **bad** idea. Furthermore with only one wall the printed wing will definitely have structural flaws. Here are some other options:

- ***0.4mm / one wall / 2% infill*** — a little bit better with a 10% increase in weight but there are still structural flaws.
- ***0.4mm / two walls / whatever infill*** — way too much.
- ***0.2 mm / two walls / …*** — is in fact similar to *0.4 mm / one wall /…* which was already rejected and, in addition, it will probably double the printing time.

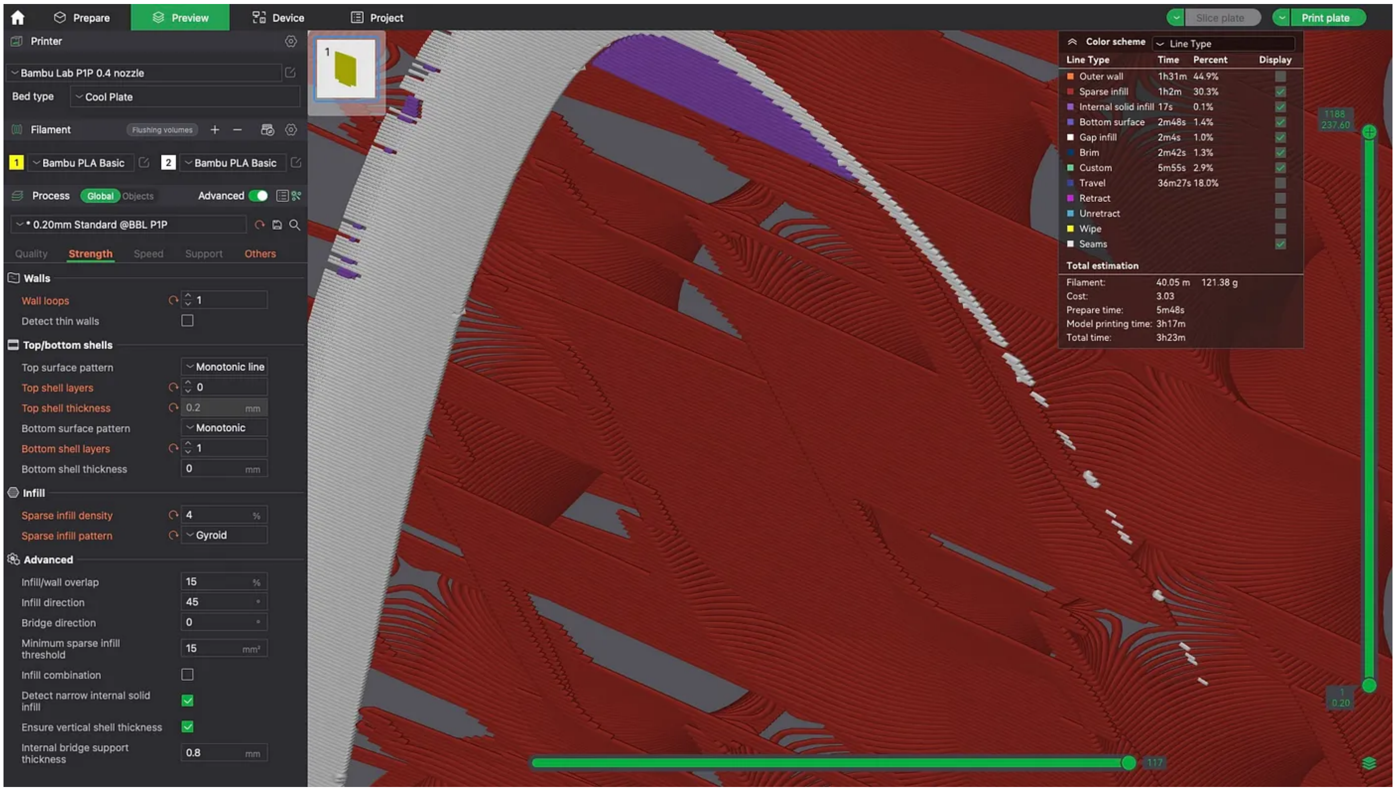
- *0.3 mm / two walls / …* — is increasing W1 by 50% — 900g instead of 600g — and a greater than 1000g 3D-printed wing is not my goal, at least not for *ALTius* Mk1 anyway.

Dead End? Not Really.

The structural flaws of a 3D-printed wing are related to the FDM (fused deposition modelling) technology. What we are printing is a (forgive the metaphor) a ‘squished molten plastic sausage’. The adherence between layers depends on the nozzle diameter, the layer height, the plastic temperature and the printing speed. For a 0.4mm nozzle we need a maximum 0.2mm layer height. In theory you can have two-thirds of nozzle diameter but it’s better to have a maximum of a half, a high temperature and a low printing speed for a good adhesion. We can control some of these factors but we will still result in a heavy wing.



A closer look at the infill structure near the plate (no printed walls)…

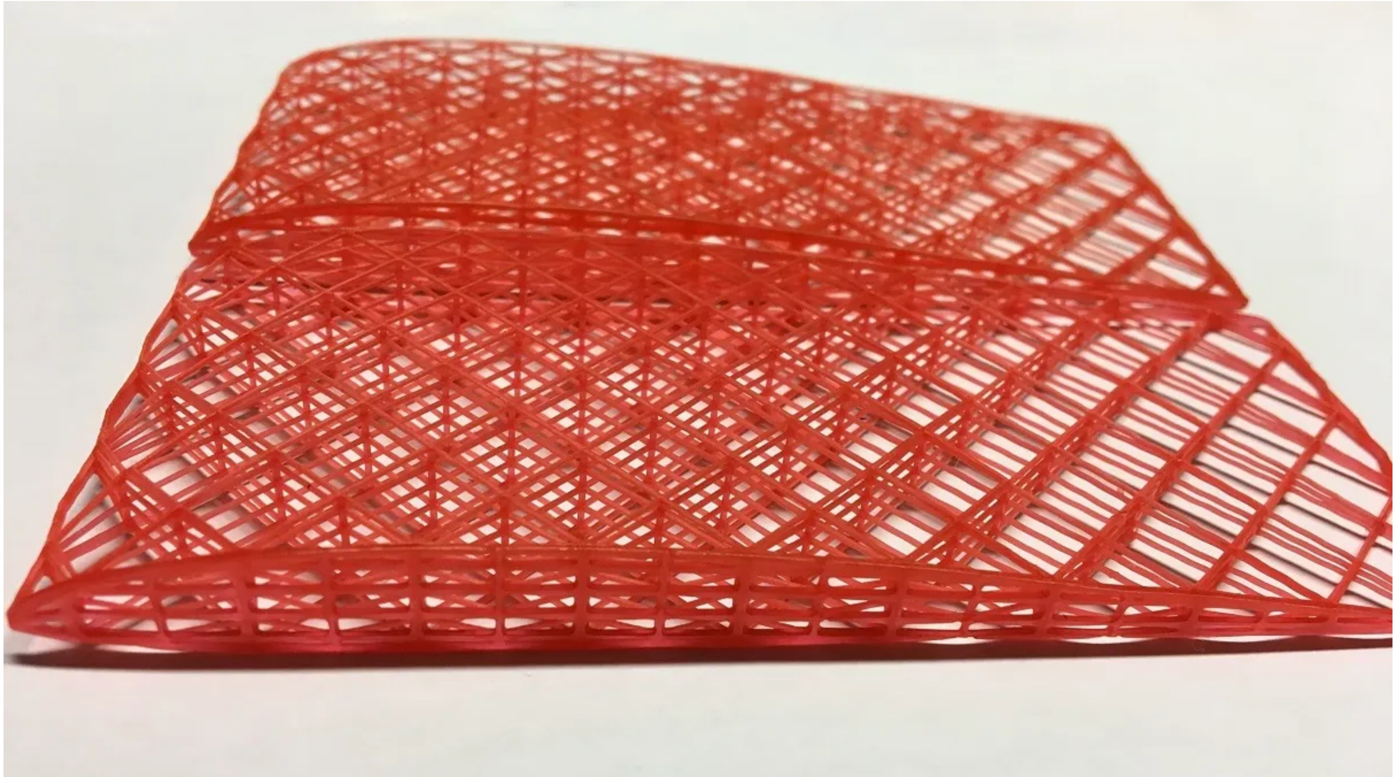


…and at the wingtip

Resin 3D-Printing to The Rescue!

Fortunately, there's a better alternative with this alternative 3D-printing technology. Consider the following comparisons:

- 0.4mm nozzle versus 0.1mm (or less) laser spot to fuse the resin.
- 0.2mm layer height versus 0.1mm or 0.15mm or 0.2mm layer. Actually, it doesn't matter too much — it's how deep the laser beam penetrates the UV resin.
- One wall / two walls versus any wall width we want with a minimum of 0.1mm. Remember that we may overlap laser paths to get a wall width of 0.25mm, for instance.
- With regard to speed we are no longer limited by the thermal constraint in FDM but we may still have mechanical constraints. We will see later what kind of speeds we achieve.
- It's no longer 'sausage over sausage' — it's a 'brick layer over brick layer' structure while the density of resin is similar: on the order of 1.15g/cm^3.



First test of lightweight internal structure printed with resin.

With a resin 3D-printer we can get some very interesting results: *0.1 mm spot / 0.25mm walls / 1% infill* is 375g. We can add a nice layer of *TeXtreme®* 80g/m² , the R&G Laminate Calculator gives us a 178–180g/m² laminate weight. Let's round it to 200g/m² for some additional resin and this gives us a 300g layer of *TeXtreme®* with resin. 675g so far with 75g reserved for joiners and spars for a nice strong wing. I think we've got something here!

However, there is an itsy-bitsy-teenie-weenie problem: there is no affordable commercial 3D-printer with resin — all are large industrial models and very expensive.

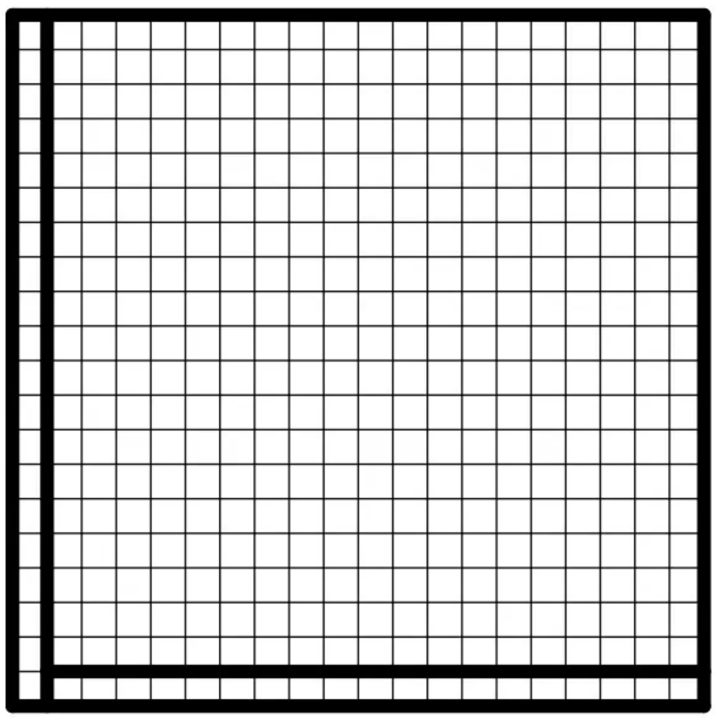
So we'll have to build the equivalent, instead.

Other Options Instead of 3D-Prints?

If the idea of 3D-printing a large F5J glider seems a little bit too much — let's call it 'the hi-tech build'— maybe I can interest you in some 'lo-tech': our good old trusty balsa. Let's try to evaluate W1, W2 and W3 if we 'print' the wing with balsa using two special 'balsa nozzles: 1mm for the foil (W1) and 2mm for the infill (W2). Competition-grade balsa has a density of 100–120kg/m³ or 0.10–0.12g/cm³. That's aproximately one-tenth the weight compared to PLA (polylactic acid) or ABS (acrylonitrile butadiene styrene)

3D-printing filament. That means the W1 weight will be W1 = 180g (`1.5 x 100 x 100 x 0.1 x 0.12 = 180`). So W1 is sorted out and the result is good. Of course we have to add some glue but we can add this weight in the W3 estimation. For W2 we need to estimate first an infill factor. Note the 1% or 2% used for plastic is not an accurate estimation.

Let's consider a geodetic rib mesh build up with balsa sheets of `B` millimeters and with a grid cell size of `C` millimeters. We will compute first the integer part of the ratio `C / B = n`. We can draw the cell as a big square composed of `n x n` smaller squares. The 'infill' / 'balsa' is the first rows of vertical and horizontal squares, in shape of letter L. That's `2n – 1` squares out of `n x n`. Hence the infill factor is `(2n – 1) / n * n`. As `n` is in general quite big we can aproximate the infill with `2 / n`.



A little visual help for balsa infill estimation

For instance: 2mm balsa sheets used for a grid with `40mm cell size → n = 20 → infill = 10%`. That's nice, even if the infill is ten times larger compared to plastic this is compensated from the ten times difference in densities and we will have a similar W2: `6000cm³ x 10% x 0.12 g/cm³ = 72g`. And a lot of space in the weight budget for W3.

Maybe the *1mm balsa foil* approach is not very appealing. Of course you can add some normal covering film or even better with paper laminating film. But I have another idea: why not use a composite surface like glass, carbon, *Kevlar®* or even a hybrid?

The *resin 3D-printed core with* TeXtreme® *surface* approach seems like a 'hi-tech solid-core'. We don't use CNCs and replace *Rohacell®* with 3D-printed spatial structure. The *balsa geodetic ribs covered with composite* approach looks like a 'lo-tech hollow-wing' or maybe a 'hi-tech balsa'. In hollow wings, builders are using a sandwich of light fibreglass, *Airex®* and light carbon. In our case probably the *Airex®* is not necessary as we have the geodetic grid to support the composite. We can afford to use some heavy fabrics like *Kevlar®* 170g/m^2 (laminate weight 420g/m^2) or carbon 200g/m^2 (laminate weight 440g/m^2) or we can use two layers of lighter fabric. We will replace the balsa W1 of 180g with a beefier composite 630–660g but the wing will be stronger.

There is another itsy-bitsy-teenie-weenie problem: the normal K40 and other, cheaper laser cutters have a working area of 30cm x 20cm or 30cm x 30cm and we will need longer geodetic ribs — so we'll have to build also a larger laser cutter.

So far we have discussed the weight — our goal for the moment is to achieve something similar to hollow-wing or solid-core technologies. We can definitely achieve this goal with 3D-printers or geodetic balsa ribs but the real benefit in this case is that we expect a better structure compared to hollow-wing or solid-core. I'll get into the details a little bit later in this series. There is also the time factor to consider. Probably we will spend some significant time in printing† but it will not be *our* time but rather 'robot time'. 3D-printers don't need human operation or supervision for long prints.

†Or maybe not — but let's keep some surprises for the 'advanced HAM' part of the Project ALTius *series.*

Money, Money, Money

The final factor we need to consider is the cost. When I'm buying or building a glider the first question I have to ask myself: "is it worth it?". "Big and cheap" is our motto here so let's consider a ratio between price (in euro using €) and wingspan (cm):

- **Foam** — in the range of 0.5–1.0€/cm, with ARF (almost ready to fly) closer to 0.5€/cm and PNP (plug and play) closer to 1.0€/cm.
- **Balsa** — in the range of 1–2€/cm with kits closer to 1.0€/cm and ARF closer to 2.0€/cm

- **Composite** — in the range of 2.0–4.0€/cm. From my personal experience *Viator* on the lower price range and *Ultima2* on the upper part — if you buy it from the manufacturer and not from a specialised shop. In the latter case you can get closer or even past 5.0€/cm.

The €1000 Question(s)

Can we make a high performance composite glider for a cost similar to a foam or balsa kit? Is the crazy goal of 1.0€/cm within our reach?

For this project the main cost is related to materials and tooling. Let's put aside for the moment the tooling — don't worry, we will get to it on the next part — and evaluate the material prices. For the wing we will need around 2m² of *TeXtreme®*, plain carbon or hybrid material and another 1m² for the fuselage and tail for a total of 3m². If you fancy a 45° bias with your layup you will probably need to bump that up to 4-5m². 200g/m² carbon is cheap but it is not suitable for the tails. Worst case scenario we can use non-woven carbon or light glass cloth. Or how about a hybrid of *Kevlar®*-carbon material or the nice look of spread tow *TeXtreme®*?

Some estimates for material costs:

- 1m x 3m of 12K (12,000 filaments per tow) 80g/m² carbon is €68.21 plus €14.01 shipping for a total of €82.22 for a simple non-biased layout for a single glider. That's 27.4€/m² —and if if you buy 15m² of carbon the price is 24€/m² which is quite a bit less.
- UV resin for 3D-printers is now 25€/kg. It's even cheaper at 20€/kg if you buy in batches of 10kg.
- ABS/PLA/PETG 3D-printing filament is 15–25€/kg.

So it seems like with €200 we can get the materials for the project **but** don't reach for your wallet or credit card. This leaves only €200 left for tooling in our €400 financial budget. Is it possible?

What's Next

We'll answer that question in the next part(s) of the series. Spoiler alert: probably you've guessed that the answer is **yes.** Between now and then, if you have any questions feel free to add them in the *Responses* section below. You get there by clicking the little 💬 below.

Thanks for reading. Until next time, best of luck with your project.

Resources

- ***Airex®*** from Airex AG. — “Sandwich applications with Airex® foams are up to 50% lighter than conventional solutions require less energy while preserving highest strength, stiffness, and thermal insulation…”
- ***Kevlar®*** from DuPont. — “Extremely strong yet lightweight and durable, Kevlar® provides the perfect balance of form and function — allowing you to redefine performance and explore new possibilities…”
- ***Kodo*** from Kraga. — “Kodo is a proof of concept that 3D printing can be used for building RC planes. It was designed as a multipurpose glider that does it all…”
- ***NetFabb*** — “a free … software for 3D Printing and the STL file format…”
- ***OpenSCAD*** — “software for creating solid 3D CAD models. It is free software…”
- ***Oracover®*** from Lanitz-Prena Folien GmbH. — “our leading product for covering RC model airplanes is patented worldwide … permits re-positioning without fear of colour-layer separation…”
- ***Project ALTius*** on RCGroups. — “altius, citius, fortius — sounds familiar? That’s the Olympic motto where ‘altius’ means ‘higher’. But the spelling (ALTius) is related also to my initials — Atudorei Lucian Tiberiu…”
- ***R&G Laminate Calculator*** from R&G Faserverbundwerkstoffe GmbH. — A handy online tool that will even ‘print out’ the results on a tape so they can be easily printed or PDF’d.
- ***Rohacell®*** — “For 50 years, Evonik’s Rohacell® structural foam has been offering the aerospace and automotive industries, medical technology, and other markets boundless possibilities for lightweight construction…”

- ***Styrofoam™ Brand XPS Insulation*** — "Since its discovery in 1941, Styrofoam™ Brand XPS Insulation has a long and rich heritage as a sustainable building product…"
- ***TeXtreme®*** — "spread tow reinforcements are a uniquely adaptable, safe and ultra light supportive solution for your carbon fiber composites…"

*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**.*

April 2023 Aeronautical Engineering Aviation Rapid Prototyping 3D Printing

Twist Distributions for Swept Wings

The author with the Penumbra2 at 60 Acres Park in Redmond, Washington in the summer of 1990. This wing was foam core and fiberglass with a spar system which consisted of plywood webs only and there were no spar caps. It used the EH 1.0/9.0 airfoil and one degree of twist over the last half of the semi-span. The winglets have the same EH 1.0/9.0 airfoil as the wing and are set at zero degrees toe-out.

Part 3: Taming adverse yaw created by aileron deflection.

Readers who have not already done so may want to read Parts 1 and 2 of this five part series before proceeding with the following. — Ed.

In Part 1 we defined and provided examples of lift distributions. Part 2 examined stalling patterns of various planforms and introduced the notion that sweep angle and coefficient of lift can affect the angle of attack of outboard wing segments. Three consistent themes have been underlying the discussion thus far:

1. Achieve and hopefully surpass the low induced drag exemplified by the elliptical lift distribution without creating untoward stall characteristics.

2. Reduce adverse yaw created by aileron deflection without adversely affecting the aircraft in pitch.
3. Maintain an acceptable weight to strength ratio.

In Part 3 we will describe a method of achieving the second goal.

Sweep and Twist

Figure 1 (reprint of Figure 8, Part 2) shows the increasing upwash which affects outboard segments of a swept untwisted wing as it produces lift. Although exaggerated in the diagram, the overall tendency is clear and does appear in practice.

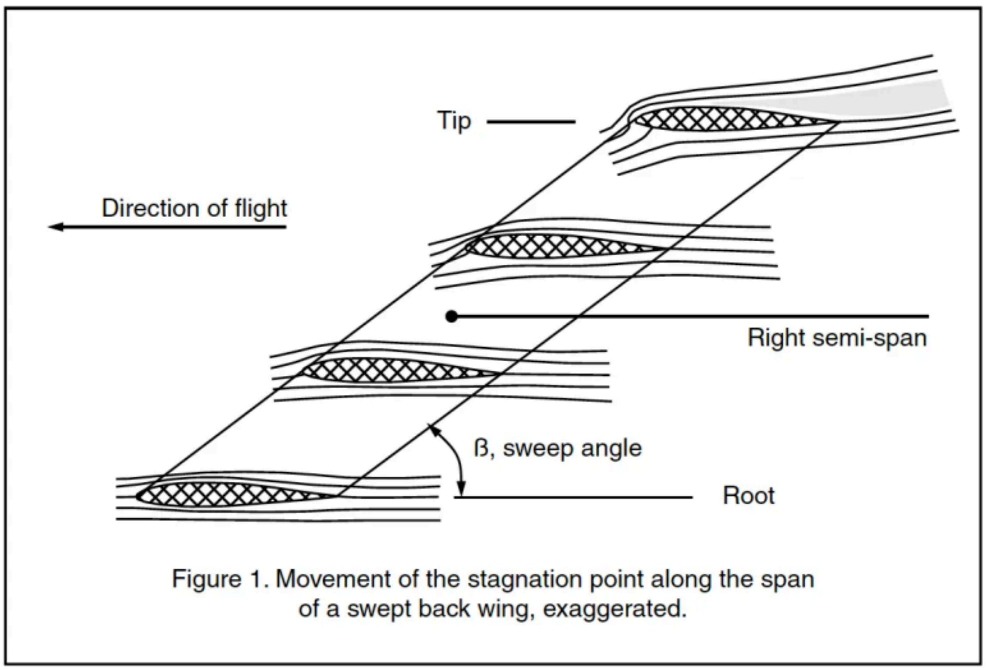


Figure 1. Movement of the stagnation point along the span of a swept back wing, exaggerated.

While there are several ways of reducing the tendency for the wing tip to stall, like careful consideration of airfoils or addition of wing fences, there are advantages to imparting some twist to the wing in the form of washout (leading edge down).

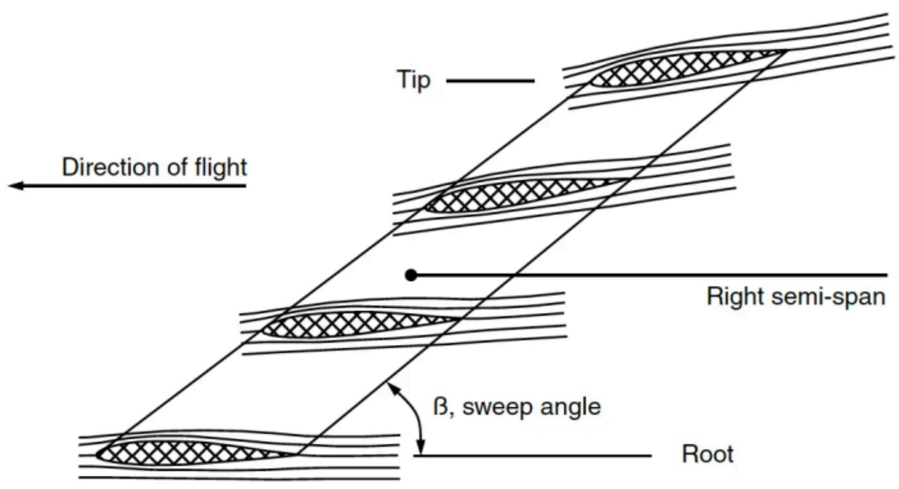


Figure 2. Alignment of wing sections to local flow by means of geometric twist, exaggerated.

Figure 2 illustrates the case where the wing is twisted such that each wing segment has the same angle of attack as related to the oncoming air flow. Since the increasing upwash ahead of the wing is directly proportional to the amount of lift produced by inboard wing segments, this illustration is obviously accurate for only one aircraft velocity and attitude. The general concept is, however, very important.

Vectors

Mass, length, pressure and time can be defined by single real numbers. The length of a spar for a two meter sailplane, as an example, may be 39 inches. As there is a unit of measurement, inches in this case, the spar length is a scalar quantity. The number which provides the magnitude, 39, is considered a scalar.

Force, on the other hand, has both a magnitude and a direction, and is therefore classified as a vector quantity. A five pound brick resting on a table in a gravitational field may be represented as shown in Figure 3A and 3B. If another five pound brick is placed on the first brick, the situation can be depicted as in Figure 3C. Note that the arrowhead always indicates the direction of the force, while the length of the line indicates the magnitude of the force.

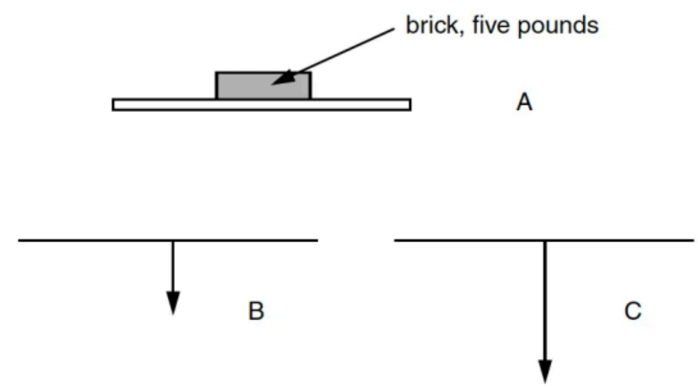


Figure 3. Examples of vector quantities.

There are two basic forces of interest to aerodynamicists — lift and drag. In a wind tunnel, the investigator may measure the lift and drag of the airfoil by setting up two scales. One scale will measure the lift generated by the section through a balance system which has its axis vertical to the tunnel test section and hence the air flow. Another scale is set up with its axis parallel to the air flow to measure drag.

The investigator can rotate the airfoil section through negative and positive angles of attack relative to the air flow. As the angle of attack increases or decreases, both lift and drag will vary. Regardless of the angle of attack, generated lift is always measured perpendicular to the air flow and drag parallel to the air flow.

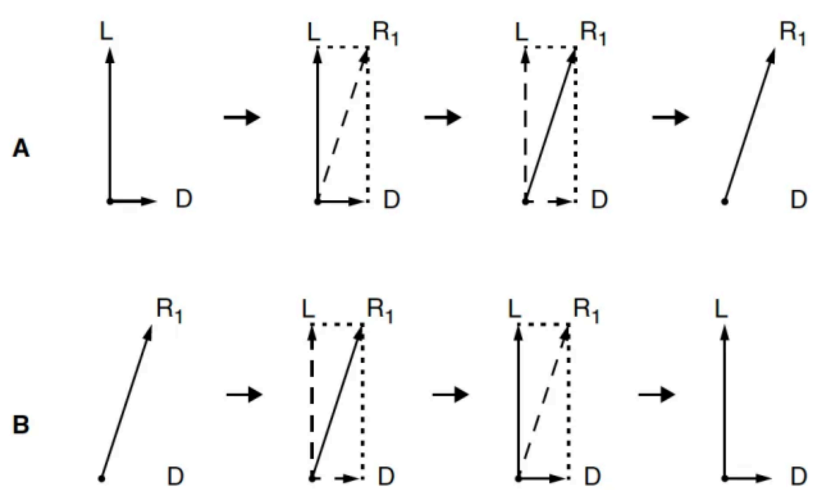


Figure 4. Calculation of resultant vectors

Figure 4A demonstrates how two vectors having the same source may be resolved into a single vector by constructing a simple parallelogram. Since lift and drag are always perpendicular to each other, they can always be resolved into a single vector by means of a rectangle (a parallelogram which has intersections of 90 degrees).

We can also perform this operation in reverse. That is, given a single vector and the angle(s) of the parallelogram, the separate component vectors may be derived.

As an example, we know that the lift vector is always perpendicular to the air flow and the drag vector is always parallel to it. By constructing the requisite rectangle on the resultant vector, we can define the lift and drag vectors. This process is shown in Figure 4B. We can perform a similar procedure on the weight vector, thereby establishing two separate component vectors : one parallel to the direction of flight and one perpendicular to it.

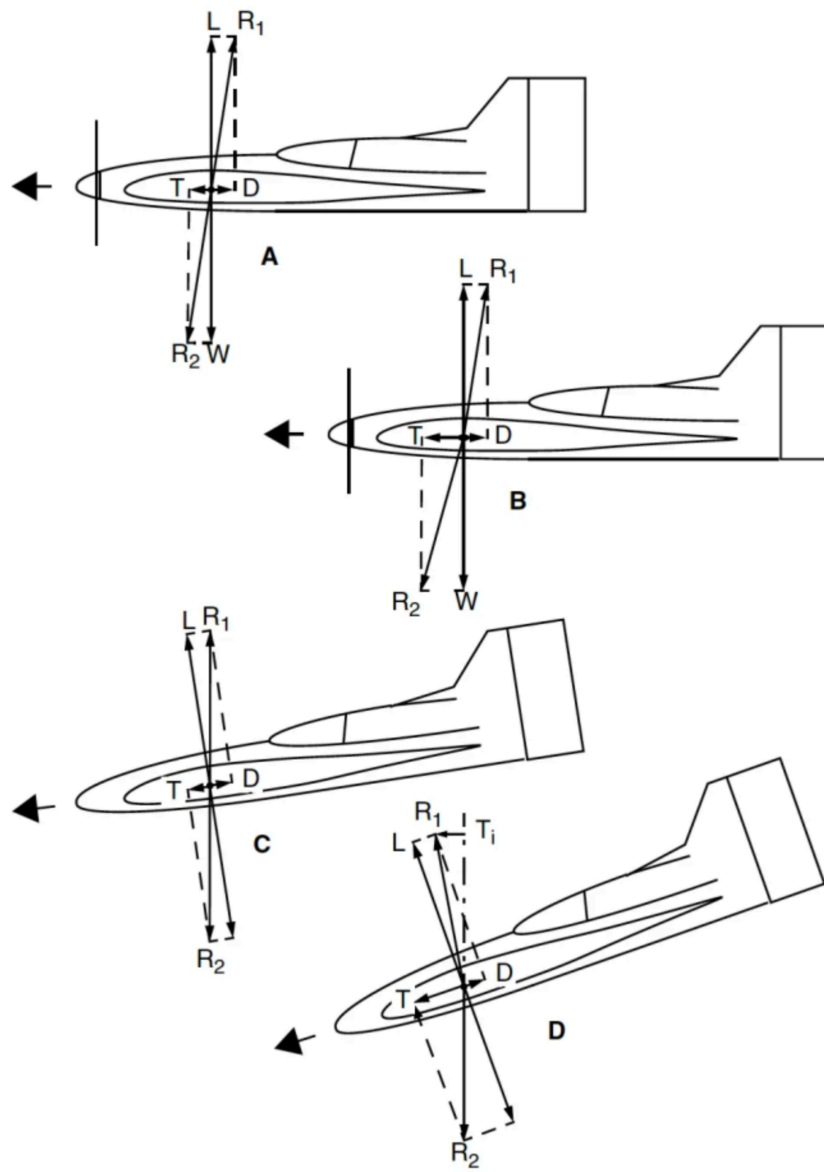


Figure 5. Force vectors on powered and unpowered aircraft which are otherwise identical.

The upper illustrations in Figure 5 provide a depiction of the vectors involved in sustained, constant velocity flight. The upper illustration, Figure 5A, shows a powered aircraft in straight and level flight. The weight of the aircraft, *W*, is counteracted by the generated lift, *L*. The drag, *D*, is counteracted by the generated thrust, *T*. There is a single vector, R_1, which can represent the combined lift and drag forces, and a single vector R_2 which can represent the combined thrust and weight vectors.

These two resultant vectors are calculated by constructing a parallelogram using the two known vectors. R_1 and R_2 are of equal magnitude and opposite direction in this case, and the aircraft is therefore flying at a constant velocity. If thrust is increased, as shown in Figure 5B, the *T* vector length increases, indicating increased thrust, thus changing the shape of the parallelogram. The aircraft accelerates horizontally. To maintain straight and level flight after application of additional thrust, aircraft trim must be adjusted so the wing continuously generates only enough lift to exactly match the aircraft weight. R_2 becomes longer and rotates forward. The drag force *D* then increases as the aircraft velocity increases. Drag will increase until it exactly matches thrust — R_1 becomes the same length as, and in opposite direction to, R_2. Once drag and thrust are again equal, the aircraft is once more stabilized in straight and level flight. The aircraft velocity will be greater and constant, the amount of lift will be unchanged, the coefficient of lift will be lower, and the wing will be operating at a lower angle of attack.

The lower illustrations in Figure 5 depict the case of a powerless aircraft of the same design. It is in gliding flight. In Figure 5C the aircraft is moving forward at a constant velocity and slight downward angle. We know the direction of the air flow, so R_1 can be resolved into the lift and drag vectors which are perpendicular to each other, as described previously. The resultant vector, R_1, is of exactly the same magnitude as R_2 and in the opposite direction, so the aircraft is flying at constant velocity. There is no engine to generate thrust so the weight *W* alone forms R_2. R_2, however, can be dissociated into two component vectors. One component vector, parallel to *D*, can be denoted *T* (thrust), the other can remain unnamed.

Consider the flight path and note that the lift vector remains at ninety degrees to the air flow and the drag vector remains parallel to the air flow. This is the same as seen in the previously described powered example.

As the glide angle steepens, the portion of the weight which is considered thrust increases. At the same time, the lift decreases and the drag increases. See Figures 6A and 6B.

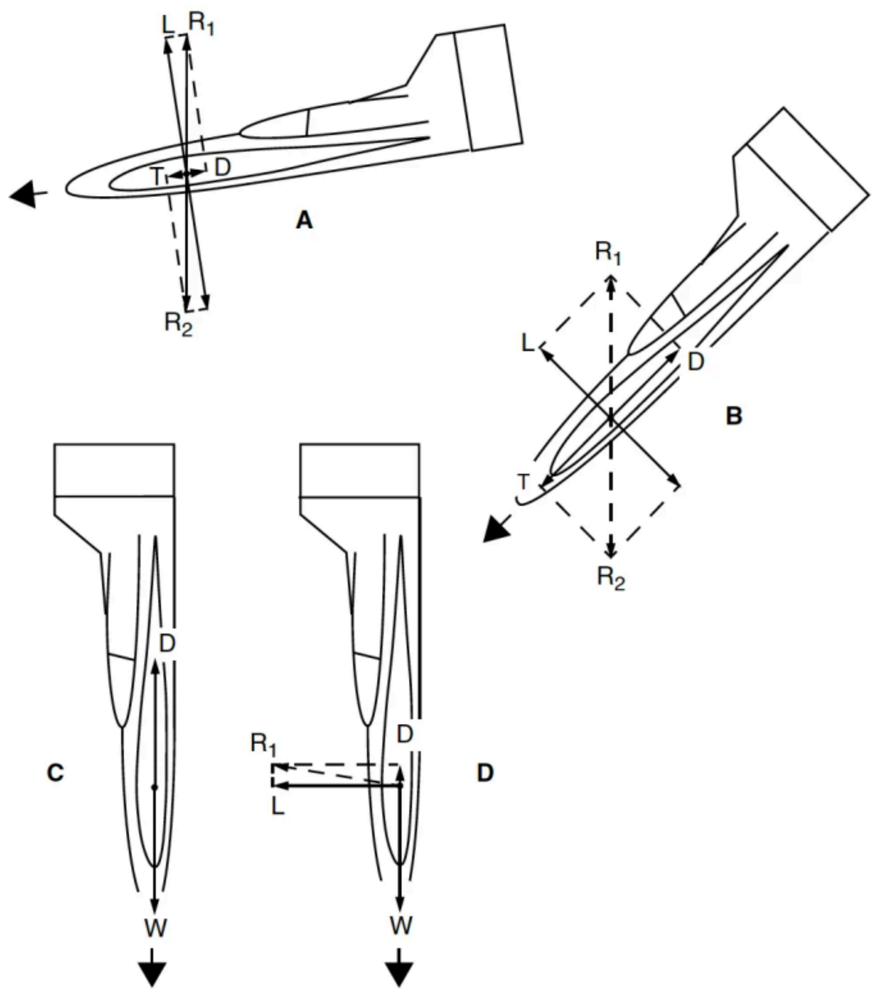


Figure 6. Force vectors on powered and unpowered aircraft which are otherwise identical.

To help explain this, take a look at the extreme. Figure 6C shows the glider in a sustained true vertical dive. The wing is operating at the zero lift angle of attack and so lift has been reduced to nothing. Drag makes up all of R_1 and weight makes up all of R_2.

If in a vertical dive we adjust the angle of attack so that it matches what was required for straight and level flight, the lift will be the same as during straight and level flight and it will be oriented exactly in the horizontal. See Figure 6D. The drag vector will also be the same length as before the change in attitude and will remain parallel to the air flow.

The resultant R_1 is rotated nearly ninety degrees from the vertical. The lift force immediately begins accelerating the wing horizontally while the weight accelerates the aircraft vertically downward. As the horizontal speed increases, the air flow changes direction so there is a reduction in the angle of attack. If we consistently maintain the initial angle of attack, the aircraft will pull out of the dive.

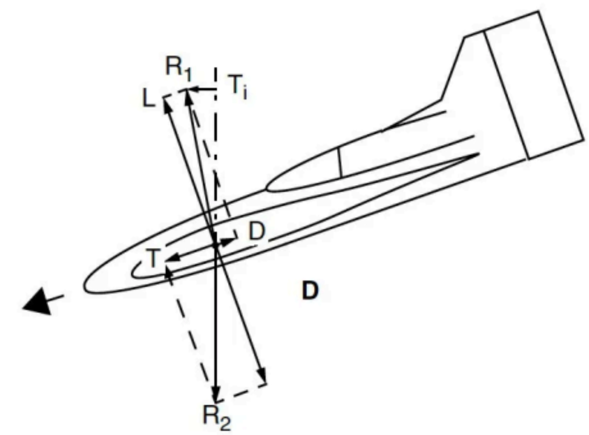


Figure 5. Force vectors on powered and unpowered aircraft which are otherwise identical.

In Figure 5D (reproduced above), the aircraft has just been put into a steep dive from straight and level flight. The aircraft is assumed to be flying at the same speed as before the change in attitude. The weight vector can be broken down into its two component parts, as was done previously, and the thrust component is accelerating the aircraft in the direction of flight. The lift and drag vectors remain oriented to the direction of flight. R_1, the resolution of the lift and drag vectors, is rotated forward of the vertical, indicating that a portion of R_1 is directed in the horizontal direction. This small force is denoted in the illustration as T_I, induced thrust. If the angle of attack is held constant, the aircraft will pull out of the dive, just as in the previous example.

Induced Thrust

We've used the term 'induced thrust' in the previous paragraph, and there are some readers who may not believe that such a thing exists, despite having a knowledge of 'induced drag.' Perhaps one of the best examples of 'induced thrust' is the action of a winglet. A very large number of aerodynamics texts describe winglets in detail, so we will not do so here. What we want to bring into focus is the production of induced thrust by the winglet.

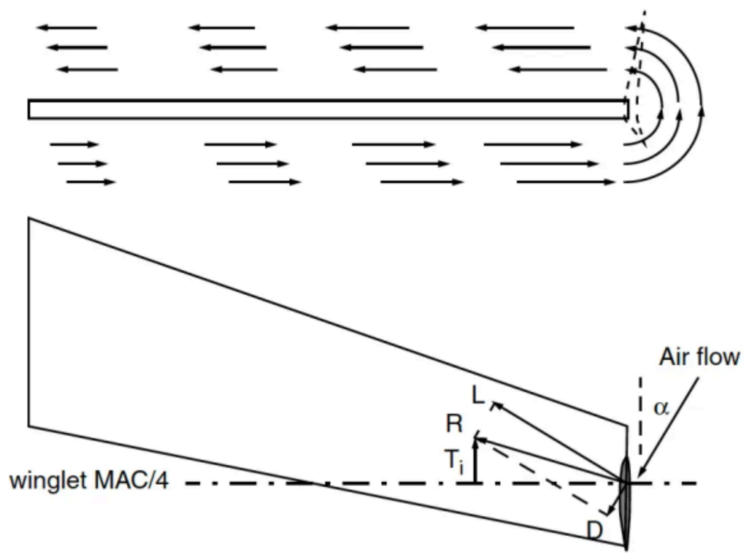


Figure 7. Induced thrust, T_i, generated by winglet.

The upper illustration of Figure 7 shows a wing from the rear, with the winglet structure defined by phantom lines. The air flow is shown traveling outboard along the bottom surface of the wing and inboard across the upper surface. The velocity of this movement is generally greater near the wing tip as shown by the lengths of the lines.

The air flow outboard of the wing tip is very close to circular, but remember, the free stream velocity is added to this circular motion, so the resultant air flow meets the winglet at an angle. The lift and drag vectors are shown in the lower illustration. Note the now familiar rotation of the resultant in reference to the winglet MAC/4 axis. (MAC/4 is the 25% chord point of the mean aerodynamic chord and is the origin for the winglet lift and drag vectors, just as for any wing segment. The MAC/4 axis and the yaw axis are in parallel planes in the presented examples.) The vector T_I is the induced thrust generated by the winglet.

We can extend the notion of 'induced thrust' from a winglet to the outer segment of a lifting swept wing. Consider Figure 8A.

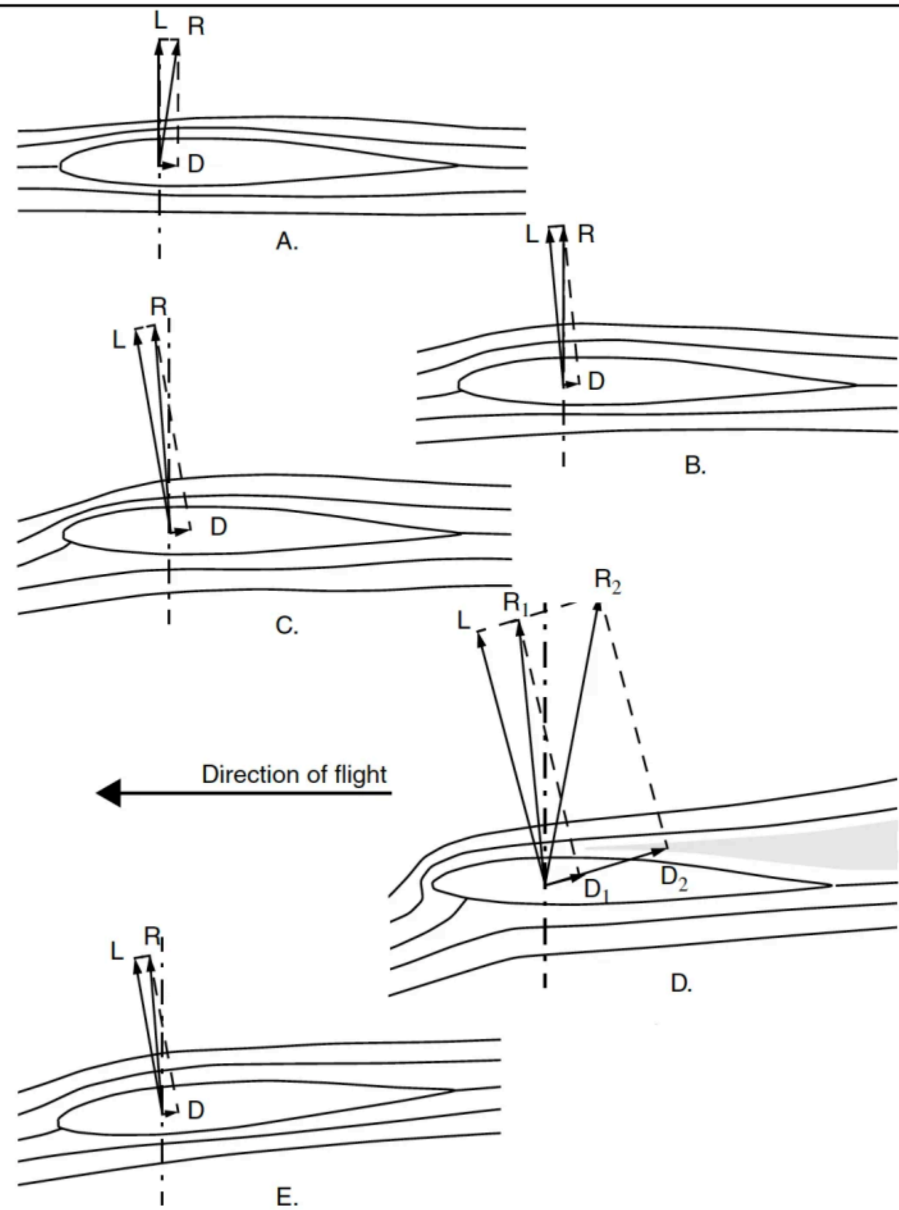


Figure 8. Rotation of lift vector caused by upwash, and a single case of the effect of twist on that rotation.

In this case, an airfoil is generating some lift while the air flow is precisely horizontal. This is a situation identical to that when an airfoil with a zero lift angle of some negative value is set in a wind tunnel at zero degrees angle of incidence to the air flow. Note that the lift vector is vertical (ninety degrees to the air flow) and the drag vector is parallel to the air flow. The resultant is rotated at an angle behind the vertical quarter chord axis. In the wind tunnel, as the airfoil angle of attack is increased, the lift vector remains perpendicular to the air flow, the drag vector remains parallel to air flow, and the axis remains vertical, perpendicular to the air flow.

In Figure 8B, the air flow is coming from below at an angle of five degrees. The lift and drag vectors have rotated to match the air flow, and the resultant coincides with the vertical MAC/4 axis.

Figure 8C shows the case where the air flow is coming up at an angle of ten degrees. The lift and drag vectors (and the resultant, of course) have rotated forward of the axis.

Figure 8D shows two situations which take place at an air flow angle of 15 degrees. We've shown a single lift vector and two drag vectors. If the drag is low, the resultant (R_1) remains well ahead of the axis. If the drag is excessive, however, the resultant (R_2) rotates behind the axis. This is an important concept to keep in mind.

The case of the outer segment of a twisted swept wing is shown in Figure 8E. The air flow is coming up at an angle of ten degrees and the airfoil is set at an angle of incidence of minus five degrees. As the wing section 'sees' an angle of attack of five degrees, the lift is of the same magnitude as in Case 8B, but the resultant is rotated to a direction nearly identical to that of Case 8C.

It may be helpful to consider the outer portion of a swept back wing to be a 'flattened' winglet, as the effects of the two are essentially identical.

Winglets, and swept wings with washout, can take advantage of the rotated R_1 because the angle of attack of the airfoil section can be held constant. The induced thrust which is produced may not seem like much of a force, but consider that if a wing section has an *L/D* of 20:1, R_1 must rotate forward of the vertical just 2.86 degrees in order for that part to get a 'free ride.' If R_1 can be rotated forward beyond 2.86 degrees, that portion of the wing is actually producing thrust. And as the *L/D* increases, the required angle of rotation gets smaller. See Figure 9 and Table 1.

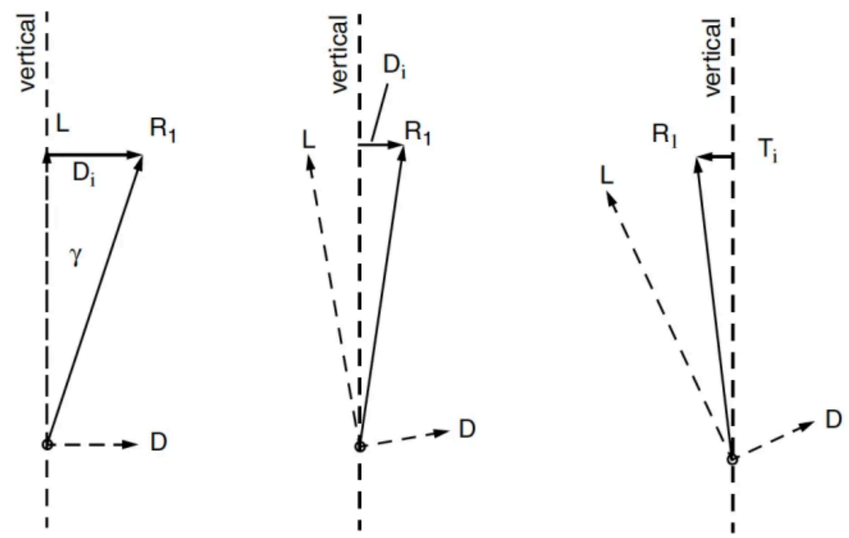


Figure 9. Force vectors demonstrating reduction of induced drag, D_i, and development of induced thrust, T_i, by rotation of lift and drag resultant, R_1.

Table 1: L/D and required rotation of R_1 for $D_i = 0$

L/D	γ, $R_1 \angle$vertical
10:1	5.71 degrees
20:1	2.86 degrees
30:1	1.91 degrees
40:1	1.43 degrees

Induced Thrust and Aileron Deflection

And now the part you've been waiting for — take a look at Figure 10. This illustration is of the outer segment of a twisted swept back wing with aileron installed.

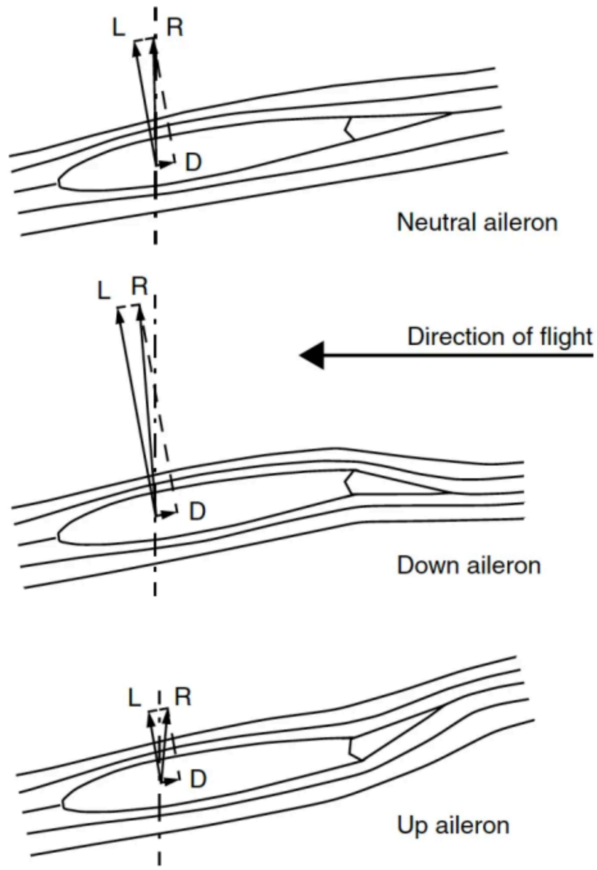


Figure 10. Generalized representation of the direction and strength of forces when the outboard aileron of a twisted swept wing is deflected.

When the aileron is in neutral position, the resultant vector is directly over the projected yaw axis.

When the aileron is deflected downward, the lift is increased substantially. The resultant is rotated forward of the axis. This induced thrust actually pushes the wing forward.

When the aileron is deflected upward, the lift vector decreases in magnitude, reducing the induced thrust. (If the aileron deflection is large enough, the lift vector changes direction.) The resultant of the lift and drag vectors rotates behind the axis, pulling the wing backward.

In an aileron induced turn, adverse yaw in a swept wing planform can be reduced or eliminated entirely by means of manipulating the lift and drag vectors of the outer portion of the wing through appropriate wing twist.

When the wing tips are lifting downward, aileron deflection acts to reduce adverse yaw. This case can be envisioned by inverting the vector diagram for a (normal) upward lifting wing. We've done the inverting and placed the results in Figure 11.

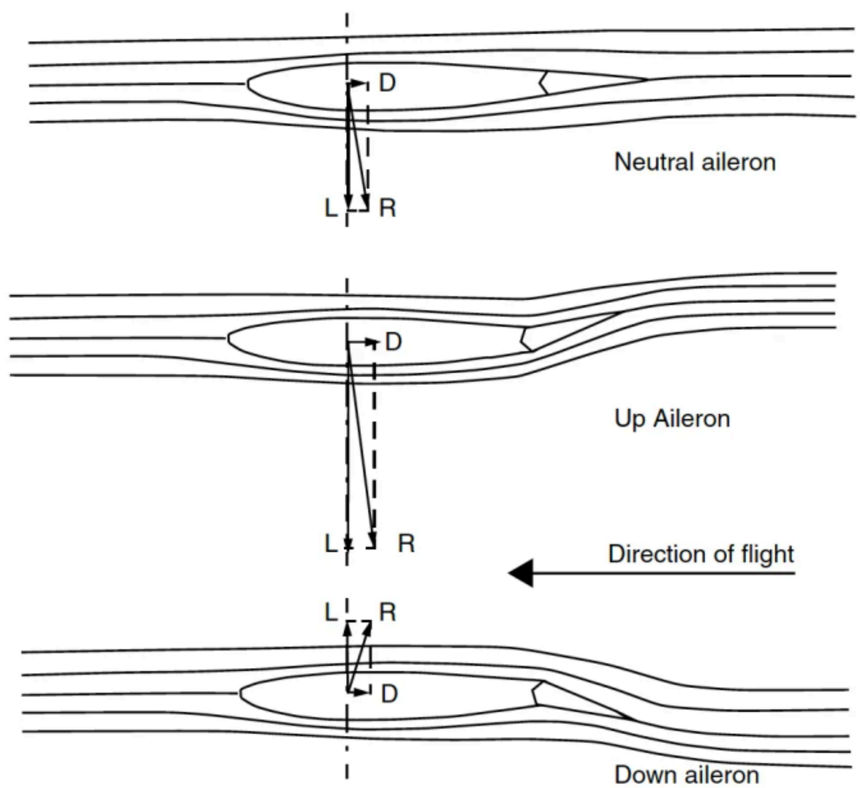


Figure 11. Generalized representation of the direction and strength of forces when the outboard aileron of a downward lifting wing segment is

Reducing Adverse Yaw

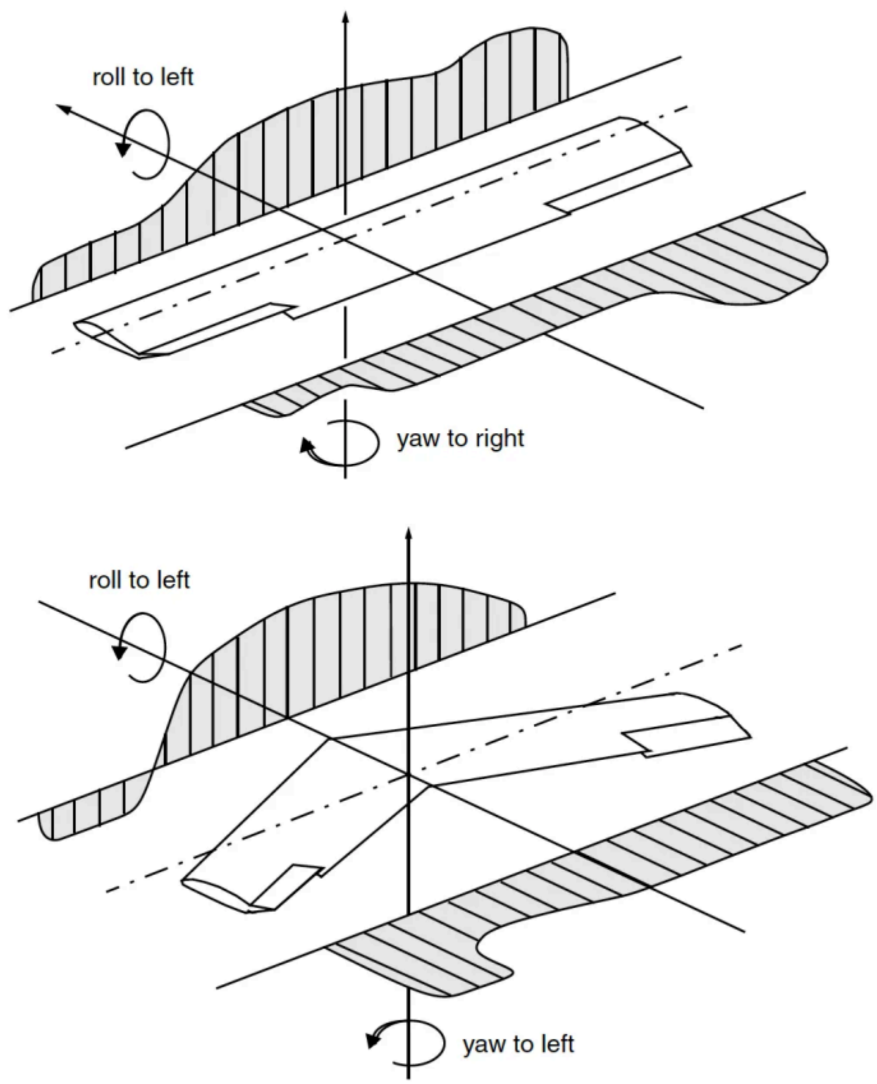


Figure 12. Lift and drag profiles for an untwisted rectangular wing with aileron deflection for left bank, no differential (upper), and for a twisted swept wing with washout, no differential (lower).

Figure 12 examines the case of the unswept wing with an elliptical lift distribution with aileron deflection for a left turn. (This diagram is a reprint of Figure 5 from Part 1.) The aileron deflection increases the drag of the wing semi-span having the downward deflected aileron and decreases the drag of the wing semi-span having the aileron deflected upward. This causes a roll to the left and a yaw to the right. This adverse yaw requires a compensating rudder deflection. Figure 12 also examines the case of the swept wing which utilizes a lift distribution which is not elliptical but which does allow for coordinated turns by eliminating adverse yaw through induced thrust. The wing semi-span with the upward deflected aileron generates more drag than the wing semi-span with the downward deflected aileron. The wing rolls and yaws to the left. In this case no compensating rudder deflection is required.

Swept wings without a vertical surface, like many of the Horten designs, can use wing twist in conjunction with sweep to produce coordinated turns, particularly at low speed (high C_l), as when thermalling. There may be some disadvantages to this methodology when flying at high speed (low C_l), but the detrimental effects can be controlled by careful design of the ailerons, including their location, size, and deflection angles.

What's Next?

The next installment will devote some space to the relationships between aileron configurations, wing lift distributions, and adverse and proverse yaw. And now that we have a method of reducing or eliminating adverse yaw, we can back up a bit and take a look at what wing sweep, increased upwash and wing twist can do for the first of those three points we keep mentioning, our quest to reduce induced drag.

References

1. Bowers, Al. Correspondence within <www.nurflugel.com> e-mail list, early 2002.
2. Gale, Ferdinando. Tailless Tale. B2Streamlines, Olalla Washington USA, 1991.
3. Gullberg, Jan. Mathematics: from the birth of numbers. W.W. Norton & Co., New York, 1997.
4. Hoerner, Dr.-Ing. S.F. and H.V. Borst. Fluid-dynamic Lift. Hoerner Fluid Dynamics, Vancouver Washington USA, 1985.
5. Horten, Dr. Reimar. Lift distribution on flying wing aircraft. Soaring June 1981, pp. 40–42.
6. Jones, Bradley. Elements of Practical Aerodynamics, third edition. John Wiley & Sons, New York, 1942.
7. Jones, Robert T. Wing Theory. Princeton University Press, Princeton New Jersey USA, 1990.
8. Kermode, A.C. Mechanics of Flight. Pitman, London, 1980.
9. Masters, Norm. Correspondence within <www.nurflugel.com> e-mail list, early 2002.
10. McCormick, Barnes W. Aerodynamics, Aeronautics, and Flight Mechanics. John Wiley and Sons, New York, 1979.
11. Nickel, Karl, and Michael Wohlfahrt. Tailless Aircraft in Theory and Practice. American Institute of Aerodynamics and Astronautics, Washington D.C., 1994.
12. Shevell, Richard S. Fundamentals of Flight. Prentice-Hall, Englewood Cliffs New Jersey USA, 1983.
13. Simons, Martin. Model Aircraft Aerodynamics. Argus Books, Hemel Hempstead Great Britain, 1994.
14. Smith, H.C. "Skip." The Illustrated Guide to Aerodynamics, second edition. TAB Books, Blue Ridge Summit Pennsylvania USA, 1992.
15. The White Sheet, Spring 1986, No. 36. Sean Walbank editor. White Sheet Radio Flying Club, Dorset/Somerset Great Britain.

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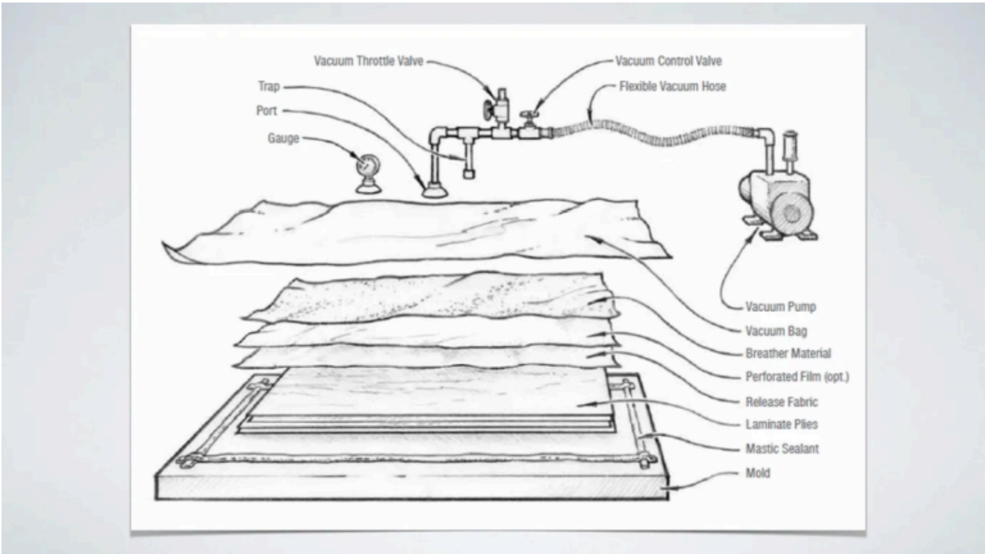
Vacuum Bagging Basics



A typical vacuum bagging setup.

A primer for those just starting out on their composite construction journey.

We are delighted to present the second in our series of selected articles from Gougeon Brothers, Inc. excellent in-house publication Epoxyworks*. See* Resources *for how you, too, can become a subscriber which is what we are and highly recommend. Many thanks to Logan Gougeon for her tireless support of this initiative. — Ed.*

What Is Vacuum Bagging?

Vacuum bagging is when a composite that is laid up and wet out by hand is then put under vacuum to compact the laminate and force out excess epoxy. Vacuum bagging has been a choice method of manufacturing and repairing composites for a long time.

Why Vacuum Bag a Laminate?

The process of vacuum bagging allows for the ease of hand lamination while producing a part that has better properties because of its compaction. Vacuum bagging a laminate removes air voids and increases the fiber-to-epoxy ratio. All in all, it is a great process to improve your composite laminate.

What Materials Do I Need for Vacuum Bagging and How Do I Use Them?

Let's dive deeper into what materials are used in vacuum bagging and how to use those materials to achieve a great composite part. The materials and how to use them will be described in the order they should be put down on the mold or laminate.

Sealant Tape

Lay down a layer of sealant tape around the perimeter of the part, leaving some space between it and the laminate. The area where the tape is put down should be clean and free of epoxy residue and stray fibers. Sealant tape is also commonly referred to as tacky tape or mastic sealant.

Release Fabric

Release fabric should be laid directly on top of the wet laminate. Release fabric leaves a textured finish when it is removed, reducing the need for surface prep before secondary bonding.

Release fabric is commonly referred to as peel ply. The most common types of peel ply are made out of nylon or polyester fibers. Some peel ply is coated with release agents.

Release Film

Perforated release film is a thin plastic with small holes that control how the excess epoxy moves from the part to the breather fabric. This is an optional layer in the vacuum bagging process.

Breather Fabric

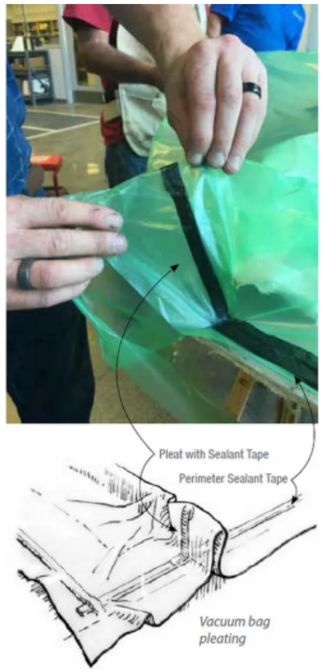
The function of the breather fabric is really two-fold. As vacuum pressure consolidates the laminate, the squeezed-out epoxy goes through the peel ply (and the release film if you are using it) and is absorbed by the breather fabric. Because of its open structure, air flows easily through breather fabric allowing the air to be evacuated from the consolidated laminate. Breather fabric is also referred to as baby blanket.

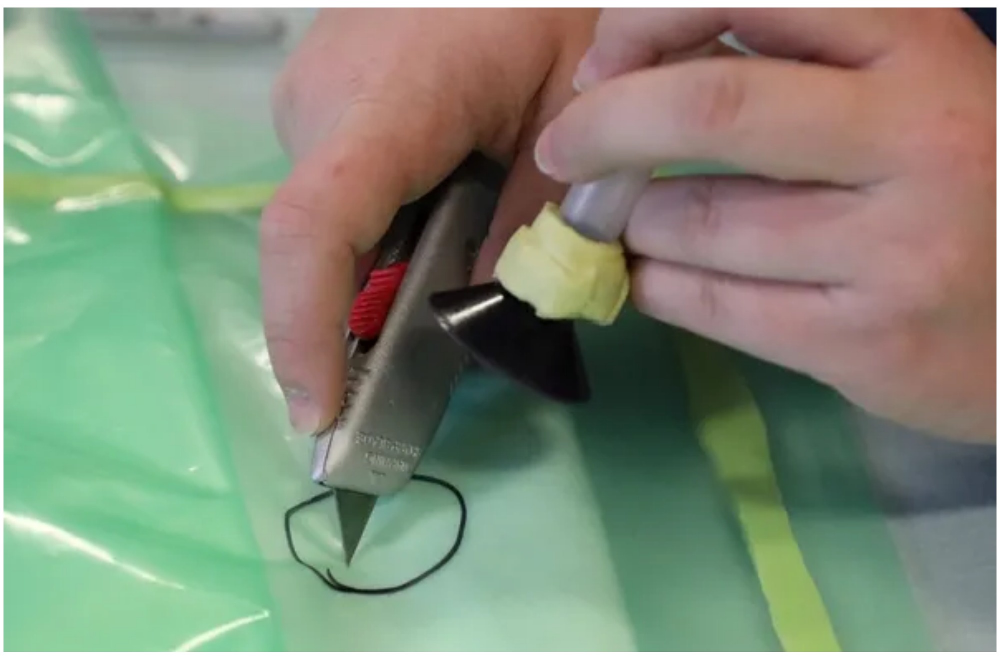
Pleating the Vacuum Bagging Film

Where there is a corner or bend in the part, put a pleat in the bag. This is a fold that sticks up and allows the vacuum bag to move and conform nicely to the part under vacuum.

Without pleats, you may get bridging or cause a tear in the bag. Bridging occurs when the bag does not fold down completely on an edge and makes the edge more rounded (it will look like a filleted edge). This fillet area will not be compressed by the vacuum pressure. If there is no pleat on a corner, it may poke a hole through the bag and cause it to rip depending on how much force is on that spot.

When laying down the bag on your laminate you will also have to take into consideration where to position your vacuum port on the bag. The hole for the vacuum port should be small and easy to seal well so no air will leak into the assembly.





Left: The fundamentals of pleating vacuum bagging film (click for larger image). | Right: Fitting the vacuum port.

Vacuum Port

The vacuum port is a fitting used as the transition point between the materials under the bag and the vacuum line.

Vacuum Bag

The vacuum bag is a plastic film sealed to the mold so a vacuum can be pulled. This layer will need to be cut oversized to accommodate for curvature in the part.

Vacuum Line

Vacuum line is an airtight flexible hose that connects the vacuum port to the vacuum. Other types of wire-reinforced hose may work, but they should be rated for crush resistance or tested under vacuum for the length of the expected cure time. Semi-rigid plastic tubing with adequate wall thickness can be used for a plumbing system, but it is often awkward to handle. If the laminate is to be cured at an elevated temperature during vacuum bagging, the tubing must also be heat resistant. Plastic tubing that withstands vacuum at room temperature may soften and collapse when heated. Rigid plastic elbows and Ts can be used for changes in direction in the vacuum line to prevent collapsing the line. Vacuum line is also commonly referred to as vacuum hose.

Vacuum Gauge

The vacuum gauge shows how much vacuum you have pulled on the part. Vacuum-bagged parts should have at least 10" of Hg of pressure acting on them to properly consolidate the part. The vacuum gauge gets added to the assembly the same way the vacuum port does.

The WEST SYSTEM Vacuum Bagging Kit (see Resources).

Vacuum Source Options

The purpose of a vacuum source is pretty self-explanatory, however, there are many different types of vacuums. Vacuum pump types include reciprocating piston, rotary vane, turbine, diaphragm, and Venturi. They may be of a positive or non-positive displacement type.

Positive displacement vacuum pumps may be oil-lubricated or oil-less. Oil-lubricated pumps can run at higher vacuum pressures, are more efficient and last longer than oil-less pumps. Oil-less pumps, however, are cleaner, require less monitoring and maintenance, and easily generate vacuums in a range useful for vacuum bagging.

Of the several types of positive displacement vacuum pumps useful for vacuum bagging, the reciprocating piston type and the rotary vane type are most common. Piston pumps are able to generate higher vacuums than rotary vane pumps, accompanied by higher noise levels and vibration. Rotary vane pumps may generate lower vacuums than piston pumps, but they offer several advantages. While their vacuum ratings are more than adequate for most vacuum bagging, they are able to move more air for a given vacuum rating. In other words, they can remove air from the system faster and tolerate more leaks in the system while maintaining a useful vacuum level. In addition, rotary vane pumps are generally more compact, run more smoothly, require less power, and cost less.

Non-positive displacement vacuum pumps have high CFM (cubic feet per minute) ratings, but generally at vacuum levels too low for most vacuum bagging. A vacuum cleaner is an example of a non-positive displacement or turbine type pump.

Air-operated vacuum generators are simple, low-cost Venturi devices that generate a vacuum using air pressure supplied by a standard air compressor. Their portability, relatively low cost and the accessibility of compressors in many shops and homes make Venturi generators ideal for smaller vacuum bagging projects.

Single-stage generators have a high vacuum rating, but move a low volume of air, limiting the size of the vacuum bagging operation. Larger two-stage pumps are comparable to mechanical pumps for most vacuum bagging operations, but require a proportionately larger compressor to run them.

Whichever vacuum generator you choose, it must hold a continuous vacuum until the epoxy reaches an effective cure. This may take 8 to 24 hours depending on the hardener selected and ambient temperature. After all the materials are in place, turn on the vacuum source and allow vacuum to be continually pulled until the epoxy has cured.

Resources

- *Epoxyworks* — The excellent quarterly magazine published by Gougeon Brothers, Inc. of Bay City, Michigan which produces the WEST SYSTEM® and PRO-SET® lines of epoxies. You can sign up for your own free subscription with this link.

- *Vacuum Bagging Basics* — This article as it originally appeared in *Epoxyworks* magazine.
- *Vacuum Bagging Kit* — "A complete starter vacuum bagging kit for room temperature repairs and small laminating projects up to 13 sq ft…"
- *WEST SYSTEM® and PRO-SET®* — While these likely need no introduction to our readers, these are "marine-grade epoxies used around the world in the commercial, marine, aerospace and industrial composite markets."

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Condor Corner

"Above the clouds." (credit: Condor)

Three generations of pilots channelling flight experience through simulator training.

The third of this series to appear in the New RC Soaring Digest*. The original version of this article first appeared in the April 2022 issue of* Soaring *magazine. — Ed.*

In the introductory article for this series, I invited SSA members, clubs, and commercial operations to contribute to the series by submitting narratives of their positive experiences using glider flight simulation. Later that month I was contacted by Jason Leonard, a professional pilot, CFIG, DG-505 owner and member of Treasure Coast Soaring Club in Vero Beach, Florida. Jason wrote to offer me help developing videos, similar to one he had posted to YouTube showing his two young sons 'flying' in *Condor*. Before interviewing Jason, I expected the focus of the article would be on how he was using *Condor* to inspire his kids. As it turned out, there was much more to his story.

It was 1992 and Robert (Bob) Leonard, a professional pilot for American Airlines, was undergoing the recurrent training required by the FAA for all Part 121 and 135 flight operations. With the airline industry having figured out long before that simulation-based flight training produced better results, in less time, and at considerably less expense than using real aircraft, Captain Leonard's recurrent training would be conducted entirely in simulation. On this particular trip, the captain had also arranged to have his eight-year-old son Jason tag along, and as luck would have it, the senior Leonard finished his training early, leaving open some scheduled time on the simulator. And so it was that young Jason Leonard found himself at the controls of his first flight simulator, an American Airlines MD-11 Level D simulator no less, flying the Checkerboard Hill approach into Hong Kong's Kai Tak airport.

Apparently, the experience made quite an impression on the youngster. For the next year, while other kids his age were playing video games, Jason could reliably be found in his room mastering Microsoft Flight Simulator using only his computer keyboard.

Impressed with his son's continued interest in flight, Jason's dad arranged for a half-hour introductory flight in an actual airplane after which he made his son the following offer: "if you continue to improve your performance in school, I'll continue providing you with flight training." Shortly after his 16th birthday, Jason Leonard was a private pilot.

After high school, Jason headed off to Flight Safety International (FSI) to pursue a career in aviation, earning commercial, instrument and initial instructor privileges in single and multi-engine airplanes. FSI's extensive use of Frasca simulators & procedural training devices further expanded Jason's experience with and appreciation for the benefits of simulation-based training.

Having graduated from FSI, and while instructing for his father-in-law's flight school, Jason added ATP, CFII, MEI and a Learjet type rating to his list of credentials. The Lear type rating led to a job flying air ambulance, and while initially exciting and challenging, seven-days-a-week on-call at all hours of the day and night started to wear thin. Jason eventually signed on with a regional airline and now flies for Spirit Airlines based out of Fort Lauderdale, Florida. With air ambulance operating under FAR Part 135 and Spirit operating under Part 121, this narrative begins to circle back to its beginning: Jason Leonard following in his father's footsteps with all his professional recurrent training taking place in simulators.

Then COVID-19 arrived. With his airline's fleet grounded and his career on hold, Jason had a need to scratch his flying itch. He started working on a glider rating at the Treasure Coast Soaring Club. Having come from the world of powered flight, he initially struggled both with the idea of flying without an engine and with wrapping his head around the glide performance of these aircraft. He knew the key to working through these issues would be extensive flight experience, but as a busy father of four young kids, time and money were at a premium. Fortunately, at this point in his life, he knew exactly how to meet those criteria.

After a few online searches, Jason found the *Soaring Forum Group* on Facebook and asked about the existence of a soaring simulator. Information and recommendations on *Condor* came flooding back, and after acquiring the software, he spent hours in simulated flight building confidence in his ability to control these beautiful and amazing machines. In addition to earning his glider category add-on rating, Jason was able to renew all his accidentally lapsed instructor ratings by also passing a check ride for CFIG.

Today when he's not out flying routes for Spirit, Jason is home leveraging his extensive instructional and flight simulation experience to entertain, educate, and inspire a third generation of Leonard aviators. I encourage you to take look at *The Benefits of Simulator Soaring* which I have linked in *Resources* below.

Left: Carter Leonard in ground effect on initial aerotow. | Right: Greyson Leonard rocking a thermal.

It shows Jason's nine-year-old son Greyson intentionally entering and recovering from spins in a *Duo Discus* and Jason coaching his 11-year-old son Carter through working a thermal and flying a traffic pattern to a landing, all from the comfort and safety of their home.

Next Month

In the next article in this series I'll be writing about the Soaring Safety Foundation's annual report and the role simulation can play in making the sport safer.

Thanks for reading! In the interim, please leave any questions you may have in the *Responses* section below — you get there by clicking the little 💬 .

Resources

- *Checkerboard Hill Approach into Hong Kong's Kai Tak Airport* — A pre-configured Google search which will provide access to a ton of eye-popping videos of this classic aviation challenge.
- *The Benefits of Simulator Soaring* on YouTube. — "leveraging his extensive instructional and flight simulation experience to entertain, educate, and inspire a third generation of Leonard aviators…"
- *Soaring Forum Group* on Facebook. — "forum for soaring related topics…"
- *Treasure Coast Soaring Club* based at Vero Beach, Florida. — "a 501(c)(3) non-profit organization with the goal of promoting the sport and art of soaring to anyone interested in learning to fly sailplanes…"
- *Condor Corner* in the New RC Soaring Digest. — The complete set of articles as they have appeared in this publication.
- *Simulation-based Glider Flight Education*, the author's website. — "to provide you with the information and resources you need to self-manage the flight training and aeronautical knowledge development required to qualify for a Private Pilot Certificate with a Glider Category…"
- *Condor* — "simulates the complete gliding experience on your computer. With it you can learn to fly gliders and progress up to a high level of competition skill. The core of the simulator is the state of the art physics model and advanced weather model aimed at soaring flight."
- *Soaring Magazine*, the official publication of the Soaring Society of America. — "each issue brings you the latest developments on safety issues, delightful accounts of individual soaring accomplishments, a sharing of ideas and experiences, tips from the great soaring pilots of our times, and…"

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Soaring the Sky Podcast

E108: A Soaring Fix from the Gliding Junkie

Our eleventh and penultimate instalment of this ongoing series where we select and present episodes from Chuck Fulton's highly regarded soaring podcast. See Resources*, below, for links where you can find* Soaring the Sky*, or simply click the green play button below to start listening. — Ed.*

On this episode we bring you a guest host and a guest pilot! Barbora Moravcová, AKA *The Gliding Junkie* on Instagram is a member of the Czech National Gliding Team, flight instructor and comes from a family of aviators with both her parents being pilots. Any free time she has you will find her in the cockpit of her *LS8*. Barbora chats with our producer Mitch about her recent adventures flying at Wave Camp and other interesting flights she has had.

We will also bring you a fun new segment where we chat with our guest pilot about some crazy scary soaring YouTube videos and what we can learn from them. So join us now and get your soaring fix with *The Gliding Junkie*.

Crazy Scary Soaring YouTube Videos

- ***Unexpected Outlanding at the Vilnius Cup*** — "Now, after some time it is really hard to watch some of my own videos … [h]ow fast situation can change dramatically…"
- ***Glider Outlanding in an Alpine Valley*** — "At that day I was flying SZD–48M 'Brawo' … taking part in Austrian Junior Gliding Championships in Kapfenberg. It was my first time there…"
- ***A Glider Stall at the Ridge*** — "In this video you can see how my glider stall, maybe for a strong sink or a change in tailwind. You notice it by the light vibrations of the camera and the aircraft's roll…"

Resources

- ***The Gliding Junkie*** on Instagram.— "I am Barbora Moravcová, glider pilot and Czech Gliding National Team member, representing my country in this beautiful and demanding sport…"
- ***Soaring the Sky*** — "an aviation podcast all about the adventures of flying sailplanes. Join host Chuck Fulton as he talks with other aviators around the globe". You can also find Chuck's podcast on Instagram, Facebook and Twitter

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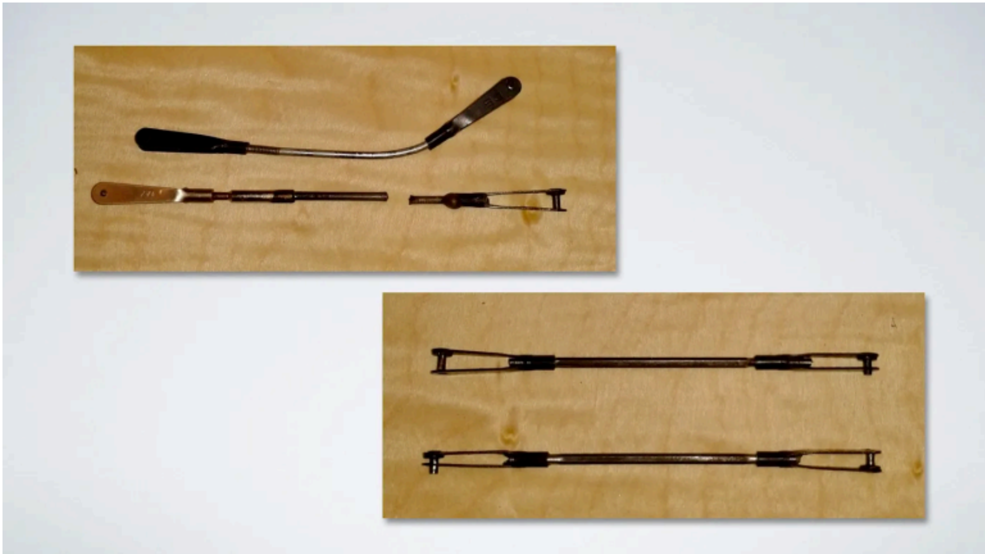
And we have some spectacular news to round things out this month: rather than mourning the upcoming 12th and final episode under the terms of our current relationship with Chuck and Soaring the Sky *— due to overwhelming demand — we're proud and thrilled to announce we've* ***renewed for another year!*** *The* Soaring the Sky Podcast *in the New RC Soaring Digest lives on! We'd like to take this opportunity to thank Chuck and we look forward to another year of working together.*

*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**.*

Super Strong Clevis Rods

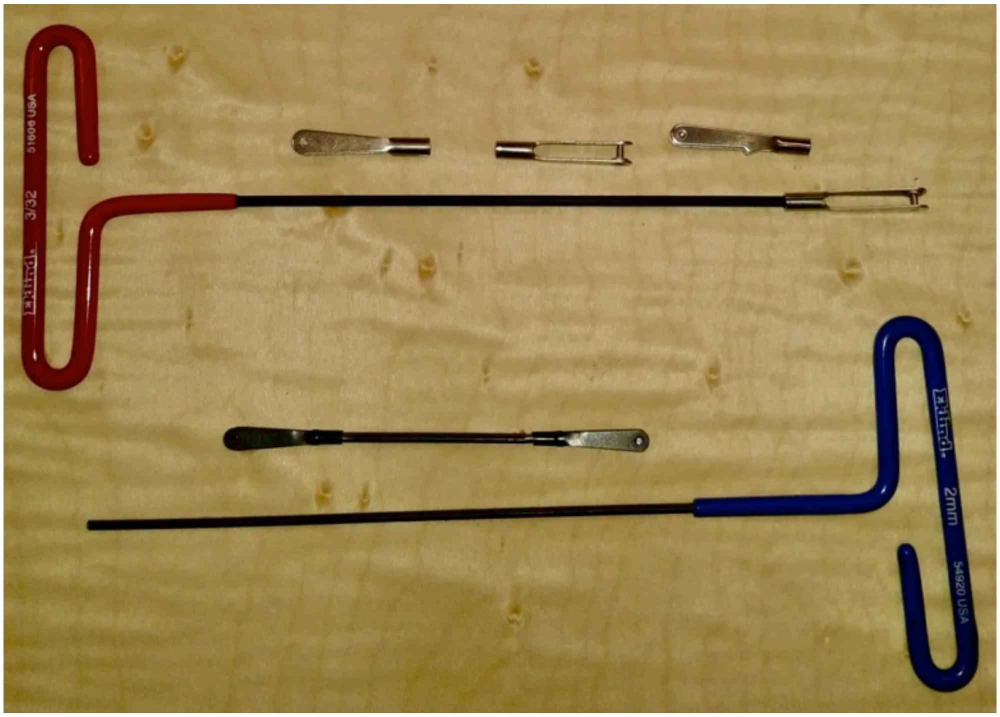


Prevent the former by adopting the latter.

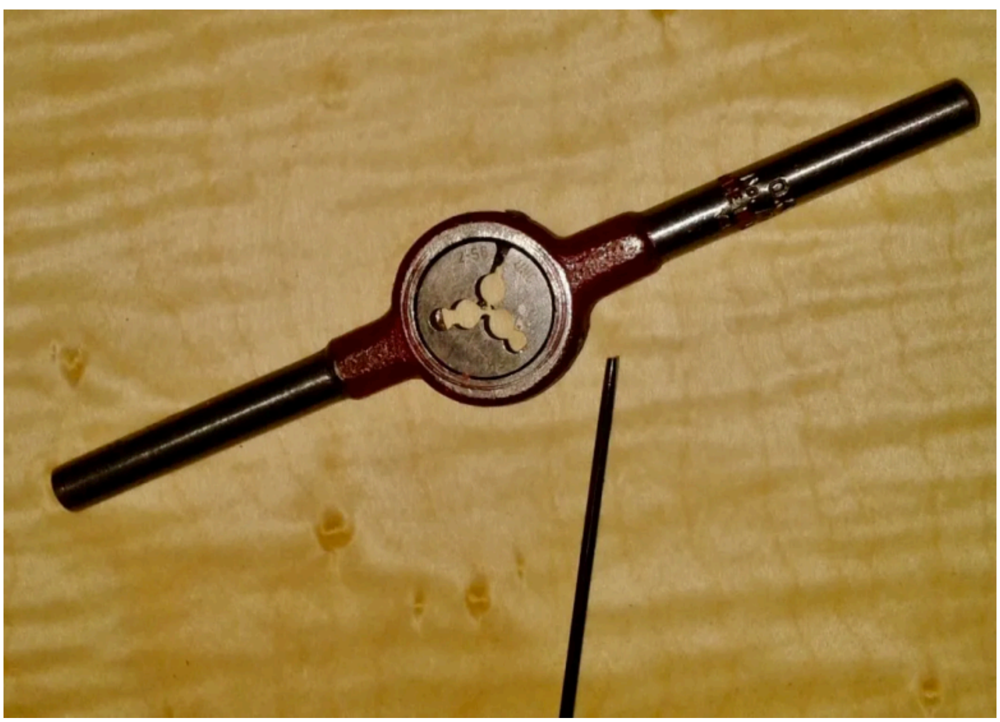
Don’t let them be the weakest link

I was having trouble with the clevis rods for my flaps bending or breaking on landing. I tried carbon rods and they broke. I tried the regular 2–56 rods and they bent. So…

I looked around the shop for something strong enough to do the job. I looked for some drill rods, but didn’t have anything small enough. I had some extra hex wrenches and realized they were strong enough not to bend or break and I could cut them to size and thread them — which I couldn’t do withdrill rod.



I found that 3/32" works for 4–40 clevises. You can thread or glue them on — they doen't solder very well. The 2mm works for my 2–56 clevises. The 2mm I got for $2 at ACE and was 10" long, so I got the two rods I needed and still have a useable tool.



I sanded the end down a bit to get the die started. It threaded just fine. And there you have it. These are in my *Royale* and are holding up great.

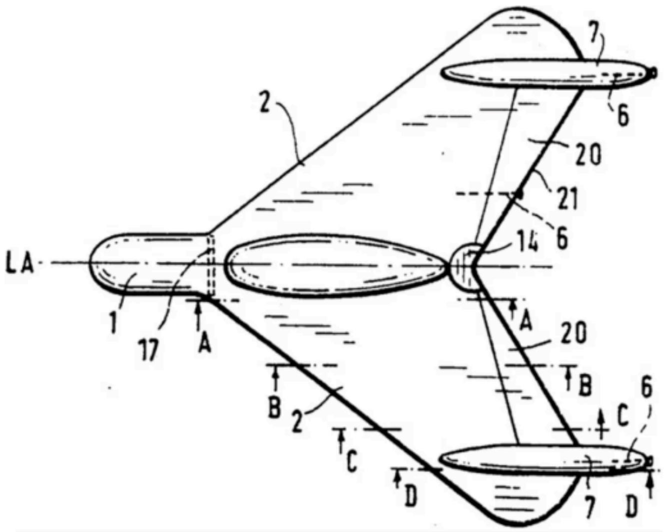
Thanks for reading, best of luck with your projects and if there is a a particular tip you would like to see consider leaving a comment in the *Responses* section. You'll find it if you click the little 💬 below.

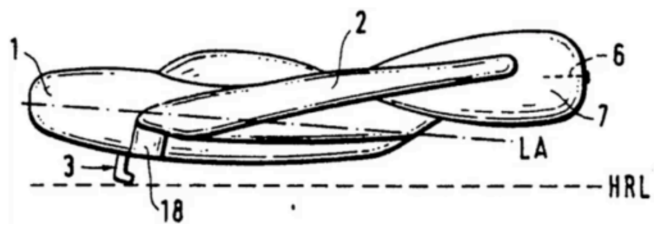
Resources

- *Tom's Tips* — The complete compendium as presented on the pages of the New RC Soaring Digest.

*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**.*

Glider Patents





US 5026313 A: Model Airplane

This is the tenth in our series of glider-related selections from the files of the US Patent and Trademark Office *(see* Resources, *below). They are presented purely for the interest and entertainment of our readers. They are not edited in any way, other than to intersperse the drawings throughout the text. Disclaimers: a) Inclusion of a given patent in this series does not constitute an expression of any opinion about the patent itself. b) This document has no legal standing whatsoever; for that, please refer to the original document on the USPTO website. — Ed*

United States Patent [19]
Meyer

[11] **Patent Number:** **5,026,313**
[45] **Date of Patent:** **Jun. 25, 1991**

[54] **MODEL AIRPLANE**

[76] Inventor: **Brunhilde Meyer,** Gerhart-Hauptmann-Weg 8, 5068 Odenthal-Gloebusch, Fed. Rep. of Germany

[21] Appl. No.: **374,914**

[22] Filed: **Jun. 29, 1989**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 142,719, Jan. 11, 1988, abandoned.

[51] **Int. Cl.**[5] **A63H 27/14**; A63H 27/00
[52] **U.S. Cl.** **446/64**; 446/66
[58] **Field of Search** 446/34, 61, 62, 63, 446/64, 65, 66, 67, 68

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,275,094	3/1942	Taylor	446/66
2,373,957	4/1945	Hornberger	446/63
2,539,357	1/1951	Wald	446/34 X
2,664,666	1/1954	Walker	446/61
3,063,191	11/1962	Main	446/61
3,246,425	4/1966	Miller	446/66 X
3,264,777	8/1966	McCreary, Jr.	446/66 X
3,902,271	9/1975	Turoff et al.	446/65
4,064,647	12/1977	Lemelson	446/65
4,388,777	6/1983	Hermann et al.	446/61
4,836,817	6/1989	Corbin	446/63 X

FOREIGN PATENT DOCUMENTS

2374929	7/1978	France	446/64
483018	4/1938	United Kingdom	446/63
575750	4/1946	United Kingdom	446/64
2104788	3/1983	United Kingdom	446/34

Primary Examiner—Robert A. Hafer
Assistant Examiner—D. Neal Muir
Attorney, Agent, or Firm—Michael J. Striker

Abstract

A model airplane of the glider or sailplane type made of foamed plastics, comprising rigid stabilizing surfaces and wings and having the bottom side of the fuselage provided with a catapulting hook disposed in the vicinity of the center of gravity in a vertical plane extending through the longitudinal axis of the fuselage, and a sweptback wing profile with a large sweepback and decreasing in thickness and depth from the wing root at the fuselage to the tips of the wing, the connecting lines between the outermost points of the profile sections of the wings having an angle of wing setting .alpha. which increases, with regard to the longitudinal axis LA of the fuselage from wing roots to wing tips.

Background of the Invention

(2) The invention relates to a model airplane of the glider or sailplane type made of foamed plastics, comprising rigid stabilizing surfaces and wings and having the bottom side of the fuselage provided with a hook disposed in the vicinity of the center of gravity in a vertical plane

extending through the longitudinal axis of the fuselage, which hook is adapted for engaging an elastic band of the catapult.

(3) Model planes are known to be more or less faithful reproductions of original or an altered scale — mostly of a scaled-down size — of very light materials (French Patent 2,374,929, German Utility Model 7,822,235, U.S. Pat. No. 4,512,690) or to be more or less imaginative aeroplane-like bodies (U.S. Pat. No. 3,619,937, U.S. Pat. No. 4,512,690) of optionally selectable materials.

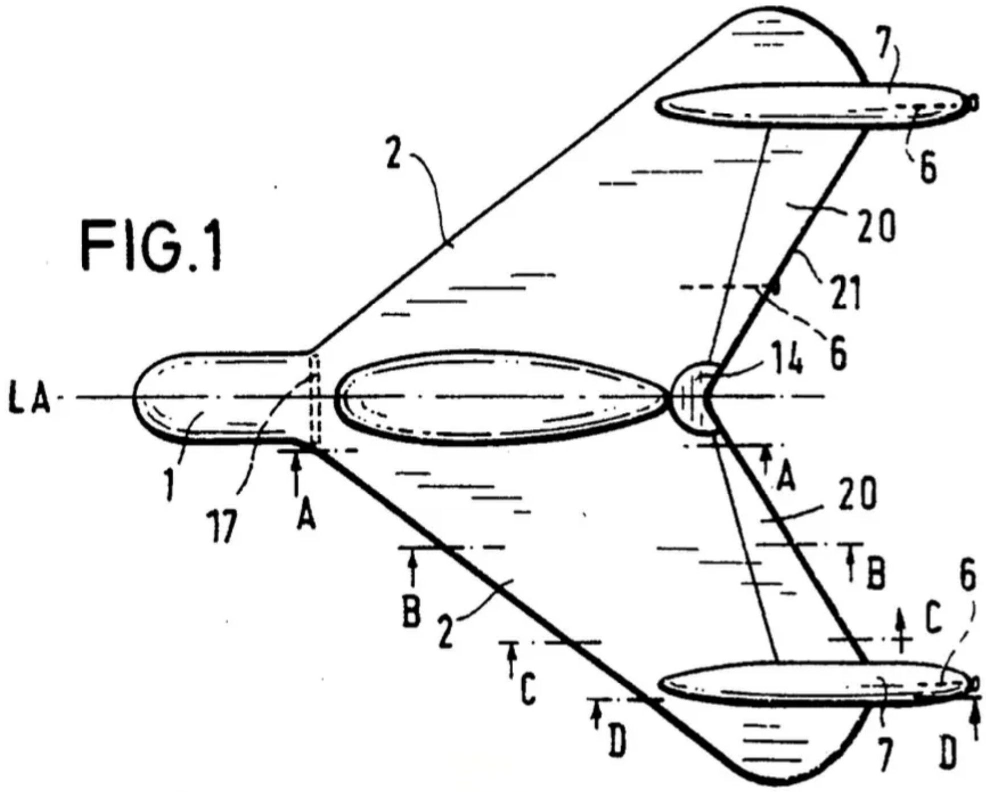
(4) In the case of air-worthy objects, the construction has to be stable in flight. The flight stability is achieved by the outer shape of the object. There also is a possibility of a limited control of the airplane by providing a construction stable in flight. Thus, one can also achieve certain aerobatic figures, in most cases, however, given a rather low technical expenditure, only during descent.

(5) Climbing flights and aerobatic figures are mostly only possible at a rather high technical expenditure either as glider tugs or by providing the airplane with a remote-controlled engine. Such model airplanes are rather expensive and require a large free area of movement without any flight obstacles. Remote-controlled model airplanes can return to the launching site, but they may also get lost in adverse weather conditions, errors in operation or due to malfunctions, resulting in corresponding financial losses. Besides, motorized model airplanes generate disturbing noise and often must not be operated in residential areas or be operated only in zones open for such purposes.

(6) Gliders for flinging or catapulting are known that are made by extrusion of very light and comparatively cheap materials, e.g. polyurethane (French Patent 2,374,929). Such model airplanes can be fit for flying without requiring much time-consuming assembling, but they cannot fly loopings safely. Due to an often unstable straight descent, they often have to be fetched from remote locations or get lost, e.g. in impassable terrains, high tree tops, in closed land areas or nearby bodies of water. In some cases, they also present a danger to

the user, other players or persons not involved in the game, if the flinging or catapulting operation is maladroitly performed, or if the flight path is adversely influenced by winds.

FIG.1



Summary of the Invention

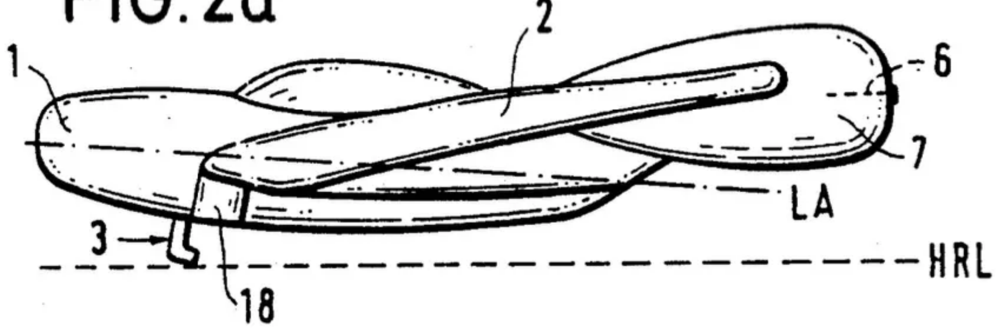
(8) It is an object of the invention to provide a model airplane of the above kind that can safely perform aerobatic figures like circles and loopings with high precision and reproducibility, and which is cheap in production.

(9) The object of the invention is achieved by providing a model airplane of the glider or sailplane type, comprising rigid stabilizing surfaces and wings and having the bottom side of the fuselage provided with a catapulting hook disposed in the vicinity of the center of gravity in a vertical plane extending through the longitudinal axis of the fuselage, in which model airplane the sweepback profile with a large sweepback of the wings decreases in thickness and depth from the wing root at the fuselage to the wing tips, the connecting line A — A, B — B, C — C, D — D between the outermost points of the profile

sections of the wings showing an angle of wing setting α, the inclination of which, with regard to the longitudinal axis LA of the fuselage, increases towards the bottom side of the fuselage in the direction of flight.

(10) This special three-dimensional profiling of the wings, namely an angle of wing setting and a profile section varying over the wing span, allows a safe performance of loopings around a horizontal axis and/or of circles around a vertical axis, in which the plane of the wings is almost vertical. Launching the model airplane can be performed with a catapulting hook, variably fixable at the bottom side of the fuselage in the vertical central longitudinal plane, in connection with a catapult, circles and loopings of different diameters d being possible. The particular aerodynamic properties of the airplane of the present invention guarantee an invariable return of the airplane to the plane's launching site.

FIG. 2a



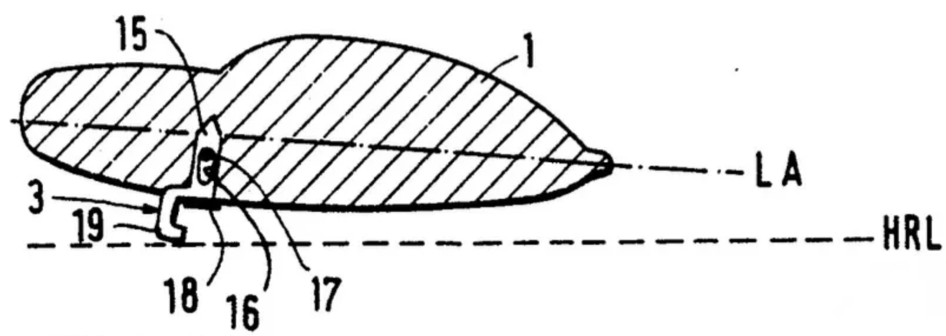


FIG. 2b

(10) This special three-dimensional profiling of the wings, namely an angle of wing setting and a profile section varying over the wing span, allows a safe performance of loopings around a horizontal axis and/or of circles around a vertical axis, in which the plane of the

wings is almost vertical. Launching the model airplane can be performed with a catapulting hook, variably fixable at the bottom side of the fuselage in the vertical central longitudinal plane, in connection with a catapult, circles and loopings of different diameters d being possible. The particular aerodynamic properties of the airplane of the present invention guarantee an invariable return of the airplane to the plane's launching site.

(11) The model airplane of the present invention is a glider or a sailplane which, as a boomerang-plane, is capable of performing aerobatic figures like circles or loopings of various and relatively small diameters. The high precision and the reproducibility of the flight performance excludes both, a loss of the airplane and a danger to people, given an adequate operation of the model airplane.

(12) The model airplane of the present invention is made of foamed plastics and maintains a high dimensional stability even after a great number of flights. The model airplane remains undamaged even when colliding with posts, trees or buildings, and even after the accompanying crashes. As an unmotorized catapult glider, such a model airplane avoids environmental pollution, is as inexpensive as can be and allows studying of the laws of fluid dynamics and aerodynamics at very low operating costs.

(13) It is an essential feature of the model airplane of the present invention that the airplane safely returns to the launching site, performing, if aptly handled, complex aerobatic figures like complex homings that is specific complicated flights to particular targets without requiring much space, if necessary even in closed rooms.

(14) The present invention both as to its construction so to its mode of operation, together with additional objects and advantages thereof, will be best understood from the following description of the preferred embodiments with reference to the accompanying drawings.

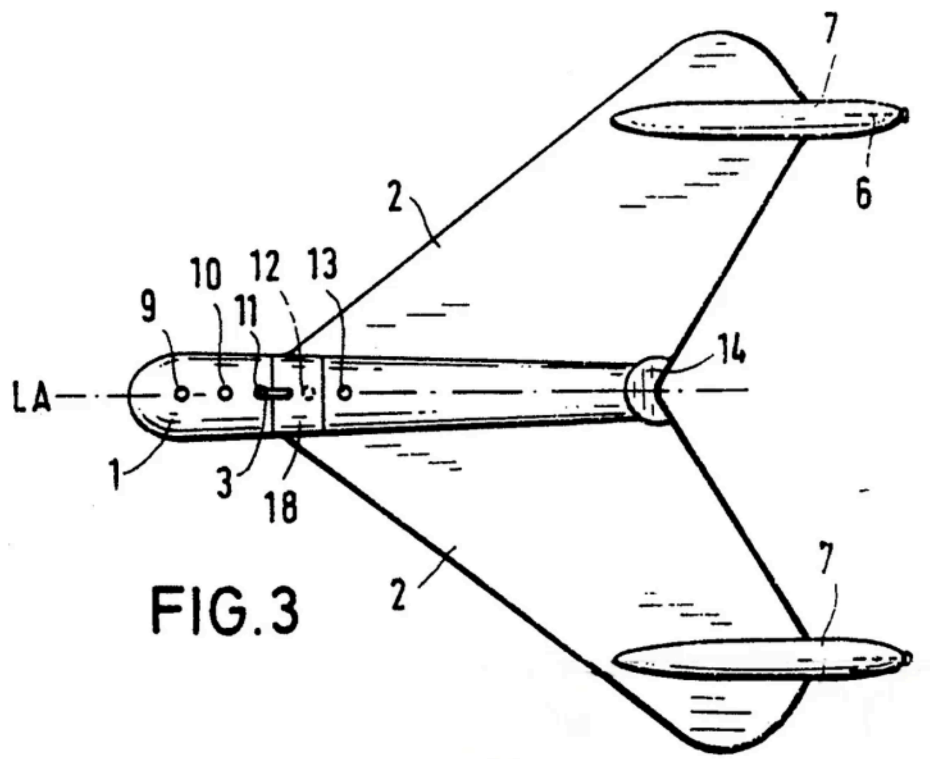


FIG.3

Brief Description of the Drawings

FIG. **1** is a top view of the top side of a model airplane of the present invention;

FIG. **2*a*** is a side view of a model airplane shown in FIG. **1**;

FIG. **2*b*** is a vertical cross-sectional view through the central longitudinal plane of the model airplane with inserted and secured catapulting hook;

FIG. **3** is a top view of the bottom side of the model airplane;

FIG. **4** is a vertical cross-sectional view of a wing in various sectional planes as indicated in FIG. **1**;

FIG. **5** is an illustration of a first aerobatic figure of the model airplane according to the present invention, launched from a horizontal position into a horizontal landing position; and

FIG. **6** is an illustration of a second aerobatic figure of the model airplane according to the present invention, launched from a position at 90° inclination with respect to the horizontal plane into a horizontal landing position.

FIG.4a

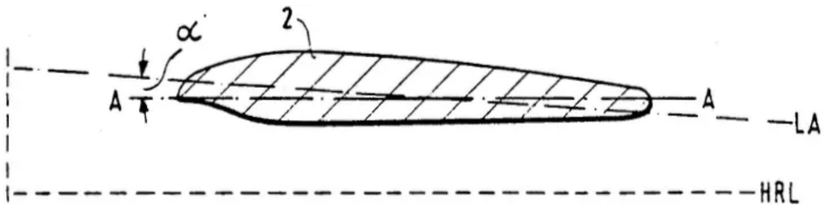


FIG.4b

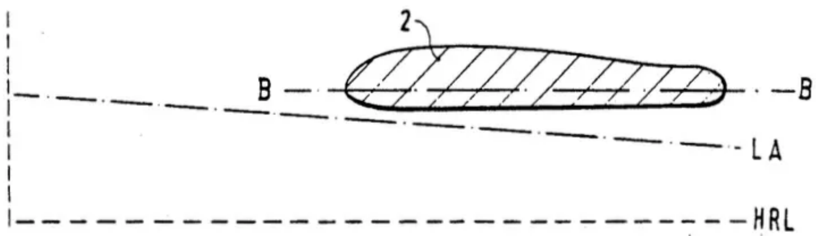


FIG.4c

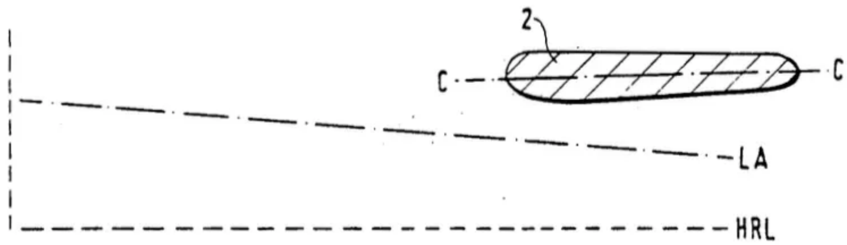
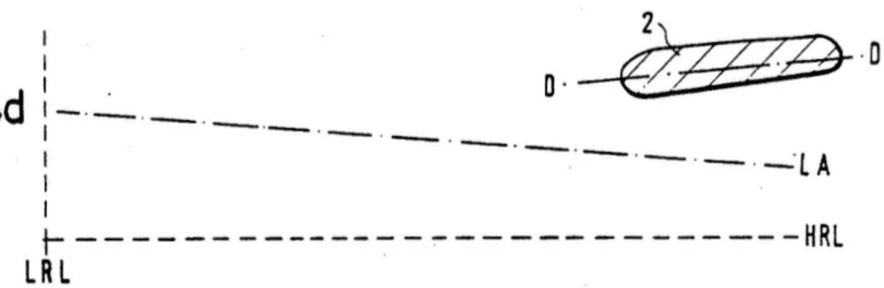


FIG.4d



Description of the Preferred Embodiment

(2) The shape of the model airplane corresponds to that of a rigid-wing aircraft with a fuselage **1** provided with sweptback wings **2** with a large sweepback and one or more fins **7** vertically stabilizing the vertical axis of the plane.

(3) The wings **2** are profiled with angles of wing setting variable over the wing span, i.e., geometrically and aerodynamically twisted, as will be apparent from the following.

(4) Launching the model airplane can be performed with a catapulting hook **3** of high operating security, variably fixable lengthwise at the

bottom side of the fuselage and twice secured, in connection with a catapult **22** having an elastic strap **23**.

(5) Trimming weights **6** of the simplest kind, e.g nails, allow variable aerobatic figures, e.g. a looping-like ascending circle with a roll and a subsequent slow straight descent back to the launching site.

(6) FIGS. **2*a*** and **2*b*** indicate a longitudinal axis LA through the fuselage **1**. The catapulting hook **3** consists of a mandrel-like hook member **15** provided with a recess **16**, for insertion into the fuselage **1**. A bolt **17** is put through the recess **16** in the hook member **15** transversely to the fuselage **1**, i.e., transversely to the longitudinal direction LA. This safely prevents the catapulting hook **3** from being pulled out upon catapulting the model airplane. Additionally, a securing strap **18** of high adhesion is provided which forms a further safety device against pulling out the catapulting hook **3**. In order to tighten the securing strap **18** over the hook member **15** inserted in the fuselage **1**, the hook **19** of the catapulting hook **3** is offset relative to the longitudinal axis of the mandrel-like hook member **15**, as is seen best from FIG. **2*b***.

(7) The catapulting hook **3** can be inserted as a trimming weight at various places in the vicinity of the center of gravity along the central longitudinal plane, in order to thereby influence the diameter d of the aerobatic figures to be performed. If the catapulting hook **3** is arranged in the vicinity of the center of gravity, i.e. approximately in position **11** of FIG. **3**, the model airplane will move along a comparatively small circular path. If the catapulting hook **3** is inserted more to the front end, the model airplane will follow a circular path of a larger diameter. Given an asymmetric trim with respect to the longitudinal axis of the model airplane, provided with a trimming weight **6**, e.g. a nail, the model airplane can perform a narrower or wider descent. These trimming weights may be inserted for example into the fins **7**. In FIG. **3**, reference numerals **9** and **10** denominate further positions for inserting the catapulting hook **3**, allowing a wider diameter of the figure. In contrast thereto, reference numerals **12** and

13 indicate positions that would allow a narrower diameter d of a circle or a looping.

(8) In order to perform loopings and circles, the model airplane is launched inclined to the ground, if a horizontal axis of the circular path, i.e. a vertical plane of flight is desired. If a vertical axis of the circular path is desired, i.e. a horizontal plane of flight in which the wings are vertically inclined towards the ground, the longitudinal axis of the fuselage is held slightly upward. Besides these, other optional planes of flight can be selected, allowing a variable diameter d of the circular path of flight and different aerobatic figures, depending on the launch speed, with the airplane always returning to the launching site.

(9) A grip surface **14** for holding the airplane upon catapulting is provided between the wings **2** at the rear end of the fuselage.

(10) FIG. **4** illustrates different profile sections of the wings at increasing distance from the wing roots, as is apparent from FIG. **1**. The line LRL is a vertical lengthwise reference line and the line HLR is a horizontal reference line, helping to exactly define the relative dimensions and angles and thereby the three-dimensional twist of the wings **2**. Moreover, the longitudinal axis LA of the fuselage **1** is indicated, the relative position of which regarding the lengthwise reference line LRL and the vertical reference line HRL is constant in all FIGS. **4*a*** to **4*d***. The connecting lines A — A, B — B, C — C and D — D are termed wing chords and connect the outermost points of the profiles in the profile sections of the wings according to FIGS. **1** and **4**. As becomes apparent from FIGS. **4*a*** to **4*d***, the angle of inclination α of these wing chords (the angle of wing setting) is increasingly inclined downward in the direction of flight with an increasing distance from the wings roots, starting outward at the fuselage, and relative to the longitudinal axis LA of the fuselage **1**. In the embodiment of FIG. **4**, the angle α of the wing chord A — A is approximately 4° relative to the longitudinal axis LA, that of wing chord B — B is approximately 6°, of wing chord C — C approximately 7° and of wing chord D — D approximately 9°. Besides that, the

distance of the wing chords projected on the central longitudinal plane of the airplane to the longitudinal axis LA increases with the increasing distance to the fuselage **1**. In this case, the angle between the longitudinal axis of the fuselage LA and the horizontal reference line HRL is approximately 5°.

(11) As is further apparent from FIGS. **4*a*** to **4*d***, the distance between the respective point of the profile and the vertical reference line LRL also increases from the fuselage **1**, which fact is represented by the backswept shape of the wings **2**.

(12) As can be seen in FIGS. **2*a*** and **2*b***, the vertical reference line extends in a plane through the lowermost point of the catapulting hook **3**.

(13) FIG. **5** illustrates a looping 8***a*** of the model airplane with a slightly upward directed longitudinal axis LA when in the launching position, performing a substantially circular figure and a horizontal axis A, having the diameter ***d***. As is evident from FIG. **5**, the model airplane returns to the launching site and may continue a horizontal descent until it lands on the ground **24**, unless it is caught before.

(14) FIG. **6** shows a circular FIG. **8*b*** in which the model airplane is brought into a launching position at an angle of 90° with respect to the ground, so that a circular flight path around a substantially vertical rotational axis is performed in a substantially horizontal plane of flight. In this flight, however, the model airplane can rotate around its longitudinal axis by an angle of 90° (in FIG. **6**, ¼ roll to the right), so that it can also land on the ground **24** with its wings in horizontal position.

(15) As is apparent from FIG. **1**, the top surfaces of the rear ends of the wings **2** are provided with control surfaces **20** rising rearward and outward. In top view they form a triangle tapered towards the longitudinal axis of the fuselage **1**. At the rear end of the wings **2**, these control surfaces **20** end in a trailing edge **21** having a height in a vertical plane passing through the trailing edge **21** of approximately ⅛

to 1/25 of the wing span, i.e. the width of the wings transversely to the longitudinal axis LA.

(16) The height of the trailing end **21** at the rear edge of the control surfaces **20** is preferably at least 1 cm. The embodiments shown in FIGS. **1** to **6** have but two wings. However, they can also be provided with combinations of a plurality of wing pairs or wings, e.g. double-deckers or triple-deckers, or one pair of wings with an additional wing, having the features described above.

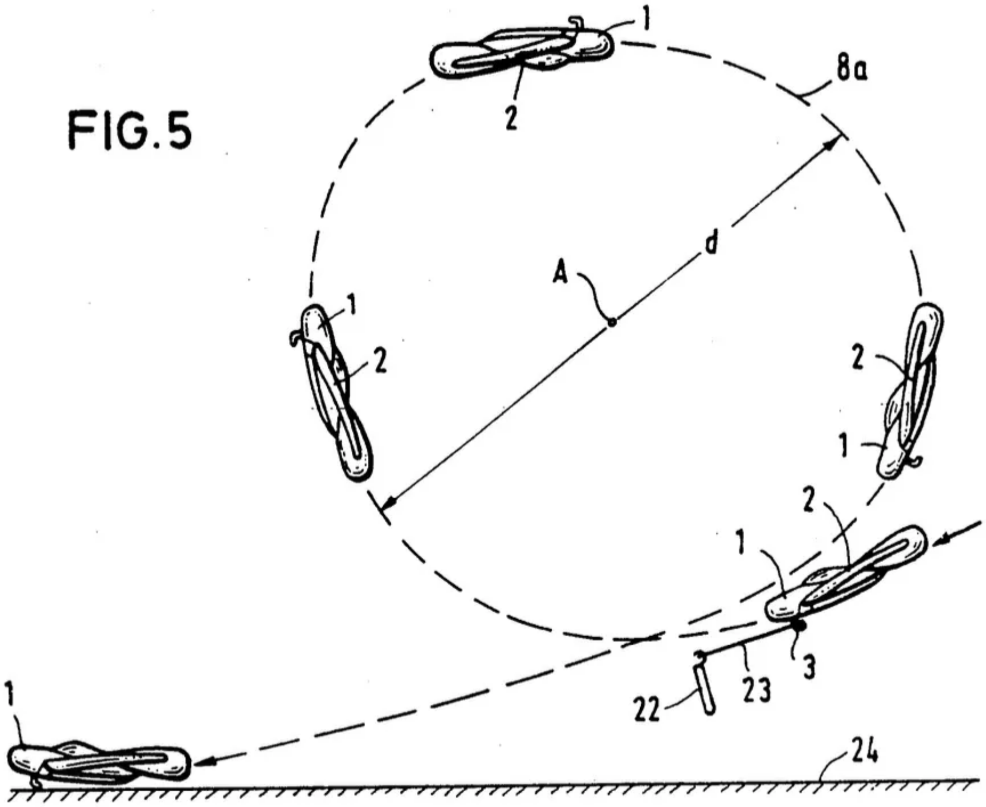
(17) In addition, rigid or movable control surfaces may be provided in canard type construction like in Canard-type-airplanes.

(18) While the invention has been illustrated and described as embodied in a model airplane, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

(19) Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

(20) What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

FIG.5

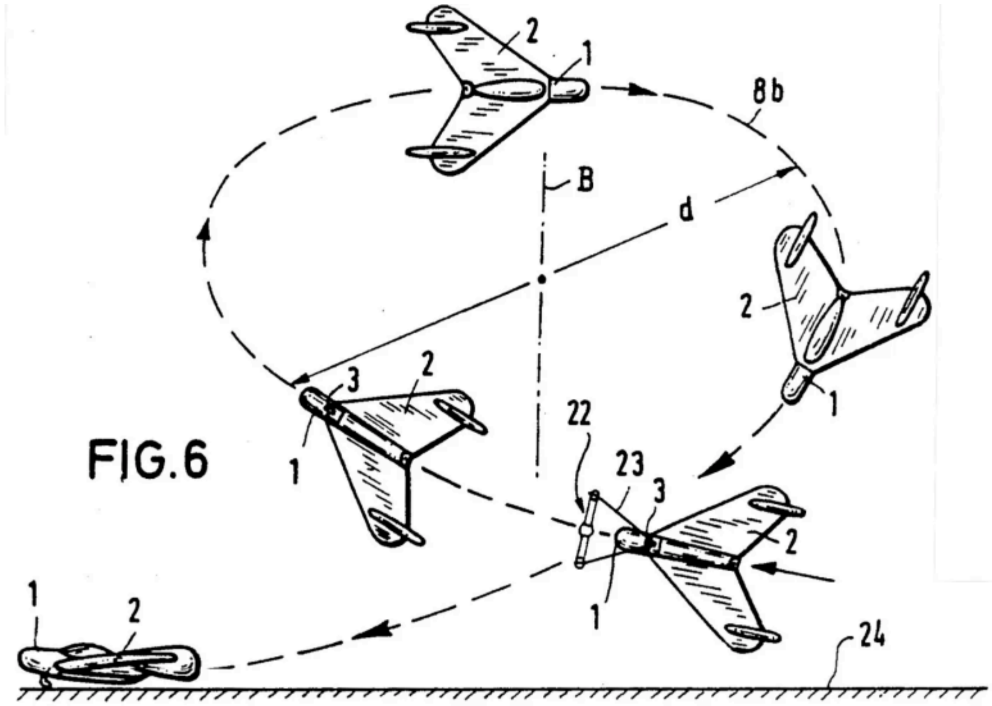


Claims

1. A model airplane comprising a fuselage having a bottom side and a longitudinal axis; a catapulting means fixed to said bottom side in vicinity of a center of gravity of said model airplane and located in a central vertical plane extending through the longitudinal axis of said fuselage; and wings, each wing having a wing root at a connection of the wings with the fuselage, a wing tip, and a sweptback profile with a large sweepback, the sweptback profile having a decreasing thickness from the wing root to the wing tip which thickness is measured in a vertical cross-sectional plane, the sweptback profile comprising a plurality of profile cross-sections extending parallel to the central vertical plane and having outermost opposite points connected by a respective plurality of imaginary lines, each imaginary line forming with the longitudinal axis of the fuselage, in a downward direction toward the bottom side of the fuselage, a respective angle of wing setting that increases, with an increase in distance of a respective profile cross-section from the wing root, from substantially 4° for a profile

cross-section taken adjacent to the wing root, to substantially 9° for a profile cross-section taken adjacent to the wing tip, and each wing having a rear edge provided with a rigid control surface extending upward and rearward, said control surface being substantially triangular in shape, tapering toward said fuselage, and defining a trailing edge having a height measured in a horizontal plane passing through the trailing edge of substantially ⅛ to 1/25 of a wing span and at least 1 cm, and each wing further comprising vertical stabilizing means extending at an end of said rigid control surface remote from said fuselage, and parallel to the longitudinal axis of said fuselage.

2. A model airplane according to claim **1**, wherein said airplane is made of a foamed plastic material, and said catapulting means comprises a catapulting hook.
3. The model airplane according to claim **2**, wherein the catapulting hook is insertable into the bottom side of the fuselage at various points in a vertical longitudinal plane.
4. The model airplane according to claim **3**, further comprising a bolt inserted into the fuselage transversely to the vertical longitudinal plane for securing the catapulting hook, said catapulting hook including a recess through which said bolt extends.
5. The model airplane according to claim **2**, wherein the catapulting hook comprises a hook member, said model airplane further comprising a strip of adhesive tape disposed transversely across the hook member for securing the hook member to the fuselage.



Resources

- *[US Patent and Trademark Office]* (USPTO) — The USPTO provides an outstanding search engine which enables digging through (seemingly) every patent in their archive. Proceed with caution — you could easily spend **days** of your time digging through their utterly fascinating files.
- *US 5026313 A* — A PDF of the original patent as downloaded from the USPTO website, on which this article is based.
- *Glider Patents* in the New RC Soaring Digest. — The complete compendium of articles appearing in this series.

Thanks to Editorial Assistant

for her invaluable assistance in preparing this article. 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.

Stamps That Tell a Story

Philatelic tributes to soaring in Japan, along with a brief history.

This article first appeared in the January, 2003 issue of Gliding *magazine. Temporal references (eg. "show today's sport in Japan*") *have been retained as originally written. — Ed.*

The Japanese Post Office issued a set of four postcards in the early summer of 1988 to be used as summer greeting cards. One (see above) shows a stylised sailplane as the imprinted postage stamp and a stylised image of the *Southern Wind*. The Postal Ministry adopted the design of the glider to show the "cooling and refreshing image" of summer.

In Japan it is a long standing custom to write greeting cards in the summer as well as for the New Year. Since 1986, these cards have actually been 'lottery cards' nicknamed *Kamo-Mail* or *Sea-Gull Mail*. It is believed that this card shown did not win anything! But due to the growing popularity of this kind of lottery, in 1988, a total of 330,000,000 summer greeting cards were printed, with the one showing the glider having the smallest print run of 72,000,000. It is not known how many of these cards were actually used, but with such a large print run they should still be available, used or unused.

There is an active gliding community in Japan flying modern as well as vintage sailplanes, so it is not at all surprising to see the Japan Post use a glider in the design. The map (above, right) shows the location of the different soaring sites, with the Sekiyado Glider Port just north of Tokyo, being the home of the Japanese Soaring Association.

Yasuhiro Yama supplied one of his photos (see below) of a *Duo Discus* to show today's sport in Japan.

A Brief History of Soaring in Japan

The first primary glider was flown on May 11, 1930, at the Tokorozawa Army Airfield by Bunzaburo Kataoka. It was designed and built by Testukichi Isobe. The flight lasted about five seconds and the machine with its pilot glided about 80 metres. A few months later, the first gliding club was formed in Japan.

Left: Duo Discus photographed by Yasuhiro Yama. | Right: The training session given by the German pilots in 1935. Mount Fuji is in the background

Japanese interest in soaring grew greatly in the mid 1930s. The Japanese Government and Military asked Wolf Hirth to come to Japan to teach the secrets of the sport to the growing aviation community.

In October 1935, Wolf and two other German glider pilots, Karl Baur and Hans Stolz, arrived on the Trans-Siberian railroad with a *Minimoa*, a Wolf and two *Grunau 8* sailplanes. A selected group of Japanese pilots was chosen to learn as much as they could from the German visitors.

In 1936, the first major gliding competitions took place, and these can be documented philatelically as well.

Several picture postcards were sponsored by the Asahi Newspaper for this All Japan First Glider Meet in September. And Japan Post authorised two pictorial postmarks (below, left).


夏之霧ヶ峰風景 樂しきハイキング
大日本帝國郵便
壹錢五厘
全日本
グライダー大會記念
11. 9. 2
上諏訪
朝日新聞社主催
日本最初のグライダー大會記念
11.9.2-4
霧ヶ峰

In the spring of 1988 a plaque was dedicated at the Sekiyado Glider Port to Wolf Hirth (above, right) for his contribution to Japanese soaring. However, there seems to be no connection between the postcard being issued and this dedication. The text on the top of the plaque reads, freely translated:

> In tribute to Mr Wolf Hirth. Mr Wolf Hirth was the teacher of the soaring sport in Japan. He was also one of the soaring pioneers in Germany. He came to Japan on October 2, 1935 and visited several places to lecture on the soaring theory and instructed for two and a half months. He left a deep impression with Japanese gliding people, thus contributing much to the development of the sport in Japan.

Most stamp collectors may not realise that Japan was the first country to issue a postage stamp honouring aviation, the 12 sen regular issue — the most expensive stamp in this series! — from 1877 shows a tiny balloon in the design.

Acknowledgements

Much help for this article came from Yasuhiro Yama, Iwatsuki-City, and Ichiro Sato, the former director of the Sekiyado Glider Port.

References

- Brütting, Georg (1952). Der Segelflug erobert die Welt. 5th edition. Chapter 11: “Im Lande der aufgehenden Sonne.” Knorr & Hirth Buchverlag, München-Ulm, Germany.
- Kawakami, Hiroyuki (1998). Japanese Gliding History, 1930–1945. Model Art Company, Japan.
- Sato, Prof. Dr.-ing. Hiroshi. “Japan” in Hubert Zuerl (1941). Der Segelflug im Wettbewerb der Völker.

Resources

- *Stamps That Tell a Story: The Series* — Catch up on your missing instalments of this excellent, informative series of articles presented previously in the New RCSD and of which this article is the most recent part.

Simine Short is an aviation researcher and historian. She has written more than 150 articles on the history of motorless flight and is published in several countries around the world as well as the United States. She is also the editor of the Bungee Cord*, the quarterly publication of the Vintage Sailplane Association. Simine is currently working on a biography of aviation and soaring pioneer Octave Chanute.*

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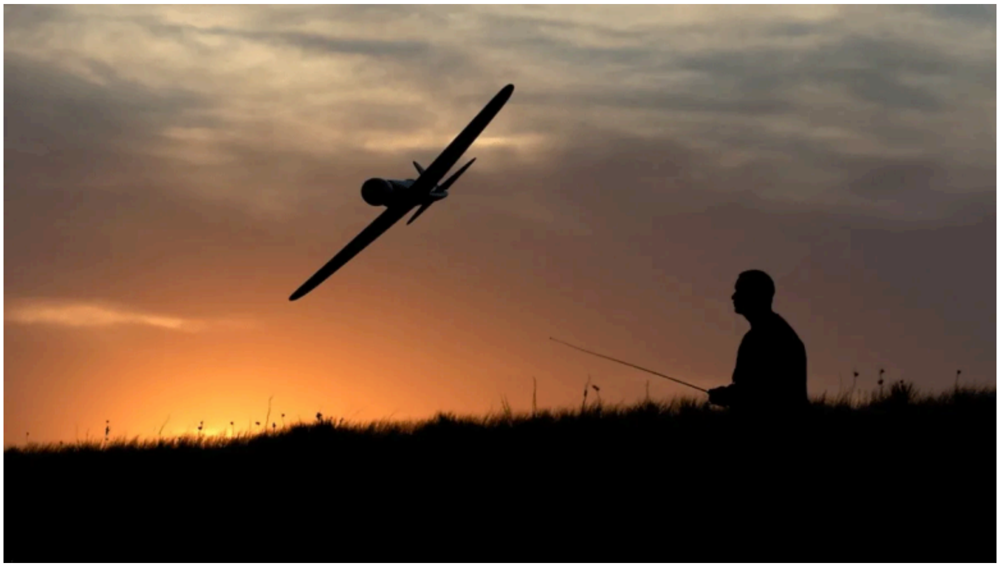
The Trailing Edge



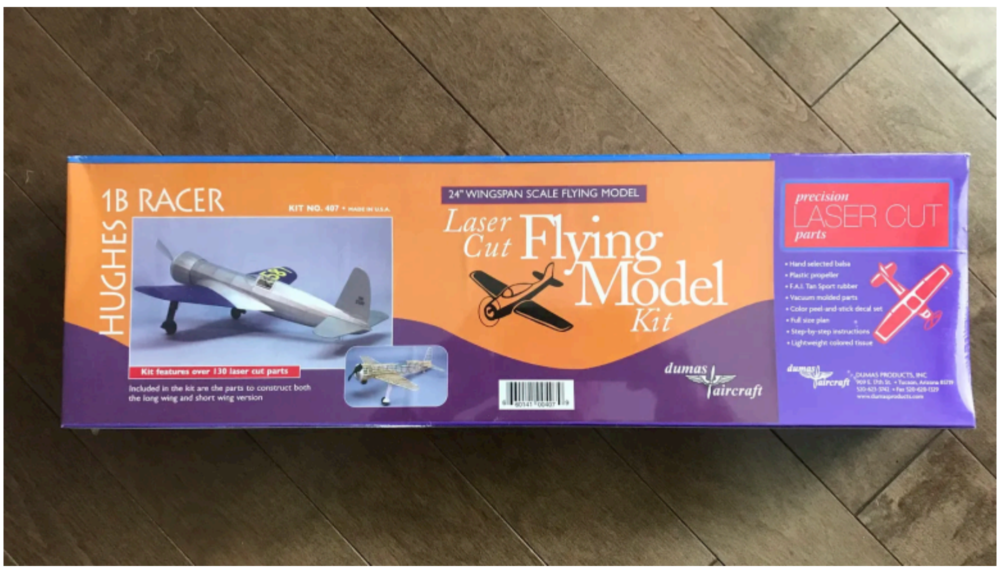
"Jack Cooper and an LEG Hughes H-1 [at] Wilson Lake, Kansas" in April of 2005. (credit: Greg Smith via Flickr under CC BY-NC-ND 2.0)

The Aviator

Anybody who has seen the 2004 Martin Scorcese film *The Aviator* will likely have fallen in love with the Hughes *H-1.* It's sumptuous silhouette is featured in the key photo above as it glides over the slope near Wilson Lake, Kansas around the time the movie was released. The *H-1* was and is truly one-of-a-kind aircraft from a one-of-kind man. We've heard it posited that if Howard Hughes had lived today the incapacitating mental illnesses which tormented his later life would have been easily treated. Whether that's true or not we'll never know but assuming for the moment it is, one can only imagine and marvel at what such a brilliant mind could have produced over the full arc of his life.

The PSS (power scale soaring) version featured above is a testament not only to the exquisite beauty of the aircraft, but also the sailplane-like slipperiness which made it ideally suited to the mission for which it was designed: to go far and to go fast. To achieve this goal, Hughes incorporated brand new technologies like flush rivets and retractable landing gear. It set a transcontinenal speed record of by flying non-stop from Los Angeles to New York City in 7 hours, 28 minutes and 25 seconds. Furthermore, the records were set by Hughes himself in the cockpit — a fact sure to melt the ice in the veins of every red-blooded aviator.

Back down here on Planet Earth, we were troubled when we read an early draft of *The Ed*'s piece for this month: 250g is not much in the way of latitude for building the future ships of our dreams. Then we rummaged through the 'to be evaluated' pile and found this:



It's kismet! When time allows — seemingly it never does — we'll dive into this and put together a sub-250g, micro-PSS version of Hughes' greatest work. Problem solved. Furthermore, when *The Ed* saw us fondling the box he shouted over the shared partition:

"You know there are some micro retracts for that, right?"

Today? Today was a good day.

New(ish) in The RCSD Shop

This beautiful chino cotton *New RCSD Logo Peaked Cap* comes in eleven colors (including camo!) to match your inimitable personal style. Thanks to the adjustable strap it is one-size-fits-all for both men and women. It features the New RCSD logo on the front and on the back you'll find the classic RC Soaring Digest sailplane motif (inset, bottom right) which appeared starting with the the very first issue from January of 1984. Order yours today.

All items in the Shop are made especially for you as soon as you place an order, which is why they are fairly priced and it takes us a bit longer to deliver them to you. Making products on demand instead of in bulk helps reduce overproduction and waste. Everybody wins. Thank you for making thoughtful purchasing decisions!

Make Sure You Don't Miss the New Issue

You really don't want to miss the May, 2023 issue of the New RC Soaring Digest when it's out — we always have some exciting things in the works. Make sure you connect with us on Facebook, Instagram, Twitter, LinkedIn and Post News or simply subscribe to our Groups.io mailing list. Please share the New RCSD with your friends — we would love to have them as readers, too.

That's it for this month…now get out there and fly!