
Radio Controlled
Soaring Digest
March 2022
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The New RC Soaring Digest

March, 2022
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In The Air

Was a humble wooden glider the subject of Canada's second saddest story of star-crossed aviation innovation?

Terence C. Gannon

"Original Toronto Star caption: This small craft of the National Research council is 18 feet long; has 47-foot wing spread." (image/caption: Toronto Public Library)

In the never-ending hunt for quirky, original and offbeat story ideas, Google is an absolutely invaluable tool — but you all know that already, of course. But in a recent search — I think it was for something clever to mark Canada's National Aviation Day for our Twitter feed— the algorithm at Google somehow dropped this irresistible nugget just one click away from the real work that really needed to be done.

And that, as they say, was the afternoon in the bin.

I thought Canada was the home of only one tragically sad, what-might-have-been aviation story: the Avro Canada *Arrow*. This aircraft has been the obsession of 'Arrowheads' since not long after that ignominious day back in 1958 when the project was cancelled and subequently all prototypes along with all the production tooling destroyed — with ''extreme prejudice". But that story is for another day, perhaps. (For those who can't wait for that day, see the *Resources* section below for relevant links.)

Yep, I'll admit it. I'm an unapologetic Arrowhead.

However, that is not the main subject of this essay. But just one other note before I leave the *Arrow*: it was also featured in the very last issue of the *RC Soaring Digest* from the legendary Bill and Bunny Kuhlman era: December of 2018. It contains just about every detail you might conceivably need for building a power scale soaring (PSS) model of same (hint, hint!)

No, it was not the *Arrow* which *yet again* caught my attention a few days ago, but rather the aircraft above and below, simply called the *NRC Tailless Glider*. That 'wasted' afternoon revealed surprisingly little about the aircraft built in Edmonton, Alberta in 1946. What I did learn, though, was that Geoffrey T. R. Hill — the designer of the Westland-Hill *Pterodactyl* series of tailless aircraft of the pre-war period — was the British Scientific Liaison Officer to the National Research Council (NRC) Canada during the Second World War. I guess it should come as no great shock, therefore, that Geoffrey Hill advised the NRC to explore the control and stability of the flying wing configuration. In other words, a logical continuation of Hill's work from the 1920s and 1930s it would seem, except with the full faith and credit (and money) of Canada's NRC.

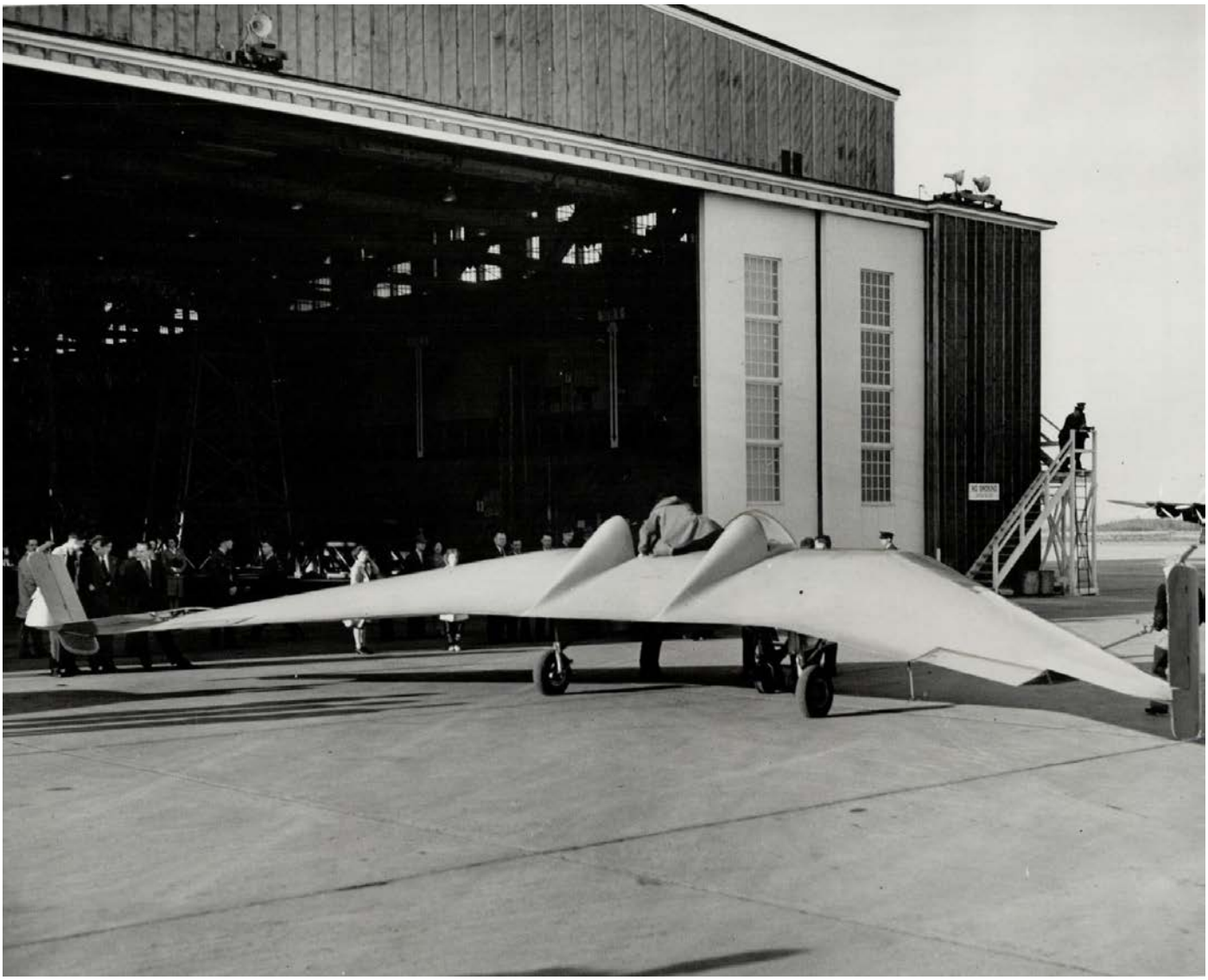
The full-size version of the *NRC Tailless Glider* was towed aloft by a DC-3,

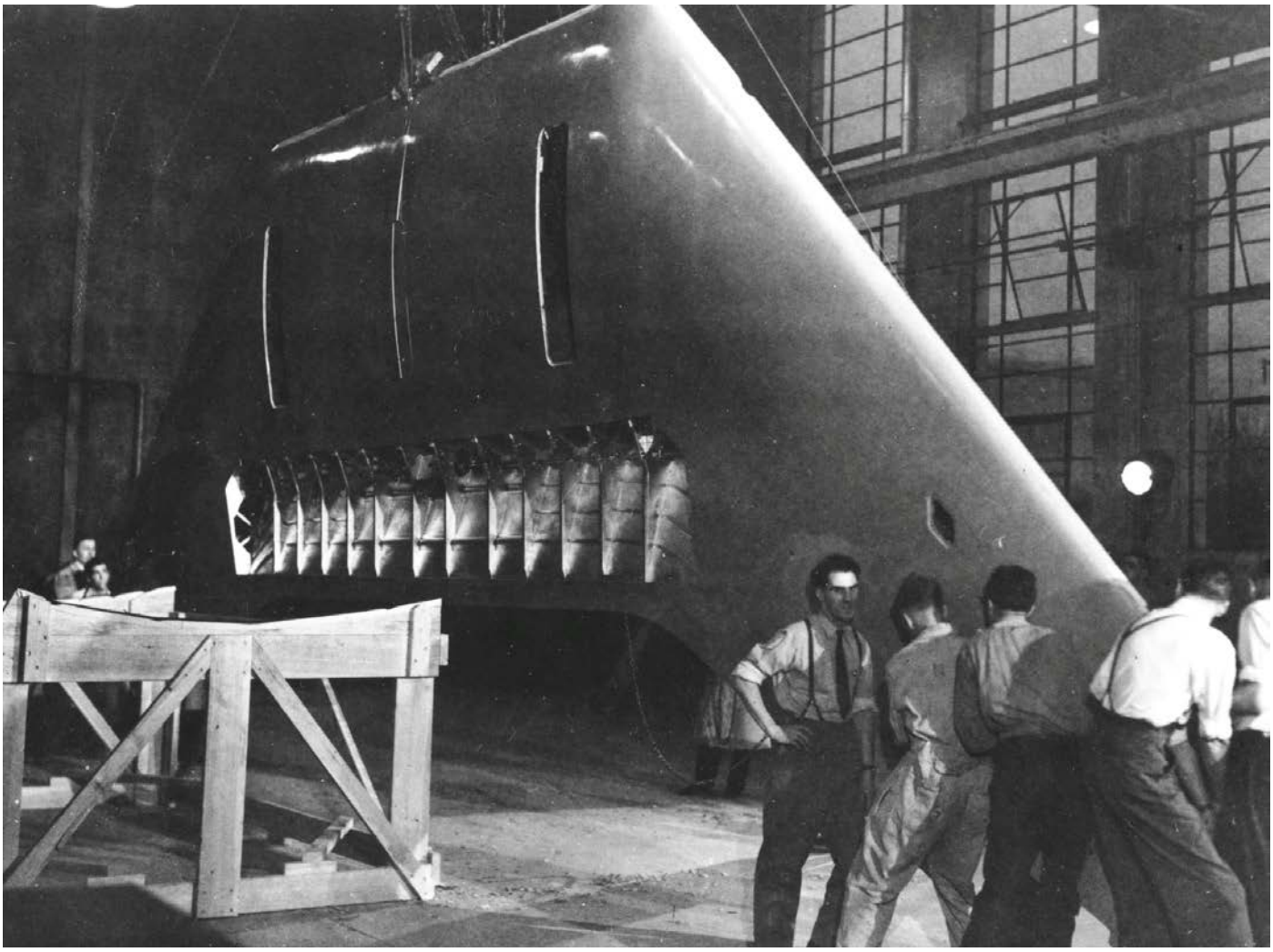
and flight tested over the next couple of years. It was eventually towed all the way from Edmonton, Alberta to Arnprior, Ontario — a distance approaching 2300 kilometres — for further testing closer to the home office of the NRC. By 1950, however, the all-too-brief testing program was coming to an end and the mostly-wooden aircraft scrapped, presumably.

The *NRC Tailless Glider* received sufficient attention during its short life that it became the subject of detailed study by NACA, the agency that eventually became NASA. The *Tailless Glider* tested out quite well according to a detailed study of a 1/10-scale model which was flown in the Langley 'free flight' tunnel. The innovative work of those aeronautical engineers up there in the frozen north was getting some justifiable attention.

The almost unbearably sad part of this story, of course, is that Jack Northrop's futuristic flying wings were being developed around the same time. Their ultimate progency, the B-2 *Spirit* stealth aircraft, wouldn't fly until 1989 nearly 40 years after the *Tailless Glider* was sawed up into souvenirs or scrap. The tailless configuration — particularly in the uncrewed systems space — may be entering a new sort of golden age. The *Tailless Glider* would appear to have had a four decade head-start. Who knows where it would have lead if the development had continued. What *this* Canadian wonders is whether **yet another** dream of Canadian aviation greatness was lost to history.

I really hope that some reader might consider doing the necessary research to build a scale model of the *NRC Tailless Glider*. It would seem to be a very worthy subject, and certainly a unique scale model that really ought to fly well. That future project would make for a great article in a future edition of the New RC Soaring Digest.





Left: "Original Toronto Star caption: A Tailless Glider which looks like a bat in flight has been flying over Edmonton and Northern Alberta in tests seeking information for development of the flying wing." (image/caption: Toronto Public Library) | **Right**: The internal structure of the NRC Tailless Glider. (image: Royal Canadian Air Force)

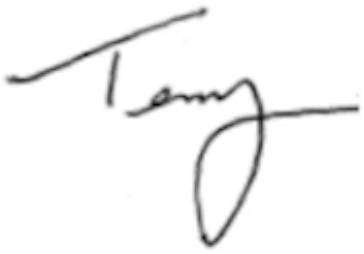
As usual, I have allowed my stream-of-conciousness prose get the better of me, so I won't delay you further as you turn to the first article in this month's issue. However, I do want to welcome a brand new contributor, Greg Lewis, who has a fantastic article on the ChocoFly 1/3-scale *ASW 17*. Greg's article is entitled *An Icon Goes Red* and (spoiler alert!) provides details on the setup of this ship for GPS Triangle Racing.

I also want to draw your attention to a new item up there on the navigation bar: *Clubs*. This month, RCSD is kicking off an ongoing series where we focus on local clubs. We hope this effort results in new interest being

generated in this community-oriented aspect of RC soaring. We kick off with *Club in Focus: Mississippi Valley Soaring Association* and hope to feature at least one new club in each issue.

Finally, I want to express my deepest gratitude to Norimichi Kawakami, whose magnificent year-long series on his exquisite *Mita 3* project comes to a close this month. It has truly been a pleasure working with you on this! (Note: don't tell anyone, but I'm trying to convince Kawakami to follow up with a new series. We're keeping our fingers crossed and stay tuned for further information.)

So until next month, fair winds and blue skies.



Resources

- **The Arrow: The path not taken 60 years ago has a nation still wondering what might have been.** — from Terence C. Gannon, Medium, January 23, 2019
- **Slope Soaring Candidate: Avro Canada CF-105 Arrow** — from the December, 2018 edition of RC Soaring Digest
- **Jack Northrop's Flying Wings: An old idea for which the best years may still lay ahead.** — from Terence C. Gannon, Medium, May 15, 2019.
- **Canadian Warplanes 5: NRC Tailless Glider** — a great article on the subject, from which some of the details for this *In The Air* were drawn.
- **Investigation of Stability and Control Characteristics of a 1/10-Scale Model of a Canadian Tailless Glider in the Langley Free-Flight**

Tunnel — NASA Technical Reports Server

Cover photo: *A moonlight flight captured by Stefan Eder of Aer-o-Tec in Germany. It's a beautiful shot, Stefan, thank you so much for the opportunity to feature it.*

Here's the ***first article*** *in the March, 2022 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****.*

Silent Arrow® Autonomous Cargo Glider Wins New Defense Contract

$2.2M program includes five GD-2000s for operational evaluation and concept-of-operations development.

The NEW RC Soaring Digest Staff

"An unmarked GD-2000 is seen here rigged and ready for C-130 deployment over an unspecified military test range." (image/caption: Yates Electrospace Corporation)

LOS ANGELES, February 14, 2022 — The unique, autonomous cargo-carrying glider developed by Silent Arrow has been awarded a new contract with the US Department of Defense's *Warfighter Lab Incentive Fund* (WLIF). The $2.2M, 12 month program begins in the first quarter of this year. The contract — which calls for the delivery of a total of five GD-2000 gliders —

will provide advanced operational demonstrations and concept-of-operations development activities.

Two of the GD-2000 aircraft called for under the terms of the contract will participate to *Exercise Emerald Warrior* at Hurlburt Field, Florida coming up later in 2022. Two additional aircraft will be delivered to an undisclosed location and the fifth aircraft will be used for training and educational purposes.

As theatres of operations during conflicts become more accessible to all adversaries, it has become increasingly important to maintain resupply operations in regions where the airspace is either contested or denied. The 60 km stand off capability of the GD-2000 combined with lower radar signature and near-zero noise signature make a glider particularly well-suited to this requirement. Most importantly, these capabilities have the potential to reduce physical threats to personnel.

This new contract is intended to prove out these capabilities in a real-world operating environment. Notably, this also includes testing out water landing and resupply-at-sea operations. The contract also calls for a transition plan to full operations to be developed based on the outcome of the project.

“An unmarked GD-2000 is seen here being loaded into a C-130 for deployment over an unspecified military test range.” (image/caption: Yates Electrospace Corporation)

“We’d like to thank the Joint Chiefs and J7 for their confidence in awarding this seminal program,” said Chip Yates, Silent Arrow’s Founder and CEO. “We are looking forward to leaning in with our mission partners and delivering these disruptive capabilities to the warfighter to create a logistical advantage while reducing physical threats to those operating in harm’s way.”

In an exclusive follow up interview with RCSD subsequent to the announcement, Yates commented: “We are humbled by the continuing interest from RC Soaring Digest writers and readers. This is a great time for gliders to rise up and address global challenges — the miniaturization of autopilots and sensors have come at the perfect moment to enable us to provide heavy lift, accurate and single-use glider capability for humanitarian and tactical use.”

Global events of the recent past have demonstrated the fragility of the global

supply chain. This has created near unlimited demand for a wide variety of additional, innovative means of completing the 'last mile' of delivery. We hope readers will take the disruptive approach of the Silent Arrow to military logistics and be inspired to help address other logistical challenges using the familiar RC glider technology employed in Silent Arrow.

Resources

- **Silent Arrow** — company website.
- **Warfighting Lab Incentive Fund (WLIF)** — From website: "used to support field experiments and demonstrations that take concepts from paper to real world execution"
- **Exercise Emerald Warrior** — From website: "a joint exercise which brings together U.S. special operations and conventional forces and those of its international partners and allies to prepare for current and future challenges"
- **J7 Directorate for Joint Force Development** — From website: "supports the Chairman Joint Chiefs of Staff (CJCS)…through joint force development (JFD) in order to advance the operational effectiveness of the current and future joint force."

*Read the complete collection of stories on the **Silent Arrow in RCSD**. Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

Letters to the Editor

Our mailbag runneth over.

The NEW RC Soaring Digest Staff

You never know what's going to turn up when your search terms include 'glider' and 'mail'. Sometimes a gem like this. We're in awe of how clever some folks are. (image/product:)

We're thrilled this 'what is old is new again' forum for readers input is beginning to take off. Check out these remarkable contributions this month.

Three Aviation Legends Captured in One Photo

Hi Terence,

I enjoyed your article about Jonathan Livingston Seagull this morning. Turns out I have a photo of Richard Bach along with Teresa James and my mom

and at an air show:

Three aviation legends: Teresa James on the left, Richard Bach in the center and my personal hero Marianne Irene Nutt — mom — is on the right.

I wish I could tell you the circumstances of the photo. I'm pretty sure it was taken in Florida. I have no idea who took the photo.

The back story is both women were former Women's Airforce Service Pilots. By the time the WASP program was disbanded these women had hundreds of hours in warbirds. And certified to fly dozens of different aircraft. Out of the thousand plus women twenty six were lost for a variety of reasons. My mom went on to become an air traffic controller for 30 plus years.

If it could be said she did it all, she did. And her fellow sisters of the air have similar histories. My mom is my hero.

Her diary from 1944 is on Kindle: *A WASP Diary: Ferrying Aircraft for the Army Air Corps*. Although I'm listed as the author all I did was transfer it to a larger format so it would be easier for someone to type it up transfer it to media storage.

David Nutt
Tucson, Arizona

David — that is one remarkable photo! Thank you so much for sending it in along with that great story. We're also happy to pass along the link for your mom's incredible diary: readers can find A WASP Diary: Ferrying Aircraft for the Army Air Corps *on Amazon. — Ed.*

Would You Listen to RCSD Articles?

I agree that this is a great idea and as you said will expand the base that can enjoy the work you all are doing.

I am a HUGE podcast consumer. Pretty much the only thing I listen to in the car. A majority of the articles in the new RCSD rely on pictures to help tell the story, just having the articles read one after the other may not make for a good podcast.

My favorite RC related podcast is the 'RC Roundtable' the guys are a good mix and they keep it interesting. I could see a podcast with a couple of people as hosts discussing the articles and having a guest on to go in depth. I would love to hear Bob Dodgson talk about his life.

Thanks,

Raymond Wright
Lusby, Maryland

Raymond — that's great feedback, thank you. We agree that not every article would be a good fit for spoken word. And we also agree that there are some characters in our community who would be great podcast guests. So leave that with us as we continue to cogitate on the possibility of an RCSD podcast. Thanks for the input — Ed.

More on Jonathan Livingston Seagull, The Movie

Thanks, Terry, for another great issue of RCSD.

Your *In The Air* column reminded me of an article written by our club historian, Gary Fogel and published in the April 2020 edition of Gull Wings, about the Jonathan Livingston Seagull models. It was part of a series of articles entitled *TPG at 50 — Looking Back* that were written in honor of TPG's 50th anniversary as an RC soaring club.

I've attached a PDF of that issue. Check out pages 18 and 19.

Cheers,

Dale Gottdank
San Diego, California

Dale — thank you so much for writing in and if readers click the link above, they will be taken directly to issue and page of the article you mention. A personal note: readers are well advised to subscribe to Gull Wings*: it's the second best 😉 publication in the world dedicated to RC soaring. — Ed.*

Older Beginners In RC Soaring

I am having a great time enjoying the new version of *RC Soaring Digest*! Good job all around.

The beautiful models shown and described are what dreams are made of, but I am mired in the basics and need help which may be the case with many model sailplane advocates. As simple as it sounds, planning a battery, receiver, and servos that work together properly is not as easy as it appears. For example, the many comments about Lipo battery fires and proper chargers opens a whole mix of issues. Other battery choices are available, but some are too heavy or bulky for the small 1.0 to 1.5 meter models I am working toward. You can see where this line of thought is going for the enthusiast who will build a model and outfit it for flight from a clean sheet of paper. I cannot believe I am the only one with this dilemma.

Is there a place in the new format RC Soaring Digest for material to be developed to cover onboard system specifics as well as how to minimize the safety hazards of battery systems? This subject speaks to the issue of bringing new RC sailplane flyers into action without being confronted with hugely expensive air-frames and radio systems. Now in my 80's, I don't have decades left to develop my own direction with the usual trial and error methods!

Thanks for your time. There are more facets to this story, but the idea is clear that you may have one of the best platforms to work from to go back and refresh the foundation under RC soaring as well as lead the new part forward.

Regards,

Karl Hube
Alpharetta, Georgia

Hi Karl — thank you so much for writing in and we couldn't agree more that there is room for a series of 'getting back to basics' articles for people just like yourself. There are ***lots*** *of poeple like you out there. How about it, RCSD readers? Anybody out there want to take this on? Perhaps with something like the Hummingbird* Mini CX RES *or similar as the subject, so folks can build along with the series? Thanks for the idea, Karl, it's a great one. — Ed.*

Send your letter via email to ***NewRCSoaringDigest@gmail.com*** *with the subject 'Letter to the Editor'. We are not obliged to publish any letter we receive and we reserve the right to edit your letter as we see fit to make it suitable for publication. We do not publish letters where the real identity of the author cannot be clearly established.*

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

An Icon Goes Red

ChocoFly 1/3rd-scale ASW 17 takes to the skies over the UK.

Greg Lewis

Most people who fly model planes do so because they love aeroplanes. We all have iconic planes we desire to own and fly. Still today at 58 if I hear the sound of a Merlin engine approaching I run out into the garden to see if it is a Spitfire going overhead.

Talking to Sean Bannister and David Woods at the excellent Ivinghoe Soaring Association (ISA) Christmas Lunch, David mentioned to Sean that I had purchased a 1/3rd-scale model of the ASW 17. Sean's eyes lit up and we went into a discussion about George Lee's exploits winning the World Gliding Championship in the late 70's with the ASW 17.

> *In the UK the ISA is a famous slope soaring club north of the UK Capital London (see Resources, below, for link). It has been fortunate to have many alumni who have made significant contributions to our sport. Sean Bannister designed and competed with his Algebra designs in five F3B World Championships before the explosion of moulded gliders in the class. His design and flying credentials are legend in the UK for many of us and his influence and inspiration reach far further than he realises. Likewise David Woods and his brother Graham have had a massive impact on the soaring landscape of the UK, including designs and construction techniques that have expanded the performance envelope. See Resources below for many video examples found on their Favonius website.*

The full-size plane was designed and manufactured by Schleicher and was billed as an evolution of the ASW 12. In reality it was a ground breaking plane in having six wing control surfaces with the attendant ability to have variable camber across the complete wing. There were 55 made and it went on to break many world records.

Like Sean, I love the shape of full-size gliders. However, I have never really had a huge desire to own a scale model of these beautiful planes despite looking like they have been sculpted by the wind.

People ask me why, and it boils down to a few key areas. As construction techniques improved large scale gliders became possible to build and in the 80’s we saw an influx of models from Europe. Planes such as the Wik Astir. These models used copies of the sections from their full-size counter parts. Despite the moulded construction and high performance sections they didn’t actually fly that well. Models were not strong enough and the sections did not translate well into the lower Reynolds numbers at which models operate.

Having flown a few scale planes in the 80's I found them very underwhelming. After a few low passes and loops as crowd pleasers that was it.

We move on 35 years and things are different. Moulded construction techniques and materials have moved on to such an extent that modern model planes are considerably stronger than in the 80s. Plus the designers have now started making scale models with wing sections purpose-made for the Reynolds Numbers of model flying rather than persisting with the scale section.

Why would I want one then? Apart from the appeal of the owning such beautiful and majestic aeroplanes, we have seen the advent of the competition class of GPS Triangle Racing. Much has been written about this discipline of model flying so I will not go into too much detail. A quick summary would be using GPS technology models fly tasks in the same way as a full-size glider does. A triangle course is used and the objective is to do the most laps you can from a set launch height and in a set time — that is **distance** flying.

As with full-size gliding there are different classes controlled by the size of the glider. In model GPS task flying they are *Light*, *Sports* and *Scale* classes. Having dabbled in *Sports* class I thought it time to step up to *Scale* class.

Building

Without question this is the most complicated model I have undertaken. Despite being moulded, the ASW 17 needs to have the radio and 'front electric sustainer' (FES) system installed. So "an electric motor and propellor" I hear you say. It is a little more than that. It is a removable propeller so you can fly the plane as a glider as well via aerotow.

Having received the plane just before a trip to Spain to fly *Sports* class GPS I thought, "expert advice is required here". David Woods was contacted and I took the plane over to David for a survey and view on how to do things. As there were no building instructions we turned to the internet and looked at several sites, from which we have cribbed some great ideas we have used before when it comes to installations of radio and motors.

One of the these sites is CMS Modell. We found two build logs on the ASW 17, with one being to the exact specification we were planning including the extra complication of water ballast for GPS Triangle Racing — see *Resources* at the end of this article for the relevant link.

It was decided that getting the plane ready for Spain was impossible. David suggested I leave the plane with him whilst I was away. Dave offered to do some planning and work out the best way to go about things.

On my return David had used his time to complete some of the major tasks of the install. Despite both of us then working on the final parts of the build we spent another two weeks, with both of us, working on the airframe to get the plane into flying condition. This did not include installing the water ballast which we decided to do after test flying.

Test Flying and Trimming

Test flying was done at the Phoenix Club, London Colney, UK which has a good sized field and a permit to fly large models up to an altitude of 430m.

Having spent time balancing the model with a digital CoG scale and using ChocoFly's set up sheet the first flight was very straight forward, only a few clicks of down trim required. After a few set up hiccups a good trim setting was found. So good in fact was the set up that on the second flight two climbs were achieved and some practice triangles done on the course.

It was obvious that the plane needed water or the wing ballast in place as it was flying so slowly and floating along like a thermal soarer. One issue which

was encountered was the lack of elevator authority on landing at low speed. This has now been cured after further flights by discovering that excessive down throw on the inboard flaps as part of the crow set up was causing a blanking effect over the tailplane.

Back to the workshop where David and I then fitted the water ballast tank which was a fiddly and complicated job. There were many proof of concepts on how to do it before we finally cracked it. Working as a two-man team was almost essential for this task. I must thank David for all of his hard work, years of aeromodelling knowledge and time to help me get this challenging project off the ground. As mentioned earlier he broke the back of the project whilst I was having fun in a warm and sunny Spain. I returned home to help with the final bits.

Water ballast installed, we could now add 3.2kg of weight to the plane. On a very calm day in December we flew the plane with an all up weight close to 18.5kg. To give you an idea of the effect of the ballast I flew one flight dry with a weight of 15.2kg. I did four laps in still air and averaged 62.8kph. Ballasted to 18.5kg I was able to fly four laps again but with an average speed of 94.6kph.

Being able to dump the ballast before landing is a great asset and does make landing easier and more relaxed.

Conclusion

In a way, boring and an anticlimax. Flying the ASW 17 is so easy and because of its size and weight it literally flies hands off for long periods of time. It has incredible speed and glide abilities and despite being over 100g/dm² responds to lift like a much smaller, lightly loaded model. It would be easy to get complacent — take offs and landings need 100% concentration as the

plane does cover considerable distances very quickly.

This model design won the last Scale Class GPS World Masters flown in 2019 and its pedigree shines through. Later in the year I hope to compete in the Scale Class European Masters against the some of the best GPS Triangle pilots in the world.

Hopefully I can do the ASW 17 justice.

Resources

ChocoFly ASW 17 Specifications

Span	7m	**Servos**	13
Weight (dry)	15.2kg	**Wing Control Surfaces**	8
Weight (ballasted)	18.4kg	**Auxiliary Functions**	retract, brake, water ballast pump, GPS reset
Weight (maximum)	19.5kg	**Radio**	JETI with standby power and dual receivers

- [ChocoFly ASW 17] — company website.
- [Ivinghoe Soaring Association] — *"one of the largest R/C glider groups in the UK, with approximately 140 members. Our activities include slope*

soaring at Ivinghoe Beacon, and flat field soaring at a private field"

- **Favonius** — David and Graham Woods website which has lots of great videos of their designs.
- **Assembling and Flying the ASW 17** — a brief (2:34) video shot by David Woods featuring the aircraft which is the subject of this article.
- **Build Log from CMS Modell Flugzeug**
- **GPS Triangle Racing Training Weekend** — John Greenfield's event coming up April 2nd and 3rd, 2022.
- **GPS Triangle Racing at Radioglide** — "*We have secured a slot in the Radioglide which takes place on the Queens Jubilee Bank Holiday weekend. Location is Buckminster and the date is 5th of June, 2022. We will be flying* Light *and* Sports *class in slots…*"

*All images are a collaboration by the author and Guy Lucas. 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**.*

Mickey Sullivan Memorial Aerotow 2021

This annual event at Clearview Field in Milton, Kansas never fails to please.

Stéphane RUELLE

Sometimes a place calls you: over the past years I have always heard from my friends in the Midwest that the Mickey Sullivan Memorial Aerotow held each year at Clearview Field (see *Resources*, below) in Milton, Kansas was a 'must go' event. The most intriguing part is that anyone I talk to about that venue doesn't talk about flying, weather or the airfield — they talk about the **food**! As you know the aerotowing community is very welcoming, laid back and the socializing is a big part of the event. Here it seems it was topped off with some great food on the field, no need to run to a restaurant in the

evening, allowing for some superb evening soaring. To make it the most deluxe experience, a large clubhouse is attached to the flying field, with a big hangar to store models and a large room with AC to relax, chill and have meals. It didn't take any time for me, in late 2020, to motivate everyone to make a collective trip to this paradise destination.

By the way, for accommodations Clearview Field has a couple of camping spots with hookups. There are plenty of hotels are on the west side of Wichita, about 25mi from the field.

The Clearview Field clubhouse and storage facility.

When I looked into it, the venue is in the middle of Kansas, about 35mi from Wichita, so almost a guarantee of uncongested airspace that is quite delightful when you fly big scale sailplanes. On our arrival we received a warm welcome from the organizers — the McCleave brothers — the owner of the field, Ken Stitt and his wonderful significant other Kim Walker. We setup close to the flight line and met with our friends from Michigan, Illinois, Minnesota, Wisconsin, Iowa, California, Texas, New Mexico, Colorado and Missouri. It was really broad attendance, Kansas being a central location for the US. It was quite a drive for everyone, but a very worthwhile one.

Pat McCleave and his Peter Goldsmith Skylark.

The field is composed of two great, long, wide strips (700ft x 150ft) oriented N-S and ENE-WSW, with no major obstacles that are close except two retention ponds on the north side. It’s better to be long than short but if you are well lined up you could use up to 1000ft of runaway. The surrounding area consists of various field crops and some cattle pasture along with groups of trees, variations of topology and bushes that combine to make this field very friendly for thermal development. Other than the owner’s house on the back of the flying area and a power line 2000ft away from where you fly, not much in the way of no fly zones.

View of the field from the clubhouse deck.

Weather in Kansas at this time of the year (mid-September) can be variable but is generally warm, with some moderate wind and heavy thermals. During our stay, we encountered some warm weather — warm enough to enjoy the AC of the club house, but not too hot to make it miserable. The thermal conditions have been unusual for this time of the year with no cloud cover, very light winds, and weak thermals except at midday; probably an inversion layer was preventing the booming thermals to take place, but for my taste that is the weather I prefer.

Towing duties were handled by the pillar of that venue Jim Frickey with is trusted Hangar 9 *Pawnee,* along with Kevin Kavaney with his Peter Goldsmith *Chmelak*, Tim Mattsson and his *Bidule 170* and me with my trusted *Bidule 111.* Anything could have been (and was) towed — from a 2m glider to a 9m half-scale Rosenthal *AS 33*.

Jim Frickey, the chief tow pilot, at work.

This event was the occasion to maiden a 9m *AS 33* built this summer from a Rosenthal kit. The first flight is always an intense moment, especially when it is the pilot's first very big sailplane. Nine meters is impressive, not so much for the wing span but a half scale fuselage is HUGE! No problem for radio install at all! It is not very easy to find a tow plane that can pull such a beast so it was decided to put a front electric sustainer (FES) system on this plane in order to be autonomous in case there is no such tow plane available. Also, it's nice to have a get-out-of-jail-free card in case something gets in the way during landing. As readers know, when the thermal cycle goes away it is generally raining sailplanes on the runaway some minutes after. In that regard, to be able to go back up and wait for the proper moment to land

safely is definitely something I want on all of my sailplanes.

Instead of a costly pylon, the *AS 33* has a brushless out runner driving a Torcman system (FES Uni 8) in the nose that has the advantage of not having to cut the nose — they never match right! That's a very big plus for me. You can also remove the prop from the airframe — for the look, of course, but certainly for safety. Last thing before take off, plug the pro adapter in, first thing on landing, get the prop adapter out. On top of that, it leaves you with the ability to test the motor when you plug the battery. Yes, like everyone, when in a rush I forgot (twice!) to plug in the propulsion battery.

A first flight is always a stressful moment but — oh boy! — the reward is also something else!

Nine meter, half-scale Rosenthal AS 33 first flight.

There were not too many mishaps during this event: a bush landing during a distressed moment, and I have the win of the weekend by flying somebody else's airplane, I flew a cross tail sailplane for a good five minutes thinking I

had an aileron problem and my sailplane was only turning one way. To top that off, I only realized it after a while as the sailplane I was flying was my *Edelweiss* — a V-tail! Build, fly, crash and repeat, as they say!

A minute of silence for my Edelweiss, along with my supportive friends.

This 2021 edition of the Mickey Sullivan definitely provided a taste of what I've been missing — and a desire to make it back in 2022. The next edition will take place September 22 through 25, so pencil it in your schedule now and see you there.

Above, a few more pictures of the 2021 event so you know what you'll be

missing if you don't make it to the Mickey Sullivan Memorial Aerotow in 2022!

Resources

- **Clearview Field** — from the website: "*Located in the heart of America, Clearview is dedicated to providing a well manicured 750' smooth grass runway for professional, amateur and beginner remote control pilots and enthusiasts. Pilots, their families and spectators can relax in the Clearview Clubhouse and enjoy great country cooking...*"

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

Electricity for Model Flyers

Part IV: The Current State of Battery Technologies

Peter Scott

The record-breaking Zephyr high altitude platform station (HAPS) mentioned in the article. It will also be the subject of a future article here in RCSD. (image: Zephyr | Airbus)

The advantages of electric flight are too obvious to repeat. The only real disadvantage is the battery. It is large and heavy and doesn't contain enough energy. The IC-heads rightly point out that when we leccies applaud our models managing a ten minute flight they can do that several times over. Each time I buy new batteries for my power models I add another 0.5Ah to the capacity, so now I bung 500g bricks into even modest models. And still I only get maybe twelve minutes. And the ducted fan flyers only get three or four minutes compared with double that for gas turbines running on paraffin (kerosene).

The key criterion is energy density. This is the amount of energy the cell can store per litre. The energy is usually specified as watt-hours (Wh). Colloquially energy density may also be used for energy per kilogram, though the accurate term for this is specific energy. Secondary factors are cyclability (how many times it will recharge), charge time and safety. A comparison of specific energies shows that currently methanol has twenty times and petrol (gasoline) forty-five times the specific energy of a lipo. However in theory lithium-air could achieve parity or better with petrol.

I have left out the lithium polymer (ie. lipo) batteries that we currently (oh dear!) use. So, what is on the horizon for we leccies? I did a major read of publically available sources that are listed at the end in the *Resources* section. They range from published company information to university reports. Of course it's anyone's guess which will mature into a form suitable for flying.

Why does this matter for glider flyers? After all we only use batteries during climbs and for powering the receiver and servos. Well, wouldn't it be nice (as the Beach Boys sang) to have a tiny battery that we could rely on for a whole day's flying and possibly charge in situ? That would make fuselage design a lot simpler and more elegant. No more easily removable canopies for one thing. Some indoor flyers use super-capacitors that can be charged in seconds.

At the moment lithium is the most-used material for batteries powering an electric motor. That is because it is highly reactive so each cell produces a high voltage and it is light. However there are three problems with it. It isn't in short supply but it is found in relatively few countries so making supply and price dependent on politics, greed and war. Its reactivity makes it dangerous under some conditions as I am sure we have all found. Perhaps most serious of all, refining it is highly polluting. Over two million litres of water are needed

to produce a tonne of lithium and the methods used run the risk of ground water pollution in the event of leakage or accidents. It is also expensive. Other metals or materials will probably become dominant eventually, with iron, zinc or aluminium being likely candidates. These are all safer, much cheaper and their sources are worldwide.

This is, I hope, is a complete summary of the technologies available or in development at the moment:

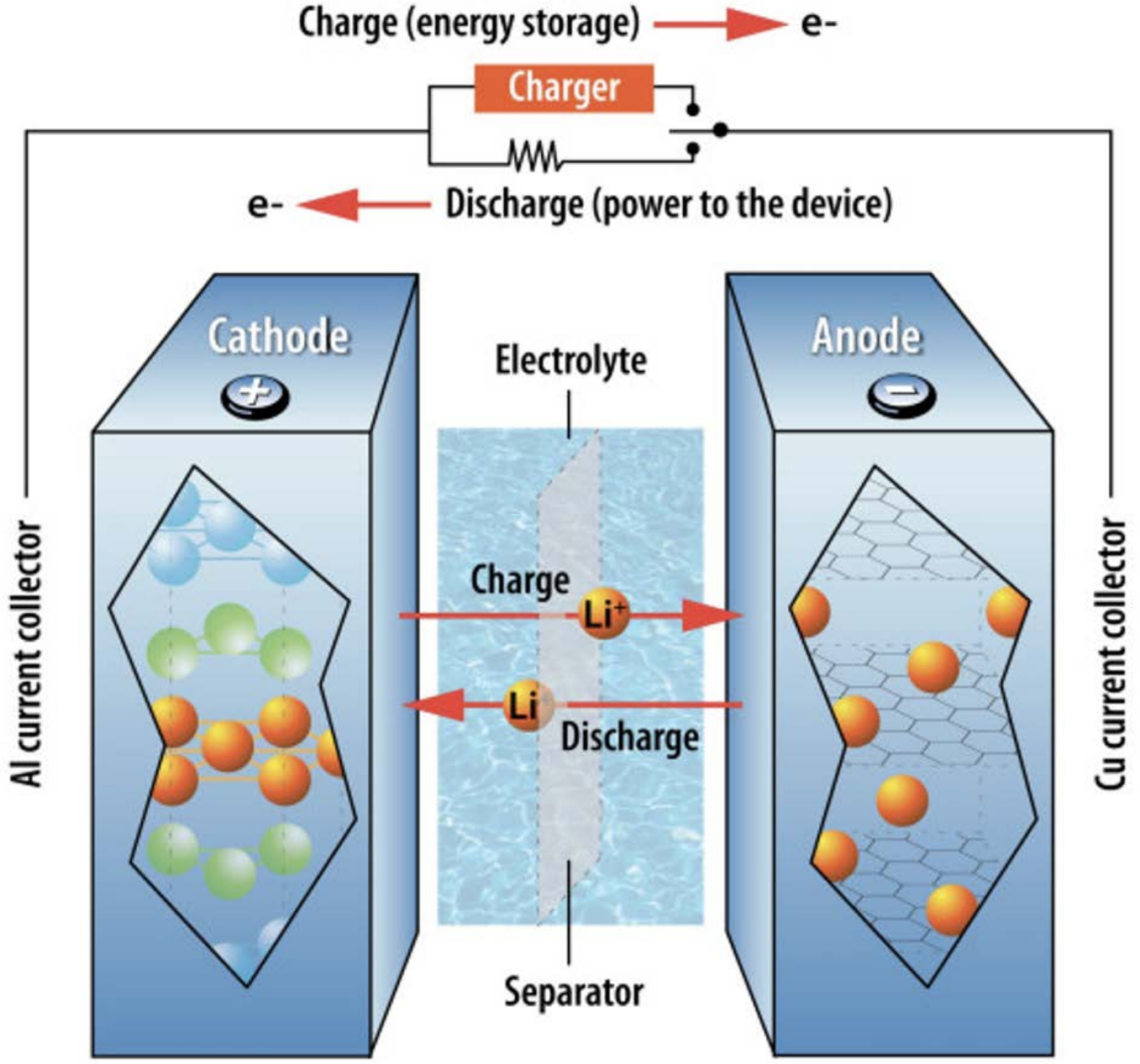
Lithium-Ion

Lithium-ion batteries (LIBs) are currently used in the majority of electric vehicles, and it's likely that they will remain dominant into the next decade. Manufacturers, including Tesla and Nissan (see *Resources* below) have invested heavily in this technology. In LIBs, positively charged lithium ions travel between the anode and the cathode in the electrolyte. LIBs have a high cyclability — the number of times the battery can be recharged while still maintaining its efficiency — but a low energy density — the amount of energy that can be stored in a unit volume. LIBs have garnered a bad reputation for overheating and catching on fire (for example Boeing jets, Tesla cars and a variety of laptops), so manufacturers have not only worked to make LIBs more stable, but they have also developed many safety mechanisms to prevent harm if a battery were to catch fire.

The LIBs on the market today primarily use graphite or silicon anodes and a liquid electrolyte. A lithium anode has been the holy grail for a long time because it can store a lot of energy in a small space (that is, it has a high energy density) and is very lightweight. Unfortunately, lithium heats up and expands during charging, causing leaked lithium ions to build up on a battery's surface. These growths short-circuit the battery and decrease its overall life. Researchers at Stanford recently made headway on these

problems by forming a protective nano-sphere layer on the lithium anode that moves with the lithium as it expands and contracts.

Movement of lithium ions and electrons in a lithium-ion battery during charging and use.



Source: Argonne National Laboratory and used under Creative Commons.

New Generation Lithium-Ion

What Is It?

In lithium-ion (Li-ion) batteries, energy storage and release is provided by the movement of lithium ions from the positive to the negative electrode back and forth via the electrolyte. In this technology, the positive electrode acts as the initial lithium source and the negative electrode as the host for lithium. Several chemistries are gathered under the name of Li-ion batteries, as the result of decades of selection and optimization close to perfection of positive and negative active materials. Lithiated metal oxides or phosphates are the most common material used as present positive materials. Graphite, but also graphite/silicon or lithiated titanium oxides are used as negative materials.

With actual materials and cell designs, Li-ion technology is expected to reach an energy limit in the next coming years. Nevertheless, very recent discoveries of new families of disruptive active materials should unlock present limits. These innovative compounds can store more lithium in positive and negative electrodes and will allow for the first time to combine energy and power. In addition, with these new compounds, the scarcity and criticality of raw materials are also taken into account.

What Are Its Advantages?

Today, among all the state-of-the-art storage technologies, Li-ion battery technology allows the highest level of energy density. Performances such as fast charge or temperature operating window (-50C up to 125C) can be fine-tuned by the large choice of cell design and chemistries. Furthermore, Li-ion batteries display additional advantages such as very low self-discharge and very long lifetime and cycling performances, typically thousands of

charging/discharging cycles.

When Can We Expect It?

New generation of advanced Li-ion batteries is expected to be deployed before the first generation of solid-state batteries. They'll be ideal for use in applications such as energy storage systems for renewables and transportation (marine, railways, aviation and off-road mobility) where high energy, high power and safety is mandatory.

Zinc-Air

Scientists at Sydney University believe they've come up with a way of manufacturing zinc-air batteries much cheaper than current methods. Zinc-air batteries can be considered superior to lithium-ion, because they don't catch fire. The only problem is they rely on expensive components to work. Sydney Uni has managed to create a zinc-air battery without the need for the expensive components, but rather some cheaper alternatives. Safer, cheaper batteries could be on their way!

Aluminum-Ion

Aluminium-ion batteries are similar to lithium-ion batteries (LIBs) but have an aluminium anode. They promise increased safety at a decreased cost over LIBs, but research is still in its infancy. Scientists at Stanford recently solved one of the aluminium-ion battery's greatest drawbacks, its cyclability, by using an aluminium metal anode and a graphite cathode. This also offers significantly decreased charging time and the ability to bend. Researchers at Oak Ridge National Laboratory are also working on improving aluminum-ion battery technology. *[Aluminium is a lot less reactive than lithium so presumably will produce a lower voltage per cell. Might need more cells in*

each pack. — PS]

Aluminium-Air

A car has managed to drive 1,100 miles on a single battery charge. The secret to this super range is a type of battery technology called aluminium-air that uses oxygen from the air to fill its cathode. This makes it far lighter than liquid filled lithium-ion batteries to give car a far greater range.

Lithium-Sulphur

What Is It?

In Li-ion batteries, the lithium ions are stored in active materials acting as stable host structures during charge and discharge. In lithium-sulphur (Li-S) batteries, there are no host structures. While discharging, the lithium anode is consumed and sulphur transformed into a variety of chemical compounds; during charging, the reverse process takes place.

What Are Its Advantages?

A Li-S battery uses very light active materials: sulphur in the positive electrode and metallic lithium as the negative electrode. This is why its theoretical energy density is extraordinarily high: four times greater than that of Li-ion. That makes it a good fit for the aviation and space industries.

Battery manufacturer Saft has selected and favoured the most promising Li-S technology based on solid state electrolyte. This technical path brings very high energy density, long life and overcomes the main drawbacks of the liquid based Li-S (limited life, high self-discharge). Furthermore, this technology is supplementary to solid state Li-ion thanks to its superior gravimetric energy density (+30% at stake in Wh/kg).

Li-S batteries typically have a lithium anode and a sulphur-carbon cathode. They offer a higher theoretical energy density and a lower cost than LIBs. Their low cyclability, caused by expansion and harmful reactions with the electrolyte, is the major drawback. However, the cyclability of Li-S batteries has recently been improved. Li-S batteries, combined with solar panels, powered the famous three-day flight of the *Zephyr* unmanned aerial vehicle. NASA has invested in solid-state Li-S batteries to power space exploration, and Oxis Energy is also working to commercialize Li-S batteries. *[The higher energy density of this cell looks promising for models. — PS]*

Solid State

What Is It?

Solid state batteries represent a paradigm shift in terms of technology. In modern Li-ion batteries, ions move from one electrode to another across the liquid electrolyte (also called ionic conductivity). In all-solid-state batteries, the liquid electrolyte is replaced by a solid compound which nevertheless allows lithium ions to migrate within it. This concept is far from new, but over the past ten years — thanks to intensive worldwide research — new families of solid electrolytes have been discovered with very high ionic conductivity, similar to liquid electrolyte, allowing this particular technological barrier to be overcome.

What Are Its Advantages?

The first huge advantage is a marked improvement in safety at cell and battery levels: solid electrolytes are non-flammable when heated, unlike their liquid counterparts. Secondly, it permits the use of innovative, high-voltage high-capacity materials, enabling denser, lighter batteries with better shelf-life as a result of reduced self-discharge. Moreover, at system level, it will bring additional advantages such as simplified mechanics as well as thermal and safety management.

As the batteries can exhibit a high power-to-weight ratio, they may be ideal for use in electric vehicles *[and model aircraft probably. — PS]*

When Can We Expect It?

Several kinds of all-solid-state batteries are likely to come to market as technological progress continues. The first will be solid state batteries with graphite-based anodes, bringing improved energy performance and safety. In time, lighter solid state battery technologies using a metallic lithium anode should become commercially available.

Solid State Lithium-Ion

Solid state batteries traditionally offer stability but at the cost of electrolyte transmissions. A paper published by Toyota scientists writes about their tests of a solid state battery which uses sulphide superionic conductors.

The result is a battery that can operate at super capacitor levels to completely charge or discharge in just seven minutes — making it ideal for cars. Since it’s solid state that also means it’s far more stable and safer than current batteries. The solid-state unit should also be able to work in as low as -30C and as high as 100C.

The electrolyte materials still pose challenges so don’t expect to see these in cars soon, but it’s a step in the right direction towards safer, faster charging batteries.

Sodium-Ion

Scientists in Japan are working on new types of batteries that don’t need lithium. These new batteries will use sodium, one of the most common materials on the planet rather than rare lithium — and they’ll be up to seven

times more efficient than conventional batteries.

Research into sodium-ion batteries has been going on since the eighties in an attempt to find a cheaper alternative to lithium. By using salt, the sixth most common element on the planet, batteries can be made much cheaper. Commercialising the batteries is expected to begin for smartphones, cars and more in the next five-to-ten years.

Metal-Air

Metal-air batteries have a pure metal anode and an ambient air cathode. As the cathode typically makes up most of the weight in a battery, having one made of air is a major advantage. There are many possibilities for the metal, but lithium, aluminium, zinc, sodium remain the forerunners. Most experimental work uses oxygen as the cathode to prevent the metal from reacting with CO2 in the air, because capturing enough oxygen in the ambient air is a major challenge. Furthermore, most metal-air or metal-oxygen prototypes have problems with cyclability and lifetime.

Graphene

Graphene batteries are available for flying now but they are just a variant of standard lipo-style batteries. However:

Samsung's Graphene Battery

Samsung has managed to develop 'graphene balls' that are capable of boosting the capacity of its current lithium-ion batteries by 45 percent, and and recharging five times faster than current batteries. To put that into context, Samsung says its new graphene-based battery can be recharged fully in 12 minutes, compared to roughly an hour for the current unit.

Samsung also says it has uses beyond smartphones, saying it could be used for electric vehicles as it can withstand temperatures up to 60C.

Grabat Graphene Batteries

Graphene batteries have the potential to be one of the most superior available. Battery manufacturer Grabat has developed graphene batteries that could offer electric cars a driving range of up to 500 miles on a charge.

Graphenano, the company behind the development, says the batteries can be charged to full in just a few minutes and can charge and discharge 33 times faster than lithium ion. Discharge is also crucial for things like cars that want vast amounts of power in order to pull away quickly. There's no word on if Grabat batteries are currently being used in any products, but the company has batteries available for cars, drones, bikes and even the home.

Sand

This alternative type of lithium-ion battery uses silicon to achieve three times better performance than current graphite Li-ion batteries. The battery is still Li-ion like the one found in your smartphone, but it uses silicon instead of graphite in the anodes.

Scientists at the University of California Riverside have been focused on nano silicon for a while, but it's been degrading too quickly and is tough to produce in large quantities. By using sand it can be purified, powdered then ground with salt and magnesium before being heated to remove oxygen resulting in pure silicon. This is porous and three-dimensional which helps in performance and, potentially, the lifespan of the batteries. We originally picked up on this research in 2014 and now it's coming to fruition.

Silanano is a battery tech startup that's bringing this technique to market

and has seen big investment from companies like Daimler and BMW. The company say that its solution can be dropped into existing lithium-ion battery manufacturing, so it's set for scalable deployment, promising 20 per cent battery performance boost now, or 40 per cent in the near future.

Gold Nanowire

Great minds over at the University of California Irvine have cracked nanowire batteries that can withstand plenty of recharging. The result could be future batteries that don't die.

Nanowires, a thousand times thinner than a human hair, pose a great possibility for future batteries. But they've always broken down when recharging. This discovery uses gold nanowires in a gel electrolyte to avoid that. In fact, these batteries were tested by recharging them over 200,000 times in three months and showed no degradation at all. *[I think these were the ones NASA was keen on, but are currently very expensive. — PS]*

Foam

Prieto Battery has managed to crack this with its battery that uses a copper foam substrate. This means these batteries will not only be safer, thanks to having no flammable electrolyte, but they will also offer longer life, faster charging, five times higher density, be cheaper to make and be smaller than current offerings.

Prieto aims to place its batteries into small items first, like wearables. But it says the batteries can be upscaled so we could see them in phones and maybe even cars in the future.

Ryden Dual Carbon

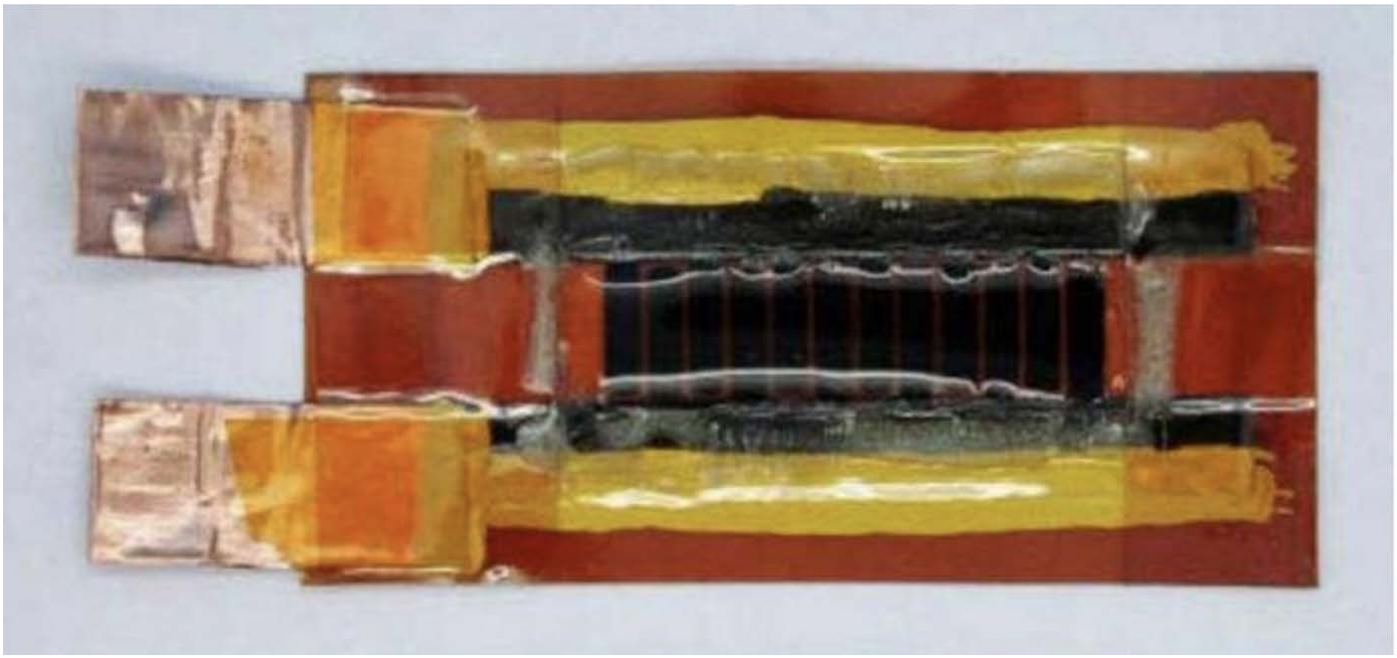
Power Japan Plus has announced a new battery technology called Ryden dual carbon. Not only will it last longer and charge faster than lithium but it can be made using the same factories where lithium batteries are built. The batteries use carbon materials which mean they are more sustainable and environmentally friendly than current alternatives. It also means the batteries will charge twenty times faster than lithium ion. They will also be more durable, with the ability to last up to 3,000 charge cycles, plus they are safer with lower chance of fire or explosion.

Carbon-Ion

Oxford, UK-based company ZapGo has developed and produced the first carbon-ion battery that's ready for consumer use now. A carbon-ion battery combines the superfast charging capabilities of a supercapacitor, with the performance of a Lithium-ion battery, all while being completely recyclable. The company has a powerbank charger that be fully charged in five minutes, and will then charge a smartphone up to full in two hours.

Laser-Made Micro Supercapacitors

Scientists at Rice University have made a breakthrough in micro-supercapacitors. Currently, they are expensive to make but using lasers that could soon change.



By using lasers to burn electrode patterns into sheets of plastic, manufacturing costs and effort drop massively. The result is a battery that can charge 50 times faster than current batteries and discharge even slower than current supercapacitors. They're even tough, able to work after being bent over 10,000 times in testing.

Iron-Air

Iron-air batteries promise a considerably higher energy density than present-day lithium-ion batteries. In addition, their main constituent — iron — is an abundant and therefore cheap material. Scientists from Forschungszentrum Jülich are among the driving forces in the renewed research into this concept, which was discovered in the 1970s. Together with American Oak Ridge National Laboratory (ORNL), they successfully observed with nanometre precision how deposits form at the iron electrode during operation. A deeper understanding of the charging and discharging reactions is viewed as the key for the further development of this type of rechargeable battery to market maturity. The results were published in the renowned journal Nano Energy.

For reasons including insurmountable technical difficulties, research into metal-air batteries was abandoned in the 1980s for a long time. The past few years, however, have seen a rapid increase in research interest. Iron-air batteries draw their energy from a reaction of iron with oxygen. In this process, the iron oxidizes almost exactly as it would during the rusting process. The oxygen required for the reaction can be drawn from the surrounding air so that it does not need to be stored in the battery. These material savings are the reason for the high energy densities achieved by metal-air batteries.

“We consciously concentrate on research into battery types made of materials that are abundant in the Earth’s crust and produced in large quantities,” explains institute head Prof. Rüdiger-A. Eichel. “Supply shortages are thus not to be expected. The concept is also associated with a cost advantage, which can be directly applied to the battery, particularly for large-scale applications such as stationary devices for the stabilization of the electricity grid or electromobility.”

There is, however, still a long way to go until market maturity. Although isolated electrodes made of iron can be operated without major power losses for several thousand cycles in laboratory experiments, complete iron-air batteries, which use an air electrode as the opposite pole, have only lasted 20 to 30 cycles so far.

Do you know of an up-and-coming battery technology not included above? By all means, please add a *Response* below and I’ll include it in a future update of this article. Thank you very much for reading.

Resources

Comparison of Energy and Power Densities

Type	Specific Energy (Wh/kg)	Energy Density (Wh/litre)	Specific Power (W/kg)	Cycles
Lead Acid	33 - 42	60 - 110	180	500 - 800
Nickel-Cadmium	40 - 60	50 - 150	150	2000
Nickel Metal-Hydride	60 - 120	140 - 300	250 - 1000	500 - 2000
Lithium-Ion	100 - 350	250 - 620	250 - 340	400 - 1200
Lithium-Polymer	100 - 265	250 - 730		
Lithium-Sulphur	500	350		
Lithium-Air	11 - 140	6000		
Iron-Air	1200	9700		

Note: For comparison of specific energies: methanol 22.7 MJ/kg; petrol (gasoline) 45 MJ/kg; lipo 0.95 MJ/kg; lithium-air 40 MJ/kg. Of course liquid fuels are not 100% methanol or petrol so the true numbers will be lower.

Articles

- A Closer Look at Prieto Battery Innovation: Foam Technology
- A Long-Life, High-Rate Lithium/Sulfur Cell: A Multifaceted Approach to Enhancing Cell Performance
- Aluminum Battery from Stanford Offers Safe Alternative to Conventional

Batteries
- Amorphous Bimetallic Oxide–Graphene Hybrids as Bifunctional Oxygen Electrocatalysts for Rechargeable Zn–Air Batteries
- Electric Car, with Light Aluminium-Air Battery, Travels 1,100 Miles on a Single Charge, Take Note Tesla
- Energy Density in Battery Packs or Gasoline
- Five Emerging Battery Technologies for Electric Vehicles
- Future Batteries, Coming Soon: Charge in Seconds, Last Months and Power over the Air
- Get Three Times More Battery Life by Using Sand
- High-Power All-Solid-State Batteries Using Sulfide Superionic Conductors
- How Lithium Ion Batteries Grounded the Dreamliner
- Interconnected Hollow Carbon Nanospheres for Stable Lithium Metal Anodes
- Iron-Air Batteries Promise Higher Energy Density Than Lithium-Ion Batteries
- Nanowire Battery Can Extend Your Phone Battery Life by Hundreds of Thousands of Times
- NASA Selects Proposals to Build Better Batteries for Space Exploration
- Nissan Adds More Range to Leaf Electric Car
- Ryden Dual Carbon Battery Charges Twenty Times Faster than Lithium Ion, Lasts Longer, Due This Year
- Samsung Hails ‘Graphene Ball’ Battery Success
- Scientists Develop a Better Graphene Battery
- Scientists See the Light on Microsupercapacitors: Laser-Induced Graphene Makes Simple, Powerful Energy Storage Possible
- Solar Plane Makes Record Flight
- Sony, HP, Dell, Toshiba Recall Thousands of Faulty Lithium-Ion Laptop Batteries

- Stanford Team Achieves 'Holy Grail' of Battery Design: A Stable Lithium Anode
- Tesla Adds Titanium Underbody Shield and Aluminum Deflector Plates to Model S
- The Critical Role of Phase-Transfer Catalysis in Aprotic Sodium Oxygen Batteries
- Three Battery Technologies That Could Power the Future

Company Websites

- Grabat Energy
- Oxis Energy
- Power Japan Plus
- Saft Batteries
- Sila
- Tesla (Gigafactory)
- Zephyr | Airbus

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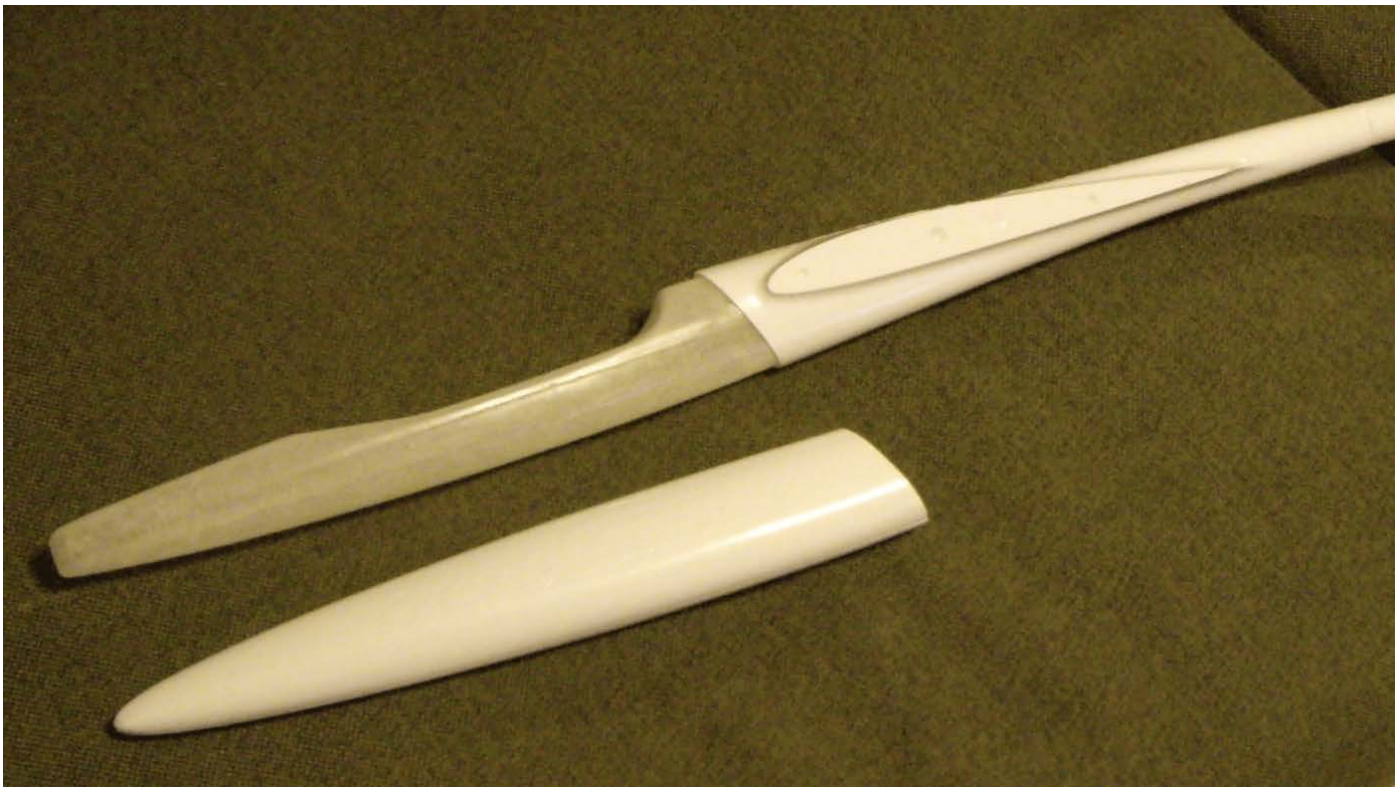
Shinobi | A Home-Grown Moulded Fuselage

Part IV: We Begin the Mould Making Process with the Nose Cone

James Hammond



*Readers who have not already done so may want to read the **previous parts** of this series before continuing with the article below. — JH*

Now we attend to making the parting frame/plug seam. Here's a short checklist to make sure everything is at the ready:

- The parting frame is waxed with mould release? Check!
- The plug is set at the correct height in the parting frame? Check!

- The mould fence is ready — waxed and beaded with modelling clay? Check!

Cutting the Modelling Clay Flush with the Parting Board

Cutting the modelling clay along the seam line to make the transition between the parting board and the plug can be easy if done right, and a nightmare if done wrongly. First, we need a cutting tool — and this has to be something thin and flat so that it can slide along the parting board surface and follow the plug profile without cutting it while slicing the modelling clay bead flush with the surface. There are many tools that can be used, but I have found that either a modified box cutter blade or a thin spatula works best.

> ***Advice:*** *Just to reiterate for emphasis: use a* ***thin*** *cutting tool — this is* ***really*** *important.*

The objective is to cut the modelling clay neatly but without doing any damage in the process. The tool will have to be carefully rounded at the tip because the last thing we want to do is cut or score the plug surface. Finally — before attempting the cut, make sure your room is not too cold. The cooler modelling clay gets the harder it becomes, and while we don't want it too soft, we also don't want it to be hard either.

Three of the thin and flat tools that can be used to cut the seam — note the box cutter blade has not been rounded. Beware!

Let's Cut the Seam

Place the cutter flat on the parting frame surface and push it gently into the modelling clay bead. With gentle pressure, you will feel the cutter touch the surface of the plug, but don't push it — feel it. Now slowly draw the cutter along the seam, all around the entire profile. Once the tool has made its way around the plug, carefully remove the cut top of the bead to expose the newly cut and hopefully flush modelling clay surface, which — if you have done a good job will be nice and flat and flush with the parting board.

The seam between the plug, parting board and the finished mould surfaces is extremely important and spending a little time here will prevent you from having regrets later. If the cut is not exactly as you would like it, then don't settle for a less than perfect joint — put in some more clay, check the alignment and repeat the process until it's really nice and flush.

The modelling clay has been trimmed to leave a nice sharp seam around the nose cone portion of the plug.

Now it's time to place the mould fence, so just as we did with the fuselage plug, we'll put a bead of clay around the cutout, and then press it lightly onto the plug surface until it seats on the parting frame board. A couple of pieces of double-sided tape under the block supports will anchor it in place for now. After that, use the cutting tool to cut the modelling clay bead parallel with the mould fence surface and the plug, in the same way as you did with the horizontal seam.

Now for the good bit: making the first part of the female mould set. Before proceeding, a few more checks:

- Are the parting board and plug surfaces all clean and pre-waxed with mould release? Check!
- Are the seams all nice and sharp? Check!

A Parting Shot: The Case For PVA

At this point, before you get your mixing pots out, you might like to think about an insurance policy in the form of a layer of PVA release agent. A light layer of PVA will almost certainly guarantee that the plug will release nicely from the mould when that exciting time comes. PVA, as it comes from the manufacturer is always rather thick but is easily diluted with water. It can be brushed on with a fine brush or better sprayed on with a normal paint spray gun or even a cheap plastic spray bottle set to a fine mist. My advice here is to seriously think about this option as it provides a virtual guarantee that the mould will release. But, if you do opt for this solution, please wait for the PVA to dry thoroughly before going to the sticky bits. If you are in a hurry, a waft with SWMBO's hairdryer accelerates things.

Gelcoating the Plug and Parting Frame

There are choices here. If you will only want to make one, or at best a few parts with your mould set then there is no real point in using expensive tooling resins for the gelcoat. Yes, they are tougher and harder but they are also a bit costly, and depending on the size of your mould set could work out to be quite an investment. For small batch moulds, I use a mixture of epoxy, fumed silica (Cabosil) and often, though not always a paint colour dye. The reasons for using the paint colour dye are several:

A Coloured Gelcoat:

- will easily show up air trapped in the laminations during the layup

- will show up paint unevenness in use — unless the paint colour is the same as the mould
- will highlight the mould finish — a big asset during polishing

A Coloured Mould Surface:

- will easily show up any dirt or wax buildup
- will help with the final buffing of the mould release wax prior to the layup by showing up unbuffed wax

Applying the Gelcoat Mix

For a nose cone of this size, not much gelcoat is required — as I remember it was 60g. To do it the 'homemade' way, thoroughly mix up the epoxy and hardener then add two tablespoons of fumed silica (Cabosil) to give a nice double cream consistency. After mixing I usually leave it alone for five to ten minutes in order to allow the silica to develop a fully thixotropic property and also to allow some of the bubbles from the mixing to disperse. A rough recipe is about one tablespoon of Cabosil to 30g of mixed resin.

With the mixture mixed to a nice smoothness, use a small soft brush to paint it carefully into the seams first, then follow that by brushing the gelcoat over the surfaces of the plug, the mould fence, and the parting frame. Try to get the surface as smooth and as even as you can, and especially avoid 'ruts' on the surface. With a little care, it's possible to get a smooth layer of about a millimetre or two (1/16~1/8") in thickness all over the surfaces. If you have the right amount of Cabosil in the mix, the gelcoat will not run too much on the curved surfaces.

The gelcoat has been applied to the nosecone. Here I should admit that despite my avowals in favour of a coloured gelcoat, in this case, I did not add the black paint dye as it was still in transit — what was that about being patient?

> ***Advice:*** *For each part of the mould, plan to get all of the glass laminating work done on the same day as the gelcoat is applied.*

E-Glass or S-Glass: What's the Difference?

E-Glass has the 'E' prefix because of its use in electrical applications such as printed circuit boards. It's normally a lot cheaper than S-Glass and is alkali-free. Historically E-Glass was the first glass type used for continuous filament formation. It's not as strong in tension as S-Glass but is normally much cheaper.

S-Glass has the prefix ‘S’ because of its higher dynamic strength than its ‘E’ counterpart. S-Glass is used when higher tensile strength (modulus) is required. For reference, S-Glass is approximately 30% stronger and 10% stiffer than E-Glass.

> ***Advice:*** *Always check when you buy fabric that what you are buying is actually S-Glass and not its lower tensile strength counterpart E-Glass.*
>
> ***Advice:*** *S-Glass is superior in strength to E-Glass; however, we are making a mould here which will end up as a pretty thick and therefore strong laminate. You might want to save some money and use E-Glass, but remember that you may need more epoxy and that can be more expensive than the fabric!*
>
> ***Advice:*** *If you buy from less-reputable companies sight unseen you may be duped, so make sure you are actually getting what you pay for. Sometimes E-Glass can be identified by thin black lines running through the weave.*

The first layer of 3oz S-Glass has been applied to the still-green gelcoat. Note the 45-degree angle.

The Epoxy/Fibre Matrix

Simply explained, what we are trying to achieve here is a composite consisting of glass or other fibres that are held rigid in an epoxy matrix and when bonded together will form a tough strong structure with both components contributing equally to the whole. But problems can arise if we are not careful and don't do our planning well.

Two Kinds of Bonding: Chemical and Mechanical

The chemical bond is far stronger and more reliable than the mechanical

type as the wet epoxy layers bonded actually unite on a molecular level to become an integrated mono-structure. But this can only happen when the first layer of epoxy is still 'green' and so is chemically filial to the new application. 'Green' is the term applied to the epoxy that has not yet hardened. If the first layer of epoxy has been allowed to harden for too long then it will have passed the stage where a chemical bond was possible.

As a simple test, in a good green state, the gelcoat should be easily marked by a fingernail but not sticky.

The mechanical bond relies on the adhesion of the wet, second layer of epoxy to a cured, or partially cured first layer, and ideally needs a roughened surface to work well. Hardened epoxy is not an ideal condition for actually bonding or glueing multi-layer composites.

That's it for this session. Next time: glassing the first mould half — otherwise known as the *The Big Stickup*.

Between now and then, if you have any questions please don't hesitate to post them to the *Responses* section below and I will do my best to answer them. Putting them here also means others will benefit from both your question and my answer.

Thanks for reading and good luck with your project!

*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**.*

Flying Back In Time

A nostalgic look back at the Ghost Squadron Aerotow held at Middle Wallop, Hampshire in October of 2015.

Chris Williams

At the front of the triangle of gliders, a Greenley tug, of course!

The military base of Middle Wallop in Southern England is reputed to be the largest grass aerodrome in Europe. For over a decade the UK scale soaring fraternity enjoyed many, many aerotows on this site, before a change of base priorities sadly bought it all to a close in 2019. This article was first published in Flying Scale Models *in 2015.— CW*

I would imagine it to be highly unlikely that 2015 will have gone down in anyone's diary as a premium flying year, but for the scale soaring fraternity, the last event of the season at Middle Wallop certainly put the crack in the

Christmas cracker. For starters, courtesy of Mr. Putin, a high pressure system all the way from Russia wrapped the UK in it's chilly embrace, and the strong breeze that was forecast failed to materialise, giving us some lovely smooth air to fly in, even if the lift was hard to find. As if that weren't enough, we had been promised a fly-by from the Vulcan, which was in the final days of its flying career, an event keenly anticipated by all concerned. In the days preceding the aerotow, things did not look quite so rosy, though. New management at Middle Wallop had seemingly resulted in a ban on all types of model flying activity on this military base, as a variety of new brooms sought to sweep clean. With John Greenfield out of the loop due to family concerns, it fell to tug pilot Pat Marsden to climb the mountain of paperwork that was required to make things happen, one of the spin offs of which was that I felt it necessary to nominate him Man-of-the-Match!

As usual, there was much to see and admire, as my pal Motley and I rolled up. Paul Bartlett's Duo Discus was one such machine, rendered more interesting by the sight of its red moustache. There was time when the sight of a propeller perched on the front of a glass machine would cause a rash of pursed lips amongst the purists, but these days they have been forced down off their high chairs, because such things can now be found on the front of full-size glass sailplanes. Known as 'sustainers' the idea is that should a glider pilot find himself low and out of ideas at the end of days soaring, he can unfurl said propeller and use it as get-out-of-jail-free card. So, you still need an aerotow to get off the ground, but once airborne, the sky is your oyster. Paul's Duo was made by Paritech, to that company's very high standard (and price!) and was impressive indeed to see in action. Long time Middle Wallop fan, Brian Sharp, had come down all the way from Scotland, bringing with him his 1:3.5 scale ASW 20 from the newly revamped Pat Teakle kit and his 3rd-scale o/d BGA 351. Over the weekend, he was the keenest of all to get a flight, and his face was never far from the ever-present

glider queue. Being of Scottish descent, his reasoning was quite simple: the £300 cost of his weekend had to be divided by each flight accomplished. Obviously, the more flights he achieved during that time , the lower the unit cost of each flight! By my reckoning, the final cost-per-flight ratio must have worked out at around 10p!

Left: Steve Fraquet's 1/4 scale Goppingen Wolf gets its 1st tow under new management. **Right**: The perils of turning back! This L213a runs out of energy on the final turn.

During the Saturday evening, somebody came up with a pretty bright idea. Antonia Gigg's better half Mel was credited with the brainstorm and his notion was this: during the half-hour stand down the next day, when the

Vulcan fly-past was due to take place, might it be a good idea to place all the gliders in a delta formation on the ground in the hopes of catching the eye of pilot as he flew by?

As V-hour approached, the tugs fell silent and the last of the gliders landed. (Brian, probably).

There was a spate of feverish activity as the gliders and tugs were manhandled, with money changing hands to see who's model would be at the front of the formation, it turning out to be a tug, unsurprisingly. Once the task was completed, the crowd fell silent, eyes scanning the Eastern horizon. ''There she is" someone shouted, and a dot became visible, trailing a thin plume of smoke. Soon, the familiar shape hove into sight, and a groan went up: it looked as though she was going to pass well to the North of us. As she came nearer, the pilot made a discernable turn to the left, and there she was, low and almost overhead, to the familiar turbine whine accompaniment. The Vulcan then made a complete 360 and, could we believe it, came past once more. Now, it is believed in some quarters that the pilot saw the delta formation of gliders on the airfield and, filled with a natural human curiosity, came around for a closer look. This is a theory to which I subscribe wholeheartedly, and may God rot the socks of anyone who says different.

There is often talk of the Vulcan Howl, a noise peculiar to that particular machine, well there is another that makes a similar sound (see *Resources*, below). Out for its annual outing, my third scale DFS Habicht was once again cavorting in the skies above Middle Wallop. The Habicht was a German glider from the 1930's, designed specifically for aerobatics. It is reputed to have dived down into the arena during the 1936 Olympic Games with enough retained energy to glide off again and land somewhere, so far unspecified by history. I find my 30lb model somewhat intimidating, if a lot a fun, hence its limited annual appearance. Flights are short, somewhere

around two minutes each, as it is absolutely mandatory that aerobatics are committed as much as possible. This usually culminates in a relatively high speed pass and roll, during which a distinctive howl is heard. It's always fun to watch the unmitigated duck and turn white, muttering, "strewth, wot the heck was *that*!" In case you are wondering, the howl is caused by the strips of Mylar on the undersides of the wing vibrating in the slipstream when the ailerons are at full deflection. To hear the howl yourself, see *3rd Scale Habicht In HD* in *Resources*, below, and hear it from the on-board video.

Left: Author's 3rd scale Habicht on its annual outing (image: Barry Cole) **Right**: Man-of-the-Match tug pilot Pat Marsden takes a walk on the dark side with 1:3.5 scale Slingsby Petrel.

Staying on a personal note, there is another downside to using something only rarely. As this weekend was to be a special occasion, I decided to use the drop-off dolly on my two-seater Minimoa, the MO 2a. Normally it's too much faff to use it at an aerotow, as somebody has to run on the to take off area and retrieve the dolly, but gets worse, I decided to utilise the headlight, too. (This was fitted to the full-size presumably to aid a record duration attempt that might terminate in a night landing.)

So, trying to remember which switch did what, terminated on the first flight with me releasing the towline instead of the wheel. The tug pilot said

something in ancient Anglo Saxon, and then we re-set.

Left: All the way from Scotland, Brian Sharp with his ASW 20. **Right**: Plenty of wing flex on this Ventus-2c.

This time I got it right, released and turned on the light. (I don't know why: it's about as dim as a concussed tortoise). I flew around, but something didn't feel right: the Minimoa was wallowing around in the turns like a crab in handcuffs. The flight terminated in a landing-of-shame, whereupon I eventually realised that activating the light switch had had the inadvertent effect of knocking the adjacent switch and thus deactivating the coupled ailerons and rudder (CAR). As the Minimoa has an enormous all-moving rudder, the consequences are rather more noticeable than usual! I can tell you, I've gone right off the use of these aeronautical gadgets.

There wasn't too much in the way of glider damage over the weekend, but one incident did stick in my mind, which illustrated the perils of 'turning back'. I don't have a PPL, of course, but in a lifetime of reading aviation literature I've come across the warning: never turn back if the engine fails on

take off, unless there's an awful lot of altitude in the bank. There is a glider equivalent to this situation, and that is when it becomes obvious to the pilot that his approach has been too high and if he's not careful, he's going to land a long way upwind with the subsequent walk-of-shame. At the decision point, several factors come into play. Dependant on the height, a model with forgiving and efficient wing section might well be able to turn back in a 360 and land safely. The alternative is to land straight ahead, or to S-turn, never more than ninety degrees to the wind. (Side-slipping is an option, of course, but let's not go there). On this occasion the unfortunate pilot of an L213a made the wrong call and decide to turn back. It's a buttock-clenching manoeuvre: the model will almost always get through the downwind leg unscathed only to come a cropper on the crosswind when it becomes obvious that there not enough left on the altimeter, and the unconscious desire to pull back on the stick takes over, with the resultant spin into the deck. That this model was built up from a kit with all the labour involved makes it all the worse, and the moral is a sober one. It's better to be red in the face than to be forced back into the workshop.

When it was all finally over, and we were packing up the car, Motley and myself were of one mind: this had been one of the Ghost Squadron's best ever events: what a cracking way to end the year. Thanks must go to the guys and gals of the GS for all their efforts, especially Mr. Marsden for all paperwork wrangling, and we can only hope for more of the same next year.

That's the way to enjoy the show.

Resources

- [3rd Scale Habicht In HD] — video by the author: "*heavy Habicht howls in HD!*"
- [Vulcan XH558 Farewell Flight at Middle Wallop, Oct 2015] — contemporaneous video shot by Simon Ellis Wildlife Photography.

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

request.

Once Upon a Timer

I regret that I have but one octave to give.

Bob Dodgson

"Dave Banks spot landing his 'song. Steve Cameron timing." (image/caption:)

This story originally appeared in the 1994 NE Sailplane *catalogue. As usual, Bob's storytelling is timeless, so we're happy to have him tell this ripper to a whole new audience.— Ed.*

We all know that soaring is an exhilarating, cerebral, idyllic experience but we are often unaware of the hidden dangers that lurk ominously behind even the most innocent phases of the activity. While I am not talking about the obvious hazards such as winch accidents, I did witness one winch accident with a truly creative twist.

Dave Banks was flying in a Northwest Soaring Society Contest at the Seattle field. He was a leading contender and went boldly up to the winch to initiate his usual aggressive launch. All was going well until the retrieval line got wound around his transmitter antennae and jerked the transmitter out of his hands. With the instincts of a champion and the speed of a gazelle, there was Dave sprinting down the field with his transmitter ever just out of his grasp — until at last and a 50 yard dash later the glider lost some momentum and the retrieval line tension relaxed a bit allowing Dave to make the catch-of-the-day. Oh yes, if I remember correctly, he went on to max the flight and win the contest. However, to a lesser pilot or to a slower sprinter, this unexpected happenstance could have spelled disaster!

But now on to the hidden danger area of soaring. I wonder how many people realize that they are taking their lives in their hands every time they offer to time for another contestant? Most of us feel pretty safe timing because even though we are concentrating on the clock, we can always stand behind the pilot while he is landing. This way, if he overshoots a landing, the plane will hit him first!

However, even this clever plan can fail if you are timing for an out of control pilot with great self preservation skills. I once saw a pilot whose plane was coming in high and fast on a landing approach and was heading straight for him and instant suicide. The plane was two feet off the ground boring in on him at thirty miles an hour! Being focused on the clock and having his human guardrail in front of him for protection, the timer wasn't worried — until at the last instant when the pilot leaped into the air allowing his prize possession to whistle by beneath him. Needless to say, the glider 'took out' a disbelieving and ever afterward wary timer.

Lest you think this leaping over your incoming glider is always a great last-ditch, desperation pilot ploy, I have seen other occasions where the pilot has

sprung into the air with great alacrity only to re-kit his glider by accidentally landing squarely on top of it. Perhaps the worst case scenario for the pilot is when he gracefully catapults himself into the air a split second early and just clears the trailing edge of the incoming glider wings on his descent — ending up astraddle the turtledeck just in time for that fiberglass fin to forever alter his vocal range. It could be claimed that this is the ultimate sacrifice by the pilot as he bravely proclaims the immortal words "I regret that I have but one octave to give for my timer."

I am not proud to say that I was personally involved in a disastrous timer mishap, in a most non-heroic fashion. At the time, there were a few radio systems that would malfunction if the glider was flying far off and low over a transmitter on an adjacent frequency. One flyer in particular was having this problem at an NWSS contest. I was flying and in a good thermal with my Windsong and was fortunate enough to have Tom Neilson as my timer. Since I was high and in good lift, I was able to keep an eye out for the guy with the brown multichannel glider who had been having radio problems. To my horror, I saw his plane heading straight toward my location at the landing circle. It was only about forty feet high and I knew that my frequency was one that was causing him problems. As the 'brown bomber' was nearly overhead, I became very apprehensive. Of course, my unsuspecting timer, Tom, was dutifully keeping me informed of my times while standing safely behind me. He did not suspect a thing. Always quick with an excuse, I afterwards blamed my stuttering problem for my failure to inform Tom of the impending danger.

Suddenly, there was a four-and-a-half pound guided missile headed straight for me at a 60 degree descent angle. Forewarned, my reflexes had the needed time and I chicken-heartedly stepped aside at the last moment — totally exposing Tom who was still looking at the clock. The lethal bird-of-prey struck him so hard that he flew twisting into the air like a flapjack and

landed on his back as flat and still as a pancake. With my contest mentality in full gear, I saw that Tom had dropped the stopwatch during his aerial maneuvers and I started shouting "I need a new timer—someone grab the stopwatch!" After seeing that Tom Neilson had finally started twitching a bit, Tom Brightbill who had been the first to arrive at the disaster scene, reluctantly left the side of his fallen comrade to man the stopwatch for the rest of my flight. Fortunately, Tom Neilson eventually came around and it was learned that the nose of the glider had struck him in the shoulder and that he had only gotten the wind knocked out and a badly bruised shoulder. Naturally Tom Brightbill piped up with "it's too bad you didn't get hit in the head and then you wouldn't have been adversely affected at all!"

One thing is clear, since that defining moment in my flying career, I have had a heck of a time finding good timers. The last good timer I had was Bill Hansen. He and I would bet quarters on air times and landings during practice. He still thinks that it was because I was losing too much money to him that when he was timing for me during a recent contest, he felt the cutting edge of my Saber on a 'slightly misjudged' landing. I swear to God "it was an accident!" I guess what it all boils down to is if you are timing for an erratic flyer like me, "ask not for whom the stopwatch tolls, it may toll for thee."

Read the collected works of Bob Dodgson in the New RCSD: see **The Dodgson Anthology**. *Also, are you a fan of the retro* ***Dodgson Designs logo****? Otherwise, now 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***.

Quick Covers

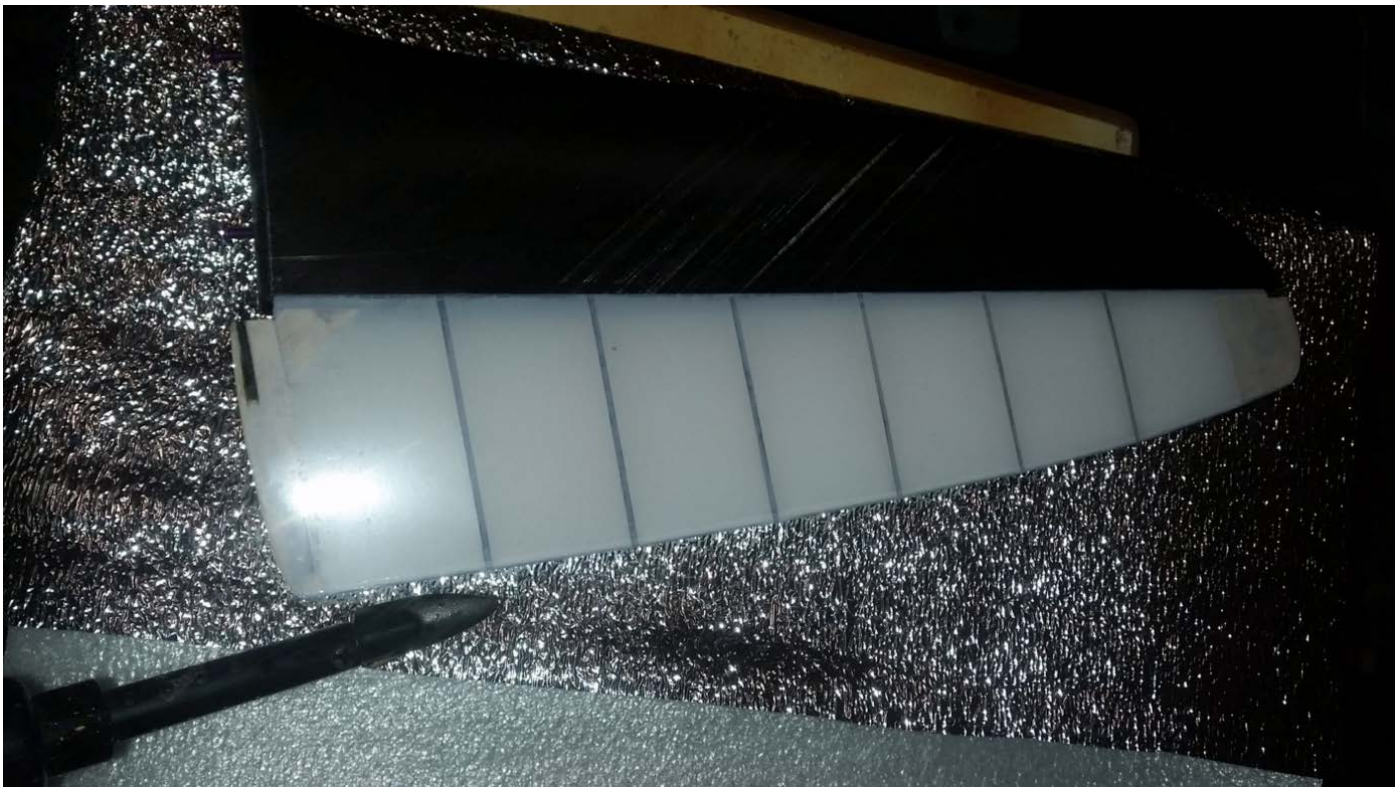
Protect your investment with this relatively inexpensive and easy-to-work material.

Tom Broeski

I used to use quilted fabric from Joann's to sew all my plane covers. However, single-sided reflective insulation is also a very good, quick alternative (see *Resources*, below, for links to both materials) for just about any size wing, tip or tail. It can be sewn, but I decided to try something else. So…

I took and folded over the material and laid the part on top.

I heated up a sealing iron to full heat. I used a tack iron, but the edge of a larger one will work fine. You can also use a soldering iron. I ran the iron around the part, pressing down and melting the inside foam and thus gluing the mylar together. The mylar will not melt.



Then cut I out the piece making sure not to cut too close.

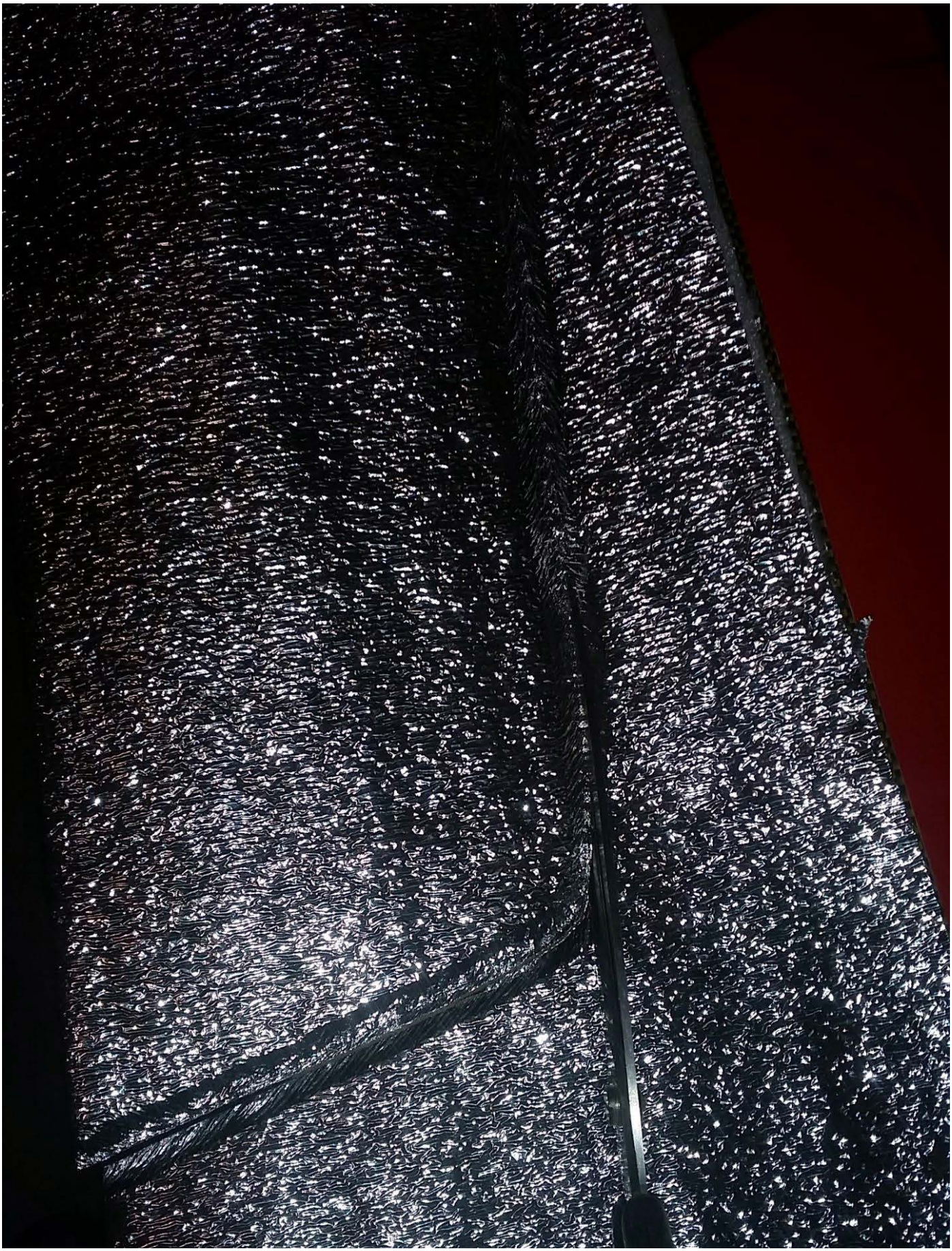
I added a couple Velcro tabs. I used thin Velcro, since the thick stuff is too

hard to separate and peels off the foam.

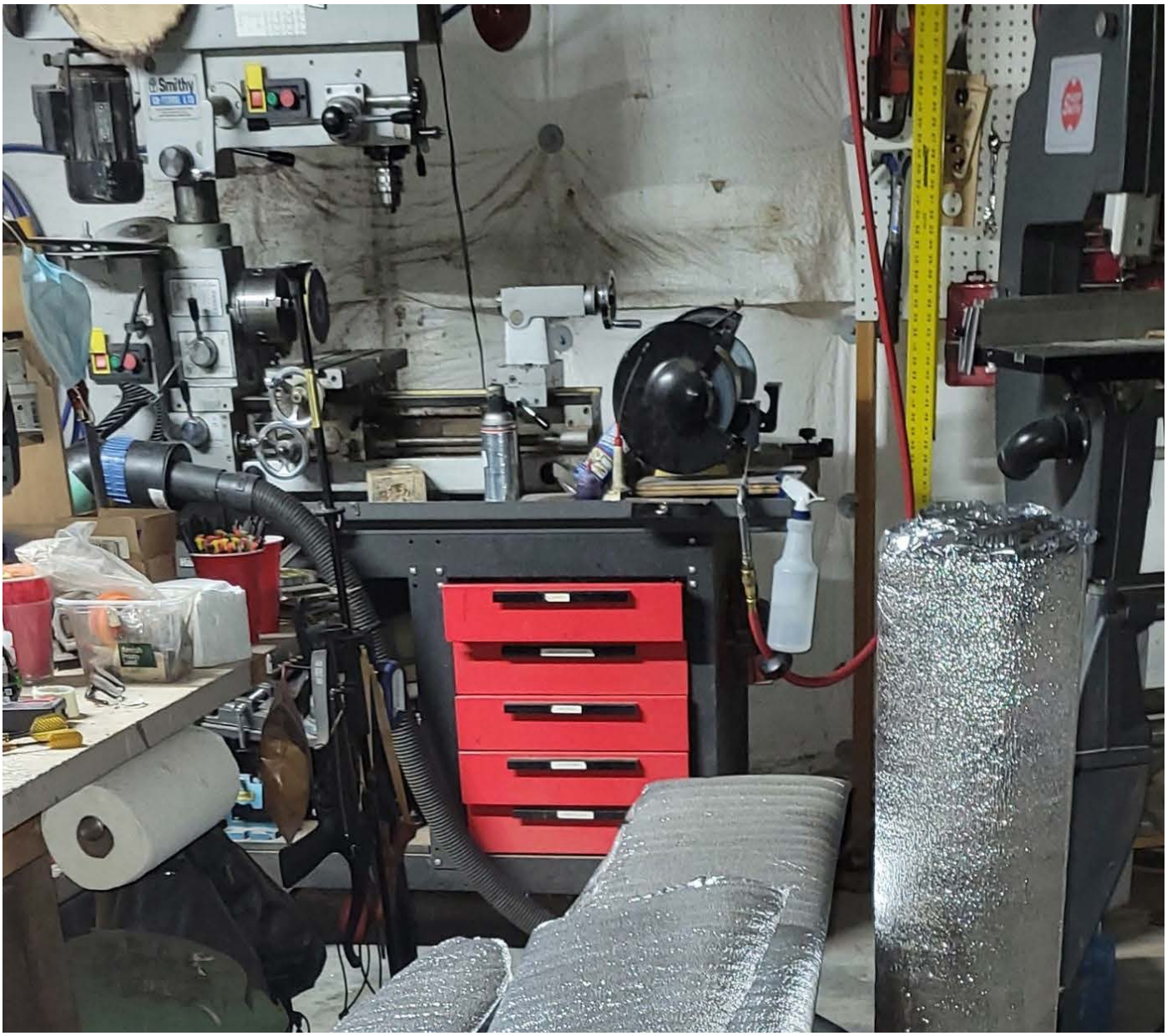
That’s it. It took only a few minutes and I didn’t have to get out the sewing machine.

Here's the *Sprite* tail and *Speedo* wing covers which I approached in the same way.

To press the fold, set iron on medium or work fast. Repeat for other half. Cut about halfway into the crease, making sure not to cut too close. If you do, just reheat the seam. I cut opposite tabs on each wing cover and put on a little Velcro tab.



I now do almost all my plane covers this way. This is a *Royale/Viper* set.



Have at it, let me know if you have any questions and thank you for reading.

Resources

- Double Faced Pre-Quilted Cotton Fabric Diamond Solids — from the Joann website. This is the material I generally use for my covers.
- SmartSHIELD Radiant Barrier Insulation — this is just one example, but a quick search will provides lots of alternatives at the local home improvement center. Be careful to select double-sided material,

however, as the single-sided version won't work.

All images are by the author. Check out all of **Tom's Tips** *here in* RC Soaring Digest. *Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

1/3rd Scale Mita Type 3 Production Notes

The final part of a twelve part series.

Norimichi Kawakami

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

Fabrication Part 55: Carrying Jigs

I immediately disassembled the fuselage and made jigs to transport it on my car.

Fuselage Carrying Jig

The fuselage is about 2,420mm long without the tail wings, so it cannot fit in the luggage compartment of my car (Subaru Forester). The fuselage tail section, which is relatively thin, is placed in front, and the rear fuselage sticks out from between the driver's seat and the passenger seat. I made a jig to mount the single-wheeled aircraft in such a way that it would not move. This is the finished jig.

The underside of the jig is made of two kinked plates. This is because when the rear seats are folded down, the floor of the luggage compartment and the back of the rear seats are not completely flat, but have a slight angle to them. This is the result of adapting the jig to the car. The bottom surface of the jig is in line with the floor of the car side, so it can take the weight on all sides.

Photo 290: Fuselage set in a car.

Outer Wings Carrying Jig

The outer wings are about 1,670 mm long. At first, I thought I could load it by folding the rear seats, but it turned out that the hatchback door was unexpectedly thick and slightly hit the wing. If I remove the wing tips, I can pack it without any problem, but if I stack it flat, it will take up a large area and I won't be able to load anything else. So I decided to carry it standing on both sides of the fuselage with the leading edge down. Photo 283 shows the jig I made for this purpose. Stand up the outer wings and sandwich the fuselage with them.

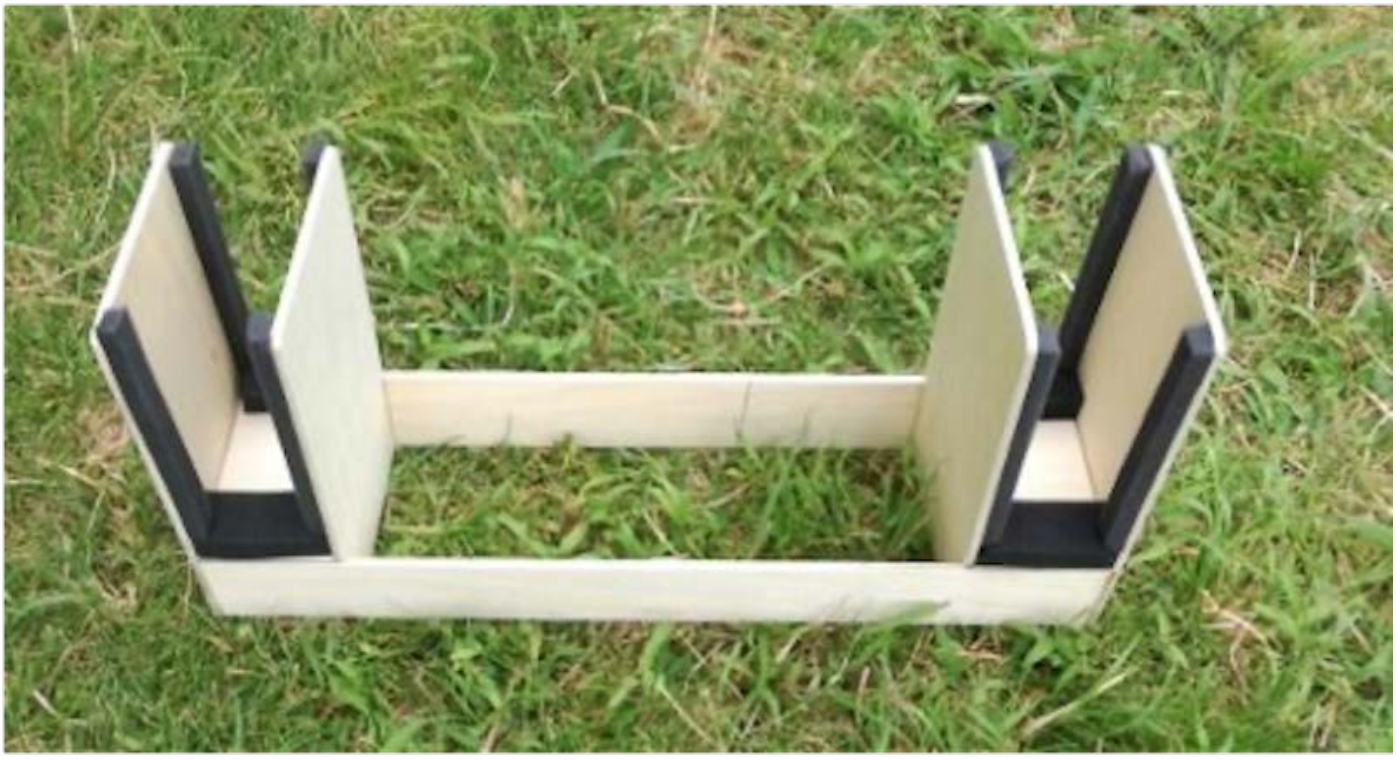


Photo 283: Jig for carrying outer wings.

Center Wing Carrying Jig

The center wing is about 1,000mm long when disassembled. The wing chord length is also 400mm, so it needs to be carried upright. The jig made for this purpose is shown in Photo 284.

Checking the Entire Machine on the Car

Now that the in-vehicle jigs for the major components have been completed, they are loaded into the car for checking.

Photo 285: In-vehicle check.

The horizontal tail is placed between the center wings. Vertical tail can also be placed behind the center wing. The left side is left empty because there is still a big dolly. I need to fit the dolly, tools, transmitter, etc. into this space. It looks like the dolly should have to be assembly type to fit this space. As for the area around the driver's seat, the rear body sticks out at the shoulder level, but I was able to confirm that it is not that much of a hindrance. With this, the on-board transportation jig was somehow completed.

Fabrication Part 56: Dolly

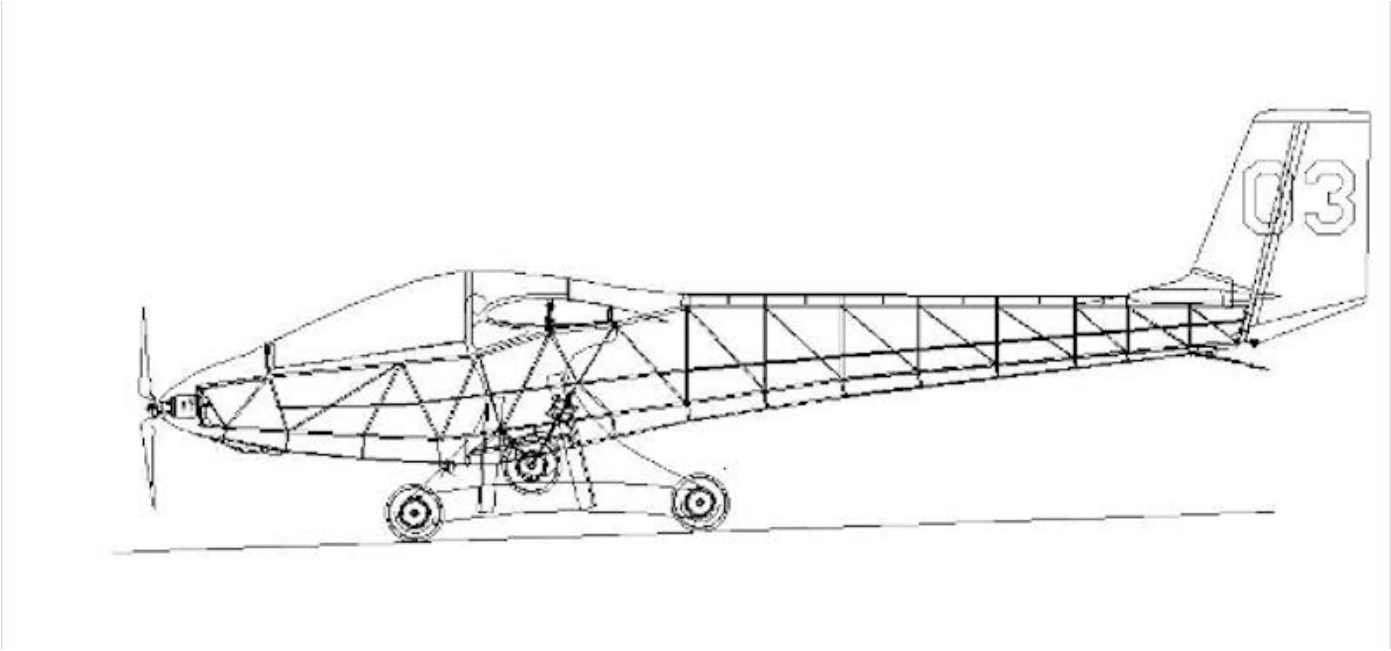
Following the fabrication of the transport jig, the ground-launching dolly was

fabricated.

Drawing of the Dolly

There are two types of dollies, depending on how they support the fuselage. One is to support the lower part of the fuselage, and the other is to support the main wing. The former is relatively compact because it is a dolly that supports the thin fuselage from below, but it lacks stability due to its narrow tread in the left-right direction. My 1/5 Mita model uses this type of dolly. In this method, a pin sticking out of the dolly is inserted into a hole in the bottom of the fuselage to tow the dolly.

The latter method supports the left and right main wings from below. Since the dolly supports the main wings across the fuselage, the tread is wider and the stability is increased, but it is inevitably larger. The leading edge of the main wings is held by a dolly to tow the dolly. This method was adopted for the 1/3 Mita model because the lower part of the fuselage is covered with cloth as in the actual model, and holes cannot be made. Drawing 66 is the drawing.



Drawing 66: Dolly.

The Dolly I Made

Photo 286 shows a dolly made mainly of 5.5mm plywood cut out according to the drawing.

The boards that connect the left and right sides are made in the same way as the front and rear. The notches are to avoid contact with the lower part of the fuselage, and by unscrewing the six screws that hold the front and rear boards together, the dolly becomes four boards, making it easier to transport. But still it is very large.

Trial Installation of the Fuselage

I immediately installed the fuselage. In this state, I held the propeller shaft and pulled it to the front. Although there was a lot of grass on the ground, I was able to confirm that the wheels rolled without applying too much force. It seems to be able to glide well.

Photo 287: The aircraft on the dolly.

Ground Test

Finally, it was time for the final ground test before the first flight. The aircraft was transported to the club's airfield for assembly and disassembly, and various ground tests were conducted to confirm that there were no major problems.

Transport to the Site and Assembly at the Site

Using the transport jig, I put the glider on my car and transported it to the club's airfield, which is located about 30 minutes from my house. I was able to confirm that I could carry it smoothly by car without any problems.

I immediately assembled the dolly and aircraft at the site. This is a picture of the assembly in progress with the help of my friends.

Photo 288: Assembly at the airfield.

Since it was the first time for me to assemble on site, I made a few mistakes in the procedure, forgot to insert washers, forgot to connect the elevator linkage, misaligned the center wing mounting bolts, and lost the nut for the rudder linkage. So it took about an hour to complete the whole assembly. I think I will be able to assemble it in less time next time. I put the assembled aircraft on the dolly and took a commemorative photo.

Photo 289: Commemorative photo after completion of assembly.

Ground Test

The first thing I did was to check the radio check.I set the output level of the transmitter to Low, and rotated the plane 360 degrees while steering it from a distance of several dozen meters, and confirmed that there were no abnormalities. I was a little worried about the reception performance because of the carbon tubes truss structure, which does not allow radio waves to penetrate, but this is a relief.

The next step is to test the propeller. After connecting the LiPo for power, I asked my friend to hold the plane and raise the throttle to full. There was no abnormal propeller shake or vibration, and the thrust was OK.

Photo 290: Propeller test.

Next was a test run on the dolly. When the throttle was gradually increased, the dolly started to move even though the grass on the ground had grown considerably. When the throttle was increased, the dolly increased speed.

Photo 291: Driving test.

I was able to confirm that the plane was generally going straight without flowing to one side. I was a little worried since the wheels of the dolly might be a little too small for the size of the plane that it might be difficult to increase speed, but it seems to be fine. However, the attitude angle of the aircraft is slightly nose-down. Therefore, the tip of the propeller hits the growing grass leaves. At the time of designing the dolly, I took into consideration that it would be about 2 degrees raising head, but in reality it is head down. Therefore, you can see in the photo that the elevator is pulled up.

I found out that the thick sponge on the wing support of the dolly was causing the problem. I made the wing support curved so that it touches the underside of the main wing, and put a 20 mm thick sponge on it to protect

the wing. If uniform pressure is applied to the lower surface of the main wing, the sponge will be compressed evenly and the fuselage attitude angle will be as designed, but due to the location of the center of gravity, the sponge on the leading edge shrinks more, resulting in this result. I will correct this by putting a spacer under the sponge on the leading edge side.

I handed the transmitter to Mr. Sato, a veteran pilot of the club, and asked him to check the feeling of the ground run. It was so straightforward that it looked like it was about to take off. I was tempted to take off as it was, but the wind direction was opposite that day, so I decided to wait until a later date for the first flight and finished the ground test.

I also found that disassembling the dolly and fuselage and carrying them into my car would take about 30 minutes.

Photo 292: The aircraft carried into the car after the ground test.

First Flight, a Success!

I dared my first flight on September 19, 2019, and it was almost a success.

Conditions of the First Flight

The weather was changing rapidly in the changeable autumn sky, but it was sunny and the wind was calm, so I decided to make the first flight. I asked Mr. Sato, a fellow club member and veteran pilot, to fly the plane, and Mr. Shiratori, a colleague from my working days, to take pictures. Also, an editor from “RC Technology” magazine came to cover the event.

Ready for Takeoff

Photo 293 shows the aircraft assembled, controls checked, and ready for launch.

Photo 293: The aircraft is ready for launch.

Take Off

The transmitter (FUTABA 10J) is currently set to airplane mode, not glider mode. This allows the pilot to adjust the throttle and fine tune the thrust. Mr. Sato gradually increased the throttle and the dolly started to run. After a few meters run, the aircraft floated away from the dolly.

Photo 294: Take off.

In fact, at this moment, we had a close call, which I will explain later. Mr. Sato, a veteran pilot, managed to take off with a quick recovery operation.

Climbing

With the propeller at full speed, the aircraft climbed powerfully into the

autumn sky.

Photo 295: Climbing.

Cruising

The aircraft folded its propellers and moved into cruising mode.

It looks as if it is flying very slowly. I still can't determine if it looks like that because the plane is big or if the speed is actually slow because the wing loading is small. However, Mr. Sato, the pilot, said that it might be better to make it a little heavier and with a more forward center of gravity to get speed. I will have to wait until we have flown it a bit more before I can make a decision. Here is a picture of it playing with the clouds (Photo 297). This is what a glider is all about.

Photo 297: Mita Type 3 rev.1 playing with clouds.

Also, he pointed out that it has a slight right roll. This is to be expected since the right main wing is 30g heavier than the left main wing. I will put a weight in the left wing to balance it out before the next flight.

Landing

After flying for about 10 minutes to get a feel for the flight characteristics, Mr. Sato moved on to landing. Before landing, he turned on the spoiler to see how it worked. Normally, the transmitter would be set to glider mode, and assign the spoiler control to the throttle stick so that he could continuously change its output. However, since it was set airplane mode, the spoiler is assigned to the toggle switch and can only be adjusted in two steps. When the spoiler is released, the plane drops altitude rapidly at a descent angle of about 45 degrees, and I was able to confirm that it works well enough to adjust the descent angle.

With the spoiler out, the glider descended close to the ground.

Photo 298: Landing approach.

This is the shot just before ground contact.

Photo 299: Final flare.

As the glider entered the final flare, it turned out that the spoilers were not protruding enough to have much of a deceleration effect. However, Mr. Sato was able to land the plane safely with a nice landing. The power consumption of the LiPo (8-cell 5,100mmAh) was only about 30% so far. It is clear that it has enough power supply.

With the above, we were able to complete its first flight. There is no problem at all with the flight characteristics. There was no sign of wing tip stall even in steep turns. The only regret is the lack of deceleration effect of the spoiler. This is very frustrating, but it cannot be corrected unless the center wing is rebuilt.

A Close Call That Occurred Just after the Take Off

Just after the takeoff, at the moment when the aircraft was leaving the dolly, the horizontal tail caught the dolly and the dolly fell over. The aircraft also lost its attitude. This moment is reproduced from the frame feed of the movie in image 300.

Photo 300–1: Pitching up for take off.

Photo 300–2: The horizontal tail wing caught the dolly and lowered nose.

Photo 300–3: The dolly is pulled down and the nose of the aircraft is lowered more and more.

Photo 300–4: Emergency elevator up brings the aircraft back to within inches of the ground.

Photo 300–5: Tail skid seems to be in contact with the ground.

Photo 300–6: Nose is raised significantly.

Photo 300–7: The plane went into a steep climb.

As the aircraft was pitched up for takeoff, the right horizontal tail hit the dolly.

As a result, the aircraft bowed heavily and was on the verge of hitting the ground. Just before the propeller struck the ground, the pilot, Mr. Sato, made a quick maneuver to recover and started to climb rapidly. The heavy dolly was flipped over backwards. The tail skid appears to touch the ground. The aircraft did not stall during the steep ascent, and it was able to escape the disaster of the first flight catastrophe with a close call. I got the benefit from the installation of a larger motor in case of unforeseen circumstances, as described in “Reconsideration of the power system”.

When I was making the dolly, Mr. Shiratori, who took the video this time, pointed out the danger of this problem. I had judged that there was little possibility of contact because the pitch attitude change of the aircraft would not be so fast for such a large aircraft, and the attitude change in the short time before the aircraft floated and left the dolly would be negligible. However, it was my mistake in judgment because the aircraft actually hit the dolly.

Making a Small Dolly

To avoid the above problem, I decided to switch to a small dolly that would not be in contact with the horizontal tail wing.

The Small Dolly I Built

The new dolly is a type that supports the fuselage from below. The shape of the dolly is quite simple, with the wheels used in the previous dolly attached to a rectangular frame.

Photo 301: Small dolly cart.

On top of this, the jig for transporting the aircraft to the airfield in my car is placed, and the dolly is complete. Place the fuselage on the dolly as shown in photo 302.

The fuselage transport jig has a stop plate in front of the main wheel.

Photo 303: Stop plate.

The main wheel hit this plate to tow the dolly. I have tried to take off with this small dolly many times since the end of September 2019, and confirmed that it can take off without any problems.

Flight Video

Cygnus Tori (Mr. Shiratori), a fellow club member, took an aerial video of this aircraft flying gracefully with his drone. This is the 2nd flight which used the completed small dolly for the first time.

This completes all the work on the 1/3 scale Mita Type 3 rev.1 that I started researching at the end of 2017 and started building in March 2018. I have been enjoying it for about 1 year and 10 months.

What I Felt through the Design and Fabrication

Followings are what I felt during the building of the first large scale aircraft

with a wingspan of over 5.3m and a weight of about 10kg.

1. It is possible to build an aircraft with a hand drill and an OLFA cutter, even if you don't have a drilling machine or an electric fret saw. I confirmed that there can't be any excuse for not making a model because of not having the tools.
2. Drawing is the most important part of making a model. I felt 80 to 90 percent of the work was drafting. Thinking about what materials to use and how to put the parts together in my head, and then expressing it in detailed drawings is the majority of the effort I have to put in. Once the detailed drawings are drawn, all that is left is to cut out the parts and assemble them following the drawings. If you can't draw a detailed drawing, it means you can't imagine how to make it in your head, and you can't make it no matter how many materials you have in front of you.
3. I was reminded that the key to successful fabrication is to spare no effort in using jigs. Jigs are very effective in making each part precisely and assembling it precisely. If the parts are made accurately, assembly is easy and there is no need for rework. Most of the parts that required rework in this project were the parts that omitted the jigs.

The above is a very long description of the design and production process, as I exposed all the problems and failures I encountered, along with the things I thought about and considered during the production process. I hope this will be of some help to those who are planning to try their hand at homebrewing. I'm sure there are many people who are refraining from going out because of the COVID-19 disaster. I hope you get your beloved machine while trying to refresh yourself by building your own during this occasion.

Resources

- **Full Size Drawings** — The full-scale drawings of the 1/3 scale Mita Type 3 rev.1 that I made in this project are available at this site. If you are interested, please take a look. You are free to copy them.

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

Club in Focus

Mississippi Valley Soaring Association

The NEW RC Soaring Digest Staff

Left-to-right: Tony Estep, Robert Samuels and Dave Quist show off their planes during a flying day in November of 2017 at one of the MVSA's three private fields outside of St.Louis, Missouri.

This is our first in an ongoing series of articles which are intended to raise interest in, and awareness of local grassroots RC soaring clubs. Would you like to be featured here and our **Clubs** *page? Let us know! — Ed.*

The MVSA is an active, AMA-sanctioned RC soaring club founded in 1975. They can be found flying most weekends at three private fields west of St. Louis, Missouri.

They hold two contests per month — *Hand Launch* on the 1st Saturday and

Thermal Duration on the second Saturday from March to November. They usually have between 40 and 60 members at any given time and between 12 and 15 at each of their contests. Their club is competitive — producing two national champions, a runner up and several competed in *The Great Race* back in the day.

The MVSA believe in camaraderie and a passion for flying. They are privileged to fly on private fields which are the best in St. Louis. They can be found at the field during the week and the weekend when the conditions are better than marginal.

If you have a dream of flying in St. Louis, seek them out. Guests are welcome. Flying guests are required to have AMA. Their annual dues are modest and affordable.

The MVSA also has a great website (see *Resources* below) which features an online calendar, maps of their fields, a great gallery of photos and videos as well as all the other details you'll need to get started with them.

The MVSA is on our 'must visit' list the next time we're in their neck of the woods, it should be for you, too!

Resources

- **Mississippi Valley Soaring Association** (home page)
- **Event Calendar**
- **Members**
- **Contact**

*All photos provided by the MVSA. Many thanks to Dan Gill for his tireless assistance in preparing this piece. Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

The Trailing Edge

February is a really, really short month.

The NEW RC Soaring Digest Staff

Readers may recall the very first instalment of The Trailing Edge, back in January of 2021, featured a beautiful and touching photo by Régis Geledan. We're so pleased to be able to feature the work of Régis once again in The Trailing Edge — a beautiful wintry shot from les Hautes-Pyrénées in southern France.

As we have mentioned before, in 2021 we dedicated ourselves to creeping forward our release date each month with the goal of eventually getting new issues into the hands of our readers by the first of each month. We're pleased that this is the fourth month in a row where we have managed to deliver on that commitment. However, you'll forgive us if we are brief because the two or three days February is missing most years really puts a crimp in things. For instance, our monthly mailing of our *Lift over Drag* newsletter fell victim to the brutal schedule. But never fear, it will be back

next month. There are also a couple of additional casualties in our various continuing series, but they'll be back in the next issue as well.

We hope you have enjoyed this month's issue, particularly our new *Clubs* feature to which we hope you'll consider contributing. Also, don't forget our *Events* calendar as well — we're only too happy to include your events there, as well. See the navigation bar, above, for ready access to both of these.

Now excuse us while we pay some bills…

Featured in the RCSD Shop

The Dodgson Designs Licensed Logo T-Shirt

We are proud that through an exclusive arrangement with Bob and Sandy Dodgson, we are offering ***The Dodgson Designs Licensed Logo T-Shirt***. If you have ever built or flown one of Bob's classic designs, or even if you're just a fan of his work, this is one item you will want to add to your collection.

It's through your support of the RCSD Shop that we manage to provide all this great, commercial-free content. We are so thankful to Bob and Sandy for their level of commitment to RCSD's success.

Make Sure You Don't Miss the New Issue

If you don't want to miss the April issue of the *New RC Soaring Digest* — coming out, no foolin', on April Fool's Day — make sure you subscribe to our **Groups.io mailing list** or connect with us on **Facebook**, **Instagram**, **Twitter** or **LinkedIn**. And please share RCSD with your friends — we would love to have them as readers, too.

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

Now get out there and fly!

The NEW RC Soaring Digest Staff

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