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Recreational Flyer

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RAA
RECREATIONAL AIRCRAFT ASSOCIATION
RÉSEAU AÉRONEFS AMATEUR CANADA

From The President's Desk

Gary Wolf RAA 7379

SPRING ISSUE

Normally we run January-February and March-April issues, but this year for two reasons we went with a Spring issue. First is that during winter it is exceedingly difficult to persuade a member to drag his plane out of the hangar and into the snow to shoot photos. Second is that this combined issue allowed extra space for Brian Steele's treatise on the current state of the art for amateur electric aircraft. Clare Snyder is hosting Brian's excel file *(see page 38)* that will allow you do perform what-ifs for candidate electric aircraft.

WINNIPEG ELECTRIC FLIGHT MEETING

On March 26th Jill Oakes hosted a well attended meeting of electric vehicle enthusiasts at Lyncrest Airport. Speakers included Dennis Jacobs from North Dakota, who spoke about his electric Pietenpol. George Bye attended by Skype to do a powerpoint presentation about his company's present single seat electric aircraft and his prototype two seat training plane that is planned for 2016-2017. Jill will write this up for the next issue.

FLY-INS

Your Chapter Liability Policy premium is based on estimates and the cost since 9-11 has been high, descending from an initial $11K to the current $7K. The premium has always been based on the insurer's estimate of the exposure, and RAA would like to provide actual numbers to reduce the premium further. Please nominate someone in your chapter to keep a count of the number of aircraft and attendees at your fly-ins this year. This does not have to be an exact number but it should be a close-enough count. At the end of the season we will then present the numbers to the insurer when negotiating next year's premium.

ROTAX BING FLOATS AGAIN

There has been a problem with composite carb floats in the Bing 64 carbs used on the Rotax 9-series engines. One batch of floats was found to absorb fuel, causing them to sink, which could result in a high fuel level and possible overflow. For awhile Rotax was asking owners to go through a checking procedure involving a calibrated syringe but now they have a program to replace all floats from the affected batch.

If your 9-series engine was manufactured after July 1, 2012 please contact your local authorized dealer to receive a new set of replacement floats. The new floats will have a dot to indicate that these are the replacement items.

There are other engine manufacturers, including HKS and Jabiru, that use the same carbs but at this writing RAA has not been notified of any replacement program except that for Rotax. If you have a Bing 64 you should contact your engine supplier to determine the program for your floats.

CHAPTER LISTINGS

Please have a look at the listing for your chapter in this issue. If it needs to be updated please ask your chapter secretary to email new text. To prevent transcription errors please send this in full so that the old listing may be deleted and the new one pasted in. Email to Gary Wolf at garywolf@rogers.com or George Gregory at gregdesign@telus.net.

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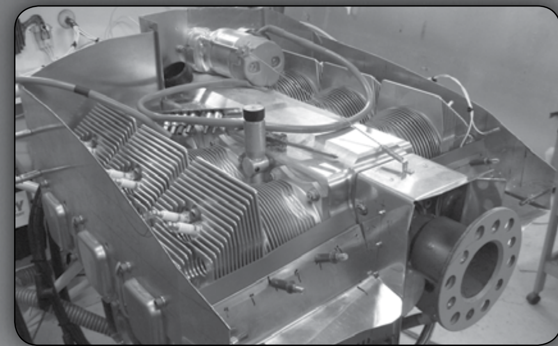
features

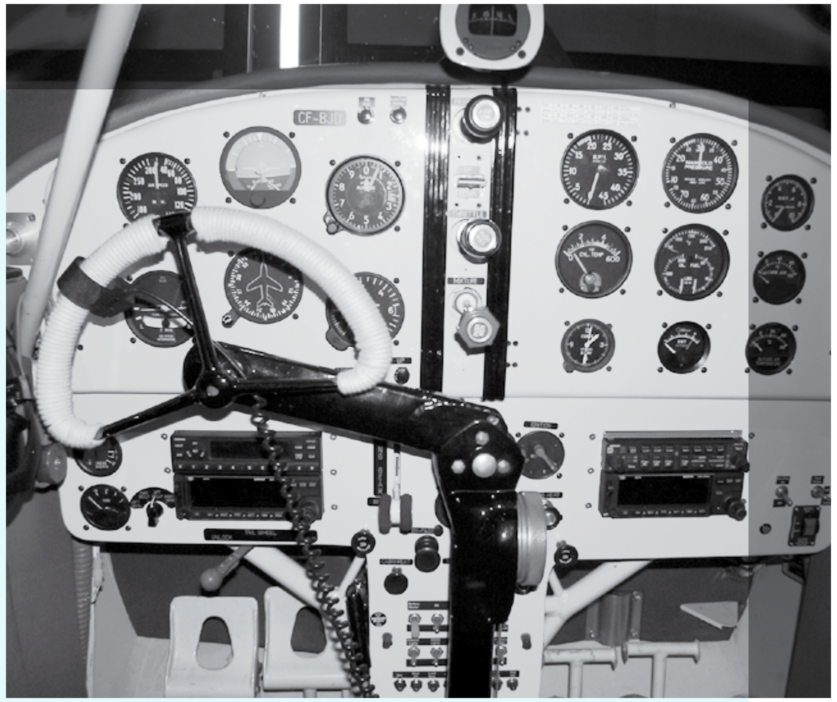
columns



George Gregory

A Cessna Airmaster, Arlington 2014
On the cover: The Silent II electric motorglider. Antonio More photo.

THE STAGGERWING FLIES



BY MIKE DAVENPORT

Jim Britton of North Vancouver, BC, the owner of the Staggerwing, and many others too numerous to name had just completed a 12 year restoration of a Beech Staggerwing, serial number 201 and Model SD17S1. In 1938, this aircraft was purpose built for Imperial Oil in Canada who used it for 9 years before declaring it surplus and selling it to Northern Wings in Quebec who in turn used it until decommissioning it in 1955. Jim purchased the remains in 2002 from a friend in Ottawa and subsequently rebuilt it. For more detail on the history and restoration, see the January issue of the RAA Flyer.

After many delays due to weather, finding and fixing snags, vacation time and work scheduling, the stars were finally aligned and the time had arrived to see if all the work done to date has validity. In short, would this thing actually fly? These were some of the thoughts going through Jim Britton's mind on Feb 22. Actually, I don't think he had any doubts.

The weather was good, the pilots were on hand, and the aircraft was checked and checked again. There was gas in the tanks. A chase plane was organized. Camera batteries were charged. All was ready. Mark Hyderman was back along with his engineer, Ron Helgeson, arrived in Langley from Salmon Arm around 10 AM in Mark's red Staggerwing CF-GKY.

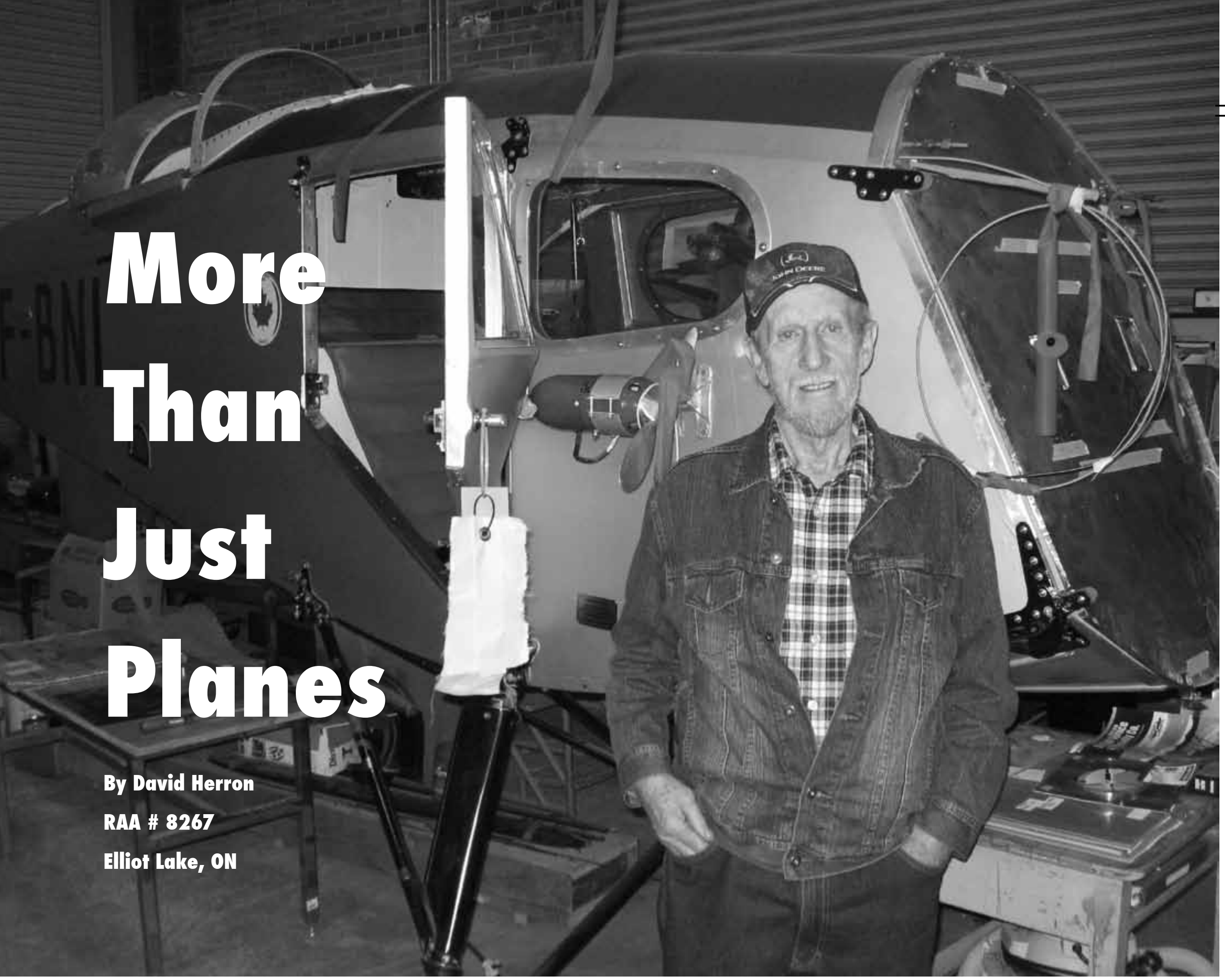
They gave BJD a thorough pre-flight and then Mark with George Kirbyson as co-pilot took to the Staggerwing into the air for the first time in over 50 years. The first flight was brief and as planned, a lift off runway 07 and a dumbbell turn back to land on 25. At that point, they had planned to switch seats putting George in the left in order to make this next flight his check ride. However, Murphy had one last problem to be solved. During the flight, the airspeed indicator was erratic and that needed to be tended to. They went back to the hanger where it was found that a fitting in the pitot head needed to be replaced. Problem solved.

The day quickly went by and as Mark needed to get home to Salmon Arm before dark, it was decided to postpone the air to air photos to another day and concentrate on George's check ride.

The second flight lasted about 15 minutes and was flown overhead the airport to check temperatures and to cycle the landing gear. This time all went well with no further snags and we ended the day with 2 happy pilots and one very happy owner. Congratulations to all involved!

Note: The first S in the model number refers to the seaplane version

Top Opposite: The"flight test team" Feb 22 left to right: Werner Griesbeck, Ron Helgeson, George Kirbyson, Jim Britton, Mark Hyderman – photo by Dennis Cardy. Bottom left, the two Staggerwings – CF-GKY – red CF-BJD yellow. Above, Bravo Delta Juliet's instrument panel.



More Than Just Planes

By David Herron
RAA # 8267
Elliot Lake, ON

OUR LIVES ARE GIFTED with special people cut from different cookie cutters and each has unique gifts on display to the world. What a stroke of luck and a great privilege it has been for me to meet the mechanically gifted Hal Cummings. "You love planes" an acquaintance said, then told me he knew a man who had built several airplanes, and had a collection of cars, "You must go meet him!"

In fact, as it turned out, Hal has been in on the construction of a half dozen airplanes, many cars, a boat cruiser - he even made his own bulldozer! He tracked down and restored his father's 1935 Hudson "Terraplane" - what a beauty! Each hobby would be a story in itself; but this is a flying publication, so I've only mentioned the others in passing.

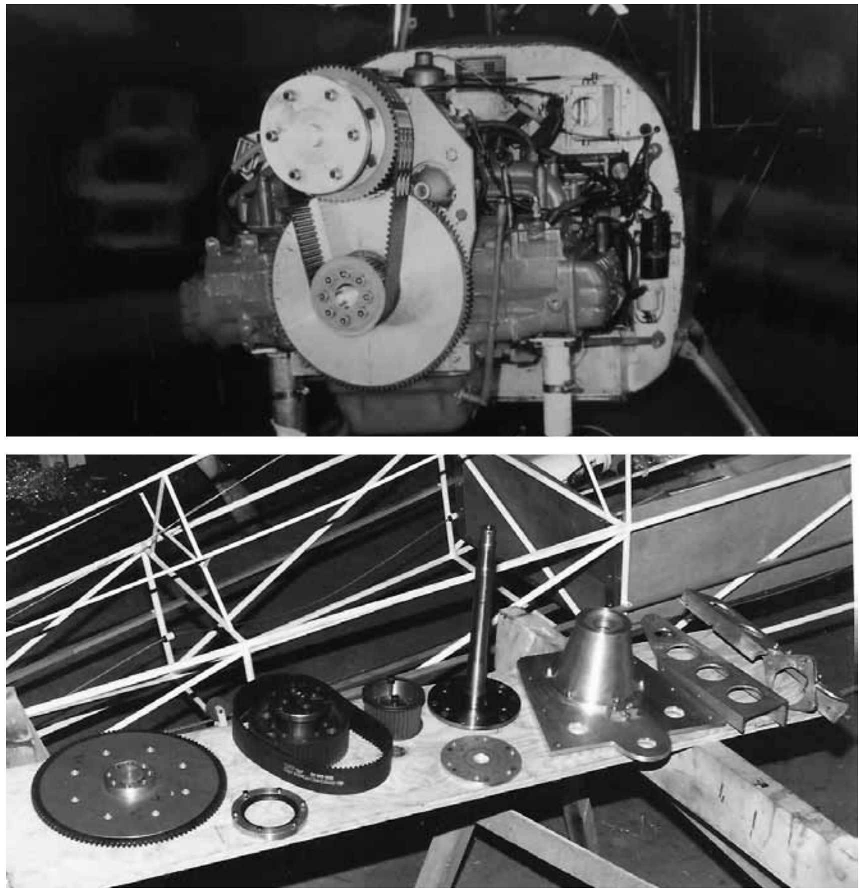
Hal is passionate about everything he does, whether it's flying or in his machine shop. He is well known in our area not only for his skill sets, but for the help he has given to many people. I for one might not be flying without his help. At 86 Hal is one of the youngest and most enthusiastic persons I know!

Born in the town of Massey Ontario in 1929, life in that area and era was not far off pioneer style, when there were no trains and commerce was supported by shipping. At about 12 years of age Hal began helping a fellow build small boats for the resort industry. With that experience, he moved on to making window sashes, then opened his own business at fifteen years of age, followed by house building. He has been an electrician, carpenter, and mechanic by trade, and is a self-taught machinist. His machine shop is 'to die for'! Perhaps we could say he saved the best of his skill-sets for the last - flying!

In 1946 a Fox Moth pilot offered Hal his first plane ride at Little Current, Ontario. There is a refurbished Fox Moth at The Bush plane Museum in Sault Saint Marie which was finished for the Museum's 25th anniversary (2014). When Hal began his flying career in 1983 it was not easy to find a flight instructor up in that rugged country, so he had to travel several hours to Sault St. Marie in order to get instruction in an ultralight class airplane. Local pilots at Espanola then further encouraged his flying with instruction in certified aircraft (Champ). In the course of time he also took some aerobatic flight training.

Hal is an excellent engine man and he developed much of his extensive engine experience over the years building two stroke and four stroke car, boat, and airplane engines. Hal was one of the first Bombardier dealers outside Quebec. In fact he tested and analyzed their first demo machine before any were released to market. For many years he even raced snow-sleds with a team of three.

I asked Hal what his favorite airplane was over the years and with a lot of nostalgia he reflected back on his first ultralight called a CGS Hawk (Oct. 1983 – July 1986). It was powered by a small 35 horsepower Cuyuna engine. He felt that it flew like bigger plane and the memory of it becomes sweeter as the years go by.



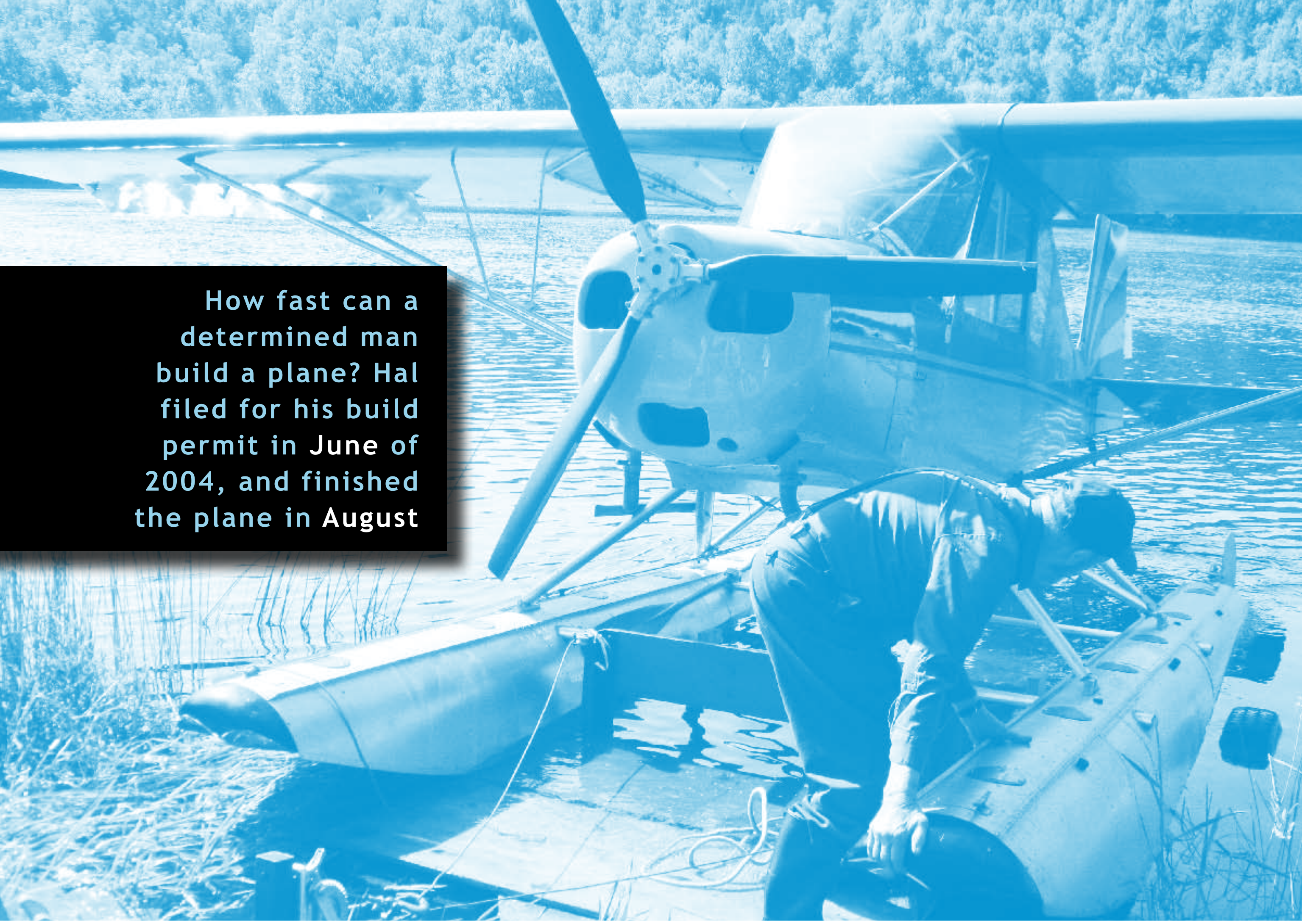
Some pictures of Hal's redrive.

Hal's next airplane was a J 3 Kitten (Sept. 1985 – May 1988) powered by 65 horsepower twin carb 532 Rotax . It could fly at 92 miles an hour and handled similarly to a Super Cub. It could take off in a scant 30 feet on skis from ice - this he knew because one day he measured the snow tracks on the ice. The bad news was it had little room for the pilot, let alone anyone else.

Hal then decided to build another airplane, a J6 Karatoo (Oct. 1989 – 2002), rag and tube built from Jesse Anglin's first set of plans, and he powered it with a Continental 85. It had good performance and side by side seating; though it did not match the Kitten, it out performed his friend's Champ with the same engine.

THE "J6 KARATOO-TANDEM" (2004)

In 2002 Hal took a short hiatus from flying, but a year later he got the flying bug back and started designing his own variation of the J6 Karatoo. The "J6 Karatoo-tandem" (2004), his latest rag and tube, is a two place,



How fast can a determined man build a plane? Hal filed for his build permit in June of 2004, and finished the plane in August

built a bit smaller with purpose. "I built it for convenience" said Hal. As he likes to keep everything to the "KISS" principal he registered it as a Basic Ultralight but he built it to the amateur build standards of his first Karatoo. This is the only tandem Karatoo in existence.

Everything Hal makes is well constructed. He thinks nothing of pulling an engine and tearing it down when he's not happy with a situation, or he may keep redesigning a cooling system until it works properly.

Hal's Tandem Karatoo is powered by a normally aspirated 72 hp Subaru EA 81, and swings a 72 inch Warp Drive three blade propeller, mated to a 1.69:1 reduction drive, (his own creation). This employs roller bearings for radial thrust and a double set of ball bearings for the end thrust. Each re-drive has been problem-free. Hal also built a redrive for his friend's Subaru powered Sprint. Later versions are ten pounds lighter than his first Karatoo version. In his trials he found the 1.69:1 the best fit for the engine, prop and rpms that he wanted to use. Hal did a test with a McCauley 74:43 two blade prop which had been used on a Continental 85 and he got the same rpms with the Subaru-and-redrive setup as on the Continental. Although the Subaru had the necessary torque to turn the McCauley, Hal felt that the heavier blade and increased surface area would be too much stress on the re-drive to be used safely.

Hal's well equipped machine shop has all the milling equipment to make his own gears but he opted to use a Gates gear, cut down and mated to a lighter backing plate like a ring gear on a flywheel. This was quicker for him than making the cutting tools for the tooth profile of the cog belt. Hal realizes that without much difficulty he could get more hp out of his Soob, but he prefers to cruise at 3800 rpm for a number of reasons; noise, stress on the engine and gph.

Hal machined his cylinder heads to ensure that they would be dead flat, but did not take enough off to raise compression. He converted the hydraulic lifters to mechanical, because the hydraulic ones stayed pumped up when cold, and this made starting difficult.. Hal uses a British SU automobile carb and loves it because it is very simple and not prone to icing. He burns approximately 2.2 gallons per hour in the Tandem Karatoo.

For the wing design of the Tandem he used a copy of his first J6 Karatoo, which is a copy of the J3 Cub, wood ribs, covered with fabric and painted by the "Hipec" process. The chord is a narrowed four feet, to accommodate folding to street legal width for road transport. Of special interest, just removing two bolts at the main spar allows the wings to swing, and everything moves with them, struts, controls, etc. For the landing gear he used the front springs out of a John Deere Gator cut in half.

Opposite, Hal's pride and joy. Left, the removal of 2 bolts allows the wings to fold to street legal width. The struts, controls, and anything else to do with the wings fold back with them - nothing to disconnect. Below, Hal's well equipped shop.

The little gem JG Karatoo cruises at 90 mph on floats and will cruise at 120 mph on wheels.

His floats were made in Quebec by the late Claude Guilbault. They are a set of second hand 1050's, similar to the new ones he had on his first Karatoo.

How fast can a determined man build a plane? Hal filed for his build permit in June of 2004, and finished the plane in August of 2004 - but he had to wait until October to receive the paperwork before he could fly the plane. Hal told me that he started the engine and re-drive a month before he began the frame construction, and as he had previously built the earlier Karatoo, that experience allowed him work faster on this one. He is not a boaster, rather a very determined and aggressive individual and when he sets his mind on a project he is tenacious, to say the least. His late wife must have been a saint. He said, "After I closed my Skidoo business and only did occasional machine shop work I had to do something!"

Hal is so focused that he seems intimidating to some of us, but we do not worship him. Often we argue with him to prove our point and he will come back with the "I tried that before, but if you want to go there I will help you," as long as its safe mind you.

Other airplanes Hal has built or helped with include:

- a Protech PT2 powered by a 0-235 Lycoming, for a friend.
- He worked on a friend's Sprint powered by a Subaru E-81 with a Hal Cummings reduction drive and converted from a tricycle to a taildragger.
- Another was a Lincoln-Sport, which had various

Hal's farm and airstrip. We should all be so blessed.

- engine re-fittings until they found that a Rotax 503 worked well with that airframe.
- Of course friends would get help with engines on various home-built aircraft.

We often say in our Northern flight community that the airplanes are just our excuse to meet with our friends in the air and more often on the ground in the hangar!

After calling a few of his friends to ask for past memories, they related, "back in the day," it was nothing for a half dozen pilots to decide to fly to Orillia or wherever they wanted to commit to

Aviation. Off they would go into the wild blue yonder with a gaggle of birds, Kitfox, Super Cub, Champ, Pelican and whatever Hal was flying. Often their most fun was with winter fly-ins when friends came from North Bay and west from Sault St. Marie to Espanola, or they might travel to Sturgeon Falls.

On one of the flights I had with Hal we took off down river towards Spanish and headed for the mouth as it opens up into the spectacular scenery of the "North Channel" of Lake Huron. Then we proceeded over the many little islands, with large romantic looking sailboats below. The flight continued to Little Current, the entrance to Manitoulin Island, returning via the La Cloche Foothills, Espanola and back to home base beside the Massey bridge. This is wonderful country and if you are in Ontario you should fly up and experience it yourself.

I have not flown with Hal for a few years, but what a privilege when I did! He is an excellent pilot. For "yours truly" it was a thrill to fly back-seat in his float plane, taking off from the Spanish. I know he continues to help a number of pilots in this region with his technical know-how and I for one am very grateful. It is people like Hal who make amateur aviation such a great hobby.

If you are ever flying floats north of Tobermory or on wheels near Espanola you should look him up Just call Bert at CYEL to make contact - and bring muffins for the inevitable coffee session!

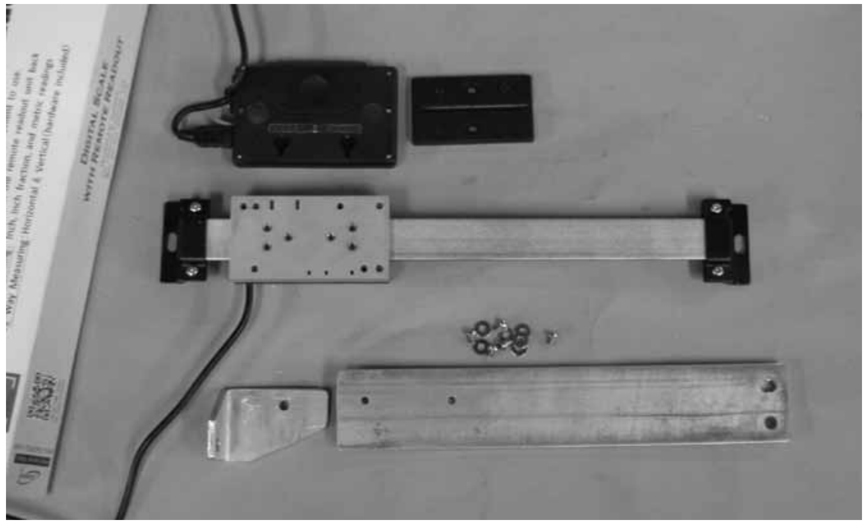
The kit includes everything necessary, even a spare battery.

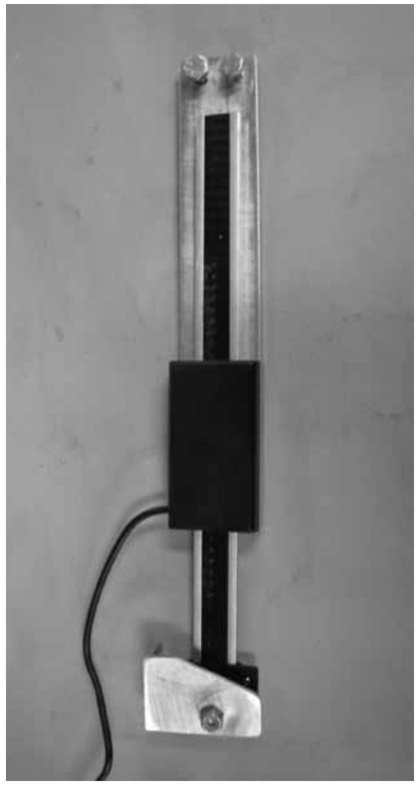
Busy Bee Tools: iGauging Digital Readout

BUSY BEE TOOLS has for nearly forty years been supplying good hobbyist quality woodworking and metalworking tools. They have ten stores in major cities across Canada and an extensive paper or online catalogue. Lately they have added the Igaging line of measuring equipment, and their Digital Read Outs are very useful and not expensive. The smallest has a range of 6" and the largest is 36", with prices ranging from $30 to $55 CDN. Digital readouts became the hot machine shop item in the eighties but the prices kept them out of the reach of hobbyists. Now they are small change.

The Igaging system consists of a mast with a slider that does the counting, linked by wire to a battery powered readout. The system includes an assortment of brackets and screws, plus spare batteries. The claimed accuracy is .002" per 6 "of mast length, which means that the 36" unit has a positional accuracy of .012". This would be too loose for a tool-and-die maker's milling table but not all that bad for a hobbyist gauging the length of a part made on a lathe.

I wanted to know the depth to which





I was machining the countersinks for flush rivets. Although I have a countersinking stop I was still getting some variation in depth, possibly because my drill press is on the large size. It could give a squeeze to the countersink stop so hole depth was varying by .003-.004". I wanted some sort of feedback and a DRO would be a good way to accomplish this.

The first matter was to mount the mast to the quill and the slider to the headstock of the drill press. On my drill there was already a collar for the depth stop so I made an aluminum angle bracket to marry to DRO's end fitting, and used an AN-3 bolt to attach. If your drill press does not have a collar you will have to make one, and this might entail finding an RAA member with a metal lathe to bore a hole in a block of aluminum, to fit your quill. A quick and dirty method would be to use a drawbolt type hose clamp and a shop made angle bracket made from angle stock. There is not much force required to push the mast through the slider so this might be an easy solution.

The rear of the DRO's slider has many threaded holes, and screws to fit are supplied. I picked two widely separated holes and found that the supplied screws were not long enough to poke through my chosen piece of aluminum bar stock. Because I did not have any longer screws on hand I just counterbored the holes with a ¼" drill bit. This meant that the perimeter of each screw head is all that is doing the work but a drop of loctite on each screw made sure that everything will stay put.

Top: The rear side of the slider has tapped holes. Below are the shop made aluminum mounts. Above left, Ready for mounting on the drill press. Above right, with a countersink stop and then a DRO to give depth feedback, it becomes very easy to countersink each hole to the desired depth.

Left, A .032 feeler gauge measures .031", close enough for a drill press. Centre, The readout is held in place by a magnet on the back. Digits are legible, 10mm high. Right, the device is ounted to the headstock and the quill.

The aluminum bar is held to the drill's headstock by a couple of AN-4 bolts threaded into holes drilled and tapped into the headstock. The heads of AN-4's just clear the mast of the DRO. Flush screws would have been better but it was a Sunday and the machine shop supply was closed.

The readout panel is easy to mount because it has a magnet on the rear side. Also supplied is a plastic bracket with some mounting nubbins if you have to attach to something that is not magnetic. I just plunked mine onto the drill's switchbox. The hardest part was to coil up the extra wire and keep it out of the way with some cable ties.

The readout will give you numbers in thousandths of an inch, 64ths of an inch (who uses this?) and hundredths of a millimeter. The resolution for decimal inches is .001" but if you want better accuracy you can switch to metric where it is .01mm, which is 2.5 times as accurate.

To check the accuracy I put a transfer punch upside down in the drill chuck and lowered it until it touched a piece of flat block. I pushed the "zero" button on the readout and then put a .032" feeler gauge on the block. The readout said .031, close enough for my purposes. Then I did the same test with a 2" gauge block and got a reading of 2.001"

I found that the DRO made it very easy to set my countersink stop to the correct depth. I just bumped the tip of its drill against the aluminum material and set the zero on the panel. I machined half a dozen test holes, readjusting the countersink by one graduation each time, and kept checking with a rivet dropped into each successive hole. I wanted the rivet to be .006” below flush and with my countersink this meant a plunge depth of .191”. After a half dozen more test holes using this number I could go consistently to the desired depth without overpowering the countersink’s cage.

Having a DRO on the drill is handy for other purposes. Would you like to know the thickness of a piece of round bar or a block of aluminum? Just chuck a drill bit upside down, zero against the table, and use the DRO to measure the thickness. Want to know the depth of blind holes in a part? Bump the drill bit against the face and zero the panel, and then measure the depth. Easy.

On a small drill press you might need to shorten the mast to clear the driven v-belt pulley. I do not know if the slider can be removed and easily reinstalled on the mast so perhaps it should just be masked off while you cut the mast. Some DRO’s use a glass scale and some use a steel scale. On either an abrasive wheel in a dremel should do the job. Take a test cut first just off one end.

One matter though – on a DRO there is no automatic shutoff so you have to do this manually. The kit gives you a spare battery but if you are forgetful you should get a few extras.

IGAGING 6” DRO #B 3136 $29.99
www.busybeetools.com
1-800-461-2879

Homebuilt: the Movie

As some of you know I am making a film about those who build airplanes for themselves. My name is Cathy Ord and I am a filmmaker. I had the privilege of growing up with a father – Larry Ord- who built an Emeraude in our basement in the 1960’s. He has passed away and I want to tell his story and the story of countless other builders. The film is intended for television. What I need is find other builders that would be interested in telling their stories and be a part of the film. If you have finished a plane or are in the process of building I would love to include you. In addition, I can’t make a movie about building planes without telling the story of the RAA. I would like to also hear from anyone who can help tell the story and history of the organization.

Contact info: cathyord@sympatico.ca 647 444 7039 (cell) 416 260 6639 (home).

An Open Letter to CARAC

Recently proposed legislation may have a dramatic effect on the rights of pilots and airports. **Kevin Maher** examines the implications of what the Canadian Aviation Regulation Advisory Council is suggesting.

Dear Sirs and Madames;

On behalf of the Duncan Flying Club, I am writing to comment on the draft NPA, “Responsible Aerodrome Development”, CARAC Reporting Notice 2013-014. By way of introduction, I hold an Airline Transport Pilots License, have worked as a professional pilot for over 30 years, own an aircraft, and am active in a local flying club. I also actively mentor young people entering the aviation industry, especially groups such as Air Cadets, Women in Aviation, and those enrolled in local aviation college programs. Additionally, and somewhat coincidentally, I serve on a land use planning committee for a local regional district.

While we recognize the very real issues that the NPA is seeking to address, the NPA as proposed could have far reaching unintended negative consequences for the aviation industry for many years to come. Before discussing the NPA in detail, it is important that all those involved in the process understand the aviation industry in Canada, and what attributes unique to Canada give us the worldwide competitive edge we currently enjoy.

Aviation is a “top down” industry in Canada. Pretty much every aircraft mechanic and pilot working in commercial aviation got there thanks to much smaller general aviation airports. Whether it was during their training or their early jobs, without the smaller general aviation airports, the glitzy high dollar end of the industry would be struggling. This can be seen in other parts of the world that don’t have strong general aviation heritage – severe pilot and mechanic shortages that are leaving brand new airplanes parked! Other countries dream of having a general aviation infrastructure and heritage as Canada does. It is very important to understand the link between small, often un-certified airports and the rest of the aviation industry. Anything such as this NPA that imperils smaller airports will eventually and inevitably hurt the entire industry, eventually depriving the government and the country of tax dollars and jobs.

The aviation infrastructure in Canada is based on a network of airports. Whether out of economic necessity or for reasons of safety, this network cannot tolerate localized “holes” in it to any degree. If you close 50% of the airports in the country over time, you do not reduce aviation activity by 50% - you reduce by much more, probably closer to 90%. An example of this is the sharing of bulk loads of fuel between smaller airports that otherwise couldn’t store an entire truck load themselves. Without the neighboring airport to partner with, this couldn’t happen, which due to the trucking costs, results in an increase in fuel cost. Aviation is an activity that requires a critical mass to function so the small scale local repression of airports and airdromes has a much more profound and long term negative effect than it would appear at first glance. Additionally and critically in this vast country of often inhospitable terrain and weather, a network of small airports across the country increases aviation safety by allowing people with mechanical or weather difficulties safe places to land. Minister Raitt's previous comments that most airports are underutilized leads me to believe that she may not full understand these issues.

As mentioned in the NPA, larger international and other certified airports already have mechanisms built in to their operational plans that mirror the ones proposed, and therefore this NPA will have little effect on them. My concern is with the smaller community airports and aerodromes, the private aerodromes, and the currently unregistered aerodromes. This NPA will at best be an economic burden and introduce another level of uncertainty to their operations. At worst, it will in many cases over time, open a "Pandoras Box" of ill thought out additional regulations that will strangle existing airports out of existence. And like "Pandoras Box", if this consultation and decision mechanism proves to be harmful to aviation, it will be very difficult or most likely impossible to undo the damage.

This NPA immediately raises six issues and concerns that will potentially imperil many existing and future general aviation airports.

1) The idea that this proposed consultation would be triggered if a proposed airport would lie within 30nm of another certified or registered airport defies any logical underpinnings. Most airports or aerodromes have control zones or aerodrome traffic zones of between 2nm and 3nm in radius. This area is sufficiently large to contain all the air traffic movement related to the operation of the airport. Furthermore, at this distance aircraft utilizing normal climb and descent profiles are above the minimum height for flight over built up areas. In other words, flights operating outside normal control zones or aerodrome traffic zones present no additional impact than any other overflying aircraft. Why would a consultation process be triggered by a distant geographical proximity to an existing airport when there would be no measurable or real operational impact in this area? The only possible reason I could think of for the 30nm proposal would be to protect an existing airports commercial monopoly. If this is the case, this anti-competitive motive should be fully disclosed to the public at large and be debated in a much wider forum. Otherwise, I believe the triggering consultative distance should be restricted to only an area that would incur aircraft related operational impacts.

2) The proposed mandatory compliance with local municipal building and fire codes, instead of the current practice of complying with the Federal Building Code, this NPA presents municipalities with a potential "Trojan Horse" to prevent airport development, by allowing them to create unreasonable and unworkable building codes that apply only to airports.

If you close half of the airports in the country over time, you do not reduce aviation activity by fifty percent - you reduce by much more, probably closer to ninety

From a public safety and construction safety standpoint a small hanger is little different than an uninhabited garage or barn. An airport fuel facility is little different than an automotive gas station. In Southern British Columbia, we have already seen two municipalities implement onerous and costly fire codes that applied to their airports only. One municipality requires a sprinkler system installed in uninhabited aircraft storage hangers that costs more than the value of the aircraft stored inside them. Another required the retroactive installation of fuel delivery system improvements to a standard not found at any other airport in Canada! Neither of these requirements provided any demonstrated safety improvements, and both have resulted in airport improvements and the resulting economic activity from them not proceeding. To enshrine the ability of local governments to place arbitrary and unreasonable standards on airport development, can, and will, result in this sort of abuse of process occurring with increasing frequency. For 50+ years the National Building Code has worked well for airport development and we see no reason why it cannot continue to do so.

The idea that municipal governments should have any influence in the creation or expansion of airports is in itself a concept fraught with peril. By coincidence I just happen to serve on a local government land use planning committee (Cowichan Bay Advisory Planning Commission.) and I see first hand how local government approaches land use decisions. Municipalities often do not understand the long term benefits of an airport or aerodrome in their community until after it is well established. The ability to host air ambulance service, the tourism and business benefits, the increased tax base, are often only apparent after they exist. A small vocal minority of voting NIMBY's is very apparent before an airport even gets under construction, and many small town politicians don't have the ability to take the broader longer term view. Conversely, some municipal governments will covet the existing aviation real estate for higher density development, thereby placing the municipalities in a position of conflict of interest with the developers of an airport. To give these voices that often lack knowledge or understanding, fail to be able to see past the next election, are NIMBYistic, or have alternate agendas, a formal say in the creation or expansion of part of our National aviation infrastructure will over the long term greatly diminish the aforementioned infrastructure.

The proposed exempting triggering revenue stream (less than $30 000) and triggering days of use per year (30) are so low as to be immaterial (ie useless) to small private aerodromes and airparks. Additionally, the expected cost of consultation and compliance are far out of line with any potential benefit when considering small private rural airfields and airparks. This small segment of aviation is often the seed where young less financially well off people are initially exposed to aviation. This segment is very sensitive to costs and these additional costs could be a tipping point. I propose that any development with a revenue stream of under $100 000 or with less than 1000 take offs and landings per year, be exempt from any proposed new consultation or development restrictions. To put these numbers into perspective, this is less than 3 take offs and landings per day and the typical annual operating cost of approximately 8 light aircraft.

The proposed NPA contains a tremendous number of undefined, vague terms that airport proponents will be expected to comply with. Terms such as "reasonable, unreasonable, acceptable, attempt, existing levels of service or operation, alternate dispute resolution process, etc." Reading this document is at times like grabbing at smoke, and the very real fear is that without precise definition and explanation, these terms could be interpreted at a later date or by another jurisdiction to be far more broad reaching and onerous than intended.

Transport Canada is already understaffed to the point that staffing levels are having negative consequences to the industry in the timely and safe delivery of services. Evidence of this is the fact that aircraft ferry permits take weeks to obtain, and supplemental type approvals can take

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ProAirsport: GloW

Will ProAirsport's innovative jet-powered SSDR self-launcher transform gliding, or microlighting, or both? Dave Unwin investigates.

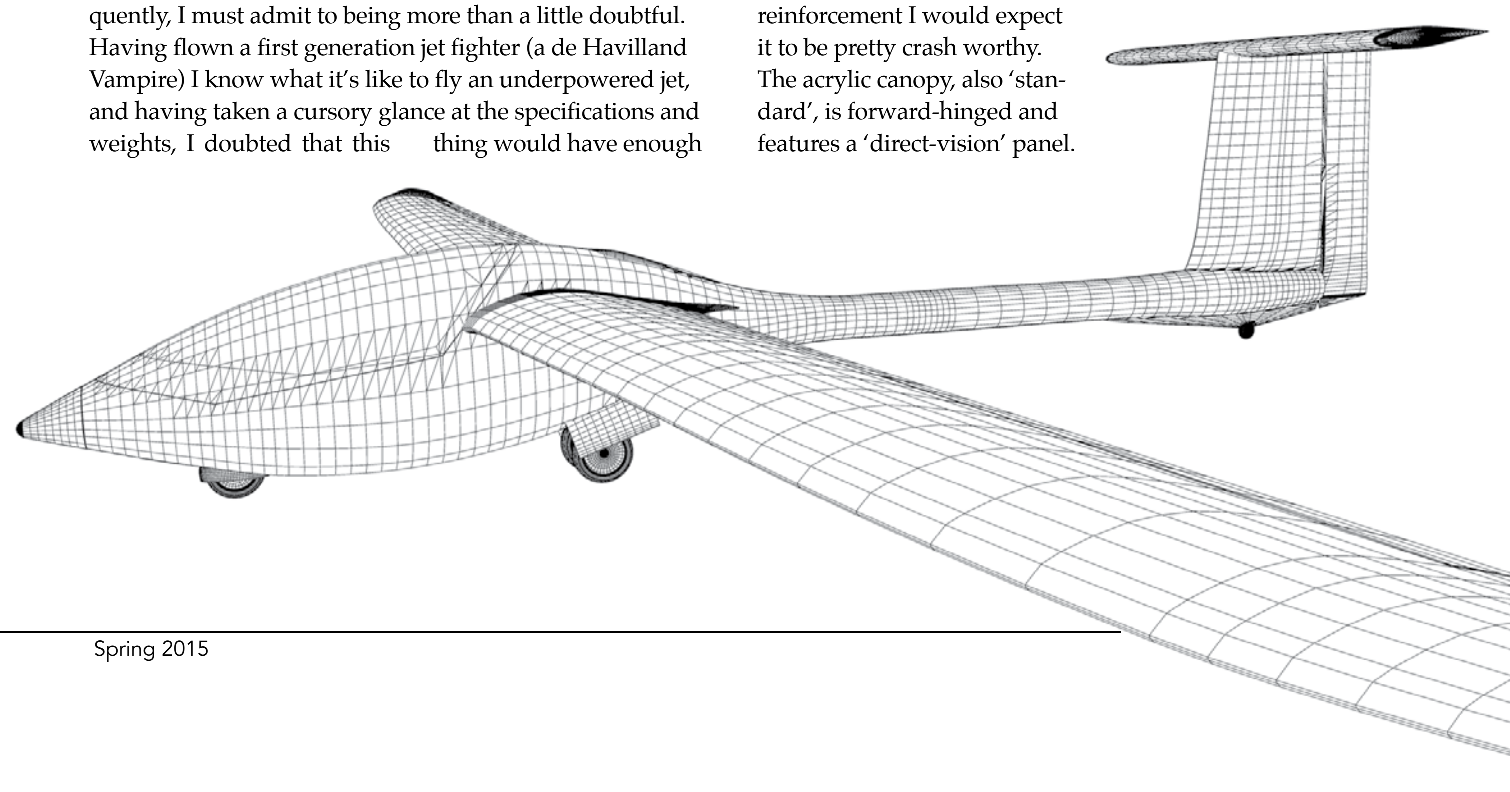
I LOVE SOARING. The first time I ever flew and my first solo were both in gliders and for me soaring flight exercises a fascination that is both difficult to explain and hard to resist. Often described as 'three-dimensional sailing' the ability to fly a heavier-than-air machine for several hours and hundreds of miles by using the atmosphere as the fuel and your intellect as the engine possesses an undeniable attraction. Of course, two inevitable downsides of the pure sailplane are that assistance is required to get the thing airborne, and when you land out. Furthermore, we all know that gliding can be almost as frustrating as it is fun, aircraft serviceability, airspace and airworthiness issues, licensing, and of course the capriciousness of the weather. However, what I find really frustrating is when everything else is beautifully aligned and the gliding club is closed or distant! Indeed, some of the subtlest soaring conditions are often found in the morning and evening. Air is a fluid, which means that the atmosphere is an ocean. And just like an ocean the atmosphere is rarely flat calm; there are endless ebbs and flows, ripples and waves, and this means there is usually some energy somewhere that can be utilised. Furthermore, from an aesthetic view point the low light of early morning and late evening can be stunning. These are two of the reasons why, although I live only 20 minutes away from the gliding club, I keep a Jodel D9 on a farm strip only ten minutes from my house. I've had some fabulous soaring flights, but I do find the engine intrusive. Of course, what I really need is a sailplane that I can rig by myself, and then safely self-launch from a 500-metre grass strip. I've never really been a fan of the engine-on-a-stick configuration, while the jet-powered self-sustainers just don't have enough thrust to self-launch. In fact, I have no desire to go back to the performance offered by early motorgliders, which were desperately underpowered and possessed two distinctly unattractive traits – a marked reluctance to leave the ground and a disturbing eagerness to return to it! In fact, some were rumoured to depend heavily on a little-known device called a 'dirt-sniffer'. Reputedly designed for underpowered jets like the Republic F-84B and early versions of the Boeing 707, the dirt sniffer remained passive until it smelt the dirt beyond the end of the runway. Somehow (I have never had how a dirt sniffer works satisfactorily explained), sensing the end of the runway and its own imminent demise induced it to produce a bit more thrust, thus allowing the motorglider to stagger into the air. Of course, your problems were far from over, as these contraptions were so gutless that encountering even slightly sinking air was enough to turn the already lamentable climb rate into a descent, and as the ASI and vario needles sagged and the oil and cylinder head temperatures went 'off the clock' the best thing to do was just look out of the windscreen and do your best to avoid tall trees and double-decker buses. They weren't very nice to fly.

Consequently, when I heard that ProAirsport was proposing a new type of self-launching SSDR sailplane, powered by a lightweight turbojet my initial reaction was one of scepticism. The history of flight is littered with the wrecks of ill-conceived aircraft, because trying to squeeze a thousand kilos of ingenuity and enthusiasm into eight hundred kilos of possibility almost always seems to end in tears. Subsequently, I must admit to being more than a little doubtful. Having flown a first generation jet fighter (a de Havilland Vampire) I know what it's like to fly an underpowered jet, and having taken a cursory glance at the specifications and weights, I doubted that this thing would have enough thrust to even taxi to the far hedge, let alone fly over it!

But then Roger Hurley, ProAirsport's CEO revealed that "project GloW" sitting in his computer was a hybrid, and that the wheels would be driven by a powerful electric motor. Instantly my initial scepticism turned to enthusiasm, and I made an appointment to meet Roger at the ProAirsport factory. Here I studied the blueprints and CGI, inspected the fuselage plug and marvelled at the small size of the jet engine.

I learned that the wings are 'standard' – with some aerodynamic tweaks – from an existing glider which straight away increased the project's credibility as - in my opinion at least - there's no point in constantly reinventing the wheel (or the wing in this case) and that choice just greatly reduces project risk and cost. Designed to meet the requirements of the new UK Single Seat Deregulated (SSDR) class and the US Light Sport category GloW will have a MAUW of 300kg and an empty weight of about 180kg, leaving a payload of 120kg. If you fill the tank its 27kg, leaving 93 for pilot and parachute. Although many lightweight machines these days sport Ballistic Recovery Systems, there simply isn't room for one in GloW.

Both the methods and materials used in its construction are standard sailplane technology. The fuselage is essentially fibreglass with aramid and carbon fibre used only for local strength. The wing is foam core and fibreglass sandwich construction. Modern composites are fantastically strong, and as the cockpit area also has local carbon/aramid reinforcement I would expect it to be pretty crash worthy. The acrylic canopy, also 'standard', is forward-hinged and features a 'direct-vision' panel.



> The jet-powered self-sustainers just don't have enough thrust to self-launch... [but] this is where GloW gets really interesting, as these wheels are driven by a powerful electric motor.

The fuselage carries the wing, engine, fuel tank, batteries and the clever powered undercarriage. The shoulder-mounted wing gently sweeps at the tips and uses a modified NN18-17 laminar flow aerofoil with only a small amount of dihedral. Large Schemp-Hirth type airbrakes are fitted to the top surface of the wing at about 45% of the chord. The location of the Titan jet engine is particularly interesting as it is fixed internally behind the cockpit and features an automatic open/close intake scoop. This very neat little turbojet is less 40cm long and weighs an astonishing 3.7kg, yet produces a creditable 390N. This should be enough to produce reasonable climb rates at around 50kts, while the 34 litre fuel tank should be good for several further climbs. Fuel quantity carried may improve, but current thinking is that only having a single fuselage tank is much simpler, particularly when rigging and de-rigging. As the engine can burn a variety of fuels, from Jet A-1 and JP-4 to diesel, kerosene and domestic fuel oil it can not only be readily refuelled from a variety of sources but is incredibly cheap! I had a delivery of domestic fuel oil only yesterday, which was 50p/litre. As it is expected that a take-off and climb to 3,000ft will burn about eight litres of fuel, the cost of a relatively high go-where-you-want launch will still be less than the average winch launch, and a lot less than the average aerotow! In the cruise, fuel flow is predicted to drop as low as half a litre a minute. The Titan is a standard commercial item which is used successfully in large R/C models and drones. All maintenance is 'on condition' and, compared to a piston engine turbines do offer several advantages. They are light, compact and have only a few moving parts. Vibration levels are low, and they are very reliable. They are also much easier to start. Indeed, there are few engines more capricious than a two-stroke that is neither hot-nor-cold (and they usually demonstrate their fickleness at the most inappropriate times, such as when you're getting low over hostile terrain). Unlike a two-stroke, starting the jet is very simple; select start, the airscoop opens, and it starts. Shutting it down is equally simple, while a significant advantage of mounting the engine inside the fuselage is that while it is spooling up (and starts producing thrust) there's very little drag produced. Unlike a large windmilling propeller mounted on top of a pylon! However, in aeronautics, as with most things in life, there is no such thing as a free lunch… or, as would be more apposite in gliding circles, a free launch! Now, although very small jets have been used on self-sustainers for some years, they simply don't have anywhere near the static thrust required to take off in a reasonable distance – if at all.

GloW has been designed for easy rigging, and a special trailer that allows solo rigging will be an option. And as the complete empty weight is only around 180kgs, rigging shouldn't be too taxing. The elevator connects automatically, and I'd prefer it if the ailerons did too. Pushrods actuate the ailerons and elevator, cables the rudder, and the tailplane, fin and rudder are entirely conventional in both construction and appearance.

Now we come to GloW's most unconventional aspect, the undercarriage.

This consists of four wheels of three different sizes mounted along the fuselage centreline. There's a small steerable pneumatic nosewheel, a tiny solid urethane wheel (more of a 'tail bumper' really) at the very tip of the tail and dual retractable mainwheels, so the aircraft sits upright wings-level. And this is where GloW gets really interesting, as these wheels are driven by a powerful electric motor. Modern electric motors put out a lot of torque and this can produce incredible rates of acceleration, (check out the Tesla car on YouTube if you don't believe me). Roger explained that this hi-tech, brushless motor is a standard commercial unit that has been specially customised for ProAirsport. The bespoke controller is supplied by the motor's manufacturer (to ensure compatibility) and the LiFePO4 battery pack and charging system all use standard parts. Using the powerful electric motor to accelerate GloW up to take off speed is the design's 'secret sauce' – and I am utterly convinced of its virtues. For take-off, GloW can be wings-level taxied, even reversed into position, with the motor also acting in place of mechanical brakes (further advantages of electrically driven wheels) before starting the jet and setting full power. With a peak output of 7kW and clever gearing the wheels will easily and quickly accelerate the aircraft to the safe speed above which it will fly (the wing has a slightly negative angle of attack on the ground), then a smooth rotation will ease it into the air and it will climb away using the thrust of the jet. As the electric energy required for take-off is wanted for only a few seconds (the acceleration really should be outstanding, in fact wheel spin could be an issue if power is applied too quickly) then take-offs from farm strips should be an option.

The design certainly looked extremely professional (Roger has assembled an impressive team of pilots and engineers, including renowned aerodynamicist John Gibson, aero-engineer Vittorio Pajno and Finance Director Stephen Lynn)

Top Left: small jet engines may be fine for cruising flight or the hunt for elusive lift, but are anemic when it comes to getting off the ground. But incorporating a powerful electric motor (left) on the main gear helps eliminate much of the disadvantage, giving the simplicity and aerodynamic goodness of a small jet with solid acceleration on the runway. Below: the jet's exhaust port is inobtrusive: overall a solution that is both lighter and simpler than a retractable motor/propeller mechanism..

and Roger emphasised that although the SSDR class is not regulated or subject to mandatory airworthiness approval, ProAirsport decided from the start that recognised standards would be adopted. Consequently the company is following guidelines in the Standard Specification for Design & Performance of a Light Sport Glider (ASTM F2564) that's now tacitly accepted in many territories.

Cost? Final prices are yet to be announced, but its clear from the design choices made and the manufacturing methods adopted that ProAirsport's objective here is to come in at the EASA-free light end of the self-launch market at significantly lower retail than any other mainstream self-launcher. I have the impression that this experienced team has put together a very do-able project.

I came away from my visit to ProAirsport completely converted to the idea. Imagine owning a self-launching microlight sailplane, free from regulatory hassle and able to take off from any reasonable field or strip? It could revolutionize soaring for many pilots, particularly those who either can't get to the gliding club as often as they like, or don't even live near a club. There are trade-offs of course. As the aircraft is – by definition – very light, although the projected best L/D is expected to be mid-30s, this will be achieved at relatively low speed. However, the same is true for the min. sink, so GloW should climb very well indeed. All aircraft are a compromise, and what's the point of owning a seriously expensive 50:1 supership if you only get to fly it twice a month? Furthermore, the reliable engine and easy starting (without any drag penalty while it starts) means I could use it to explore gentle wave systems, sea breeze fronts and shearlines, and also to investigate hills and ridges that simply aren't accessible by pure gliders. As it says on their website, convenience, simplicity, independence and lower cost can make the 'Fly More, Fly for Less' idea a real possibility.

So taken was I with the project that as I left I gave my card to Roger and said that if ProAirsport needed any help with the test flying programme I'd be delighted to help…

GloW Factsheet

Span	13.5m
Length	6.3m
Empty Mass	180kg
MTOM	300kg
Load Limits	+4g -2g
Max L/D	about 36 (estimated)
Min Sink:	120 fpm (estimated)
Turbine	Titan, max thrust 390N
Electric Motor	Customized, Peak take-off output 7kW
Batteries	Capacity options

Aeromobil News

The Aeromobil 3.0 preproduction prototype has now been finalized and has been in regular flight-testing program in real flight conditions since October 2014.

"The AeroMobil 3.0 is predominantly built from advanced composite material. That includes its body shell, wings, and wheels. It also contains all the main features that are likely to be incorporated into the final product, such as avionics equipment, autopilot and an advanced parachute deployment system.

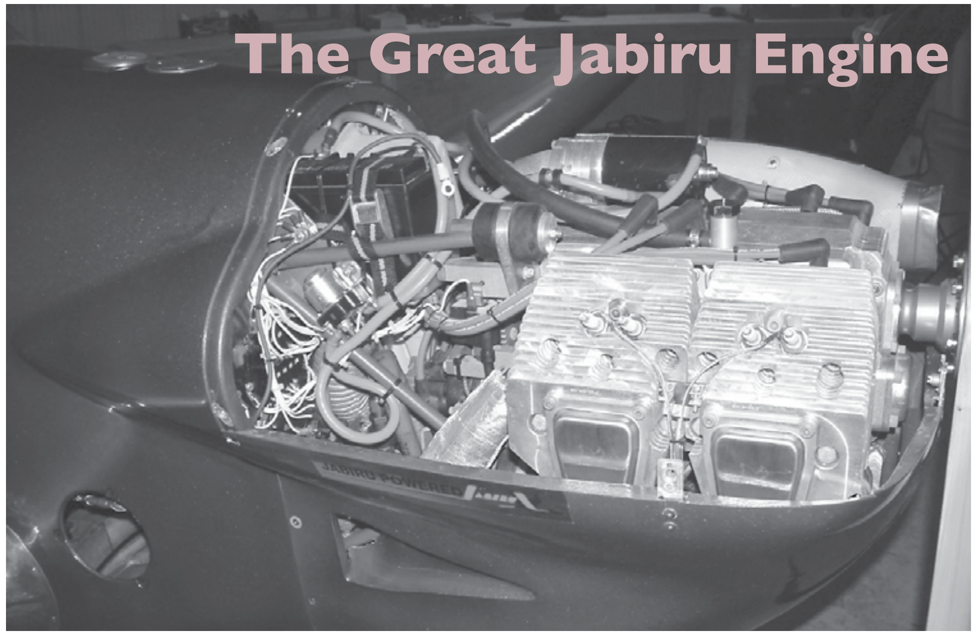
AeroMobil 3.0 also implements a number of other advanced technologies, such as a variable angle of attack of the wings that significantly shortens the take-off requirements, and sturdy suspension that enables it to take-off and land even at relatively rough terrain".

The Aeromobil will be featured at the upcoming Top Marques Monaco, the world's only live supercar show, and participated in the recent SXSW show in Austin, Texas. It has been featured Wired magazine, on BBC, CNN and the Wall Street Journal to mention a few.

Recently, Anthony Sheriff, Glenn Mercer and renowned inventor Dean Kamen were added to Aeromobil's Advisory Board.

Aeromobil hopes to offer their vehicle to to public in 2017.

The Great Jabiru Engine Debate



Stan McLure

THE CURRENT DEBATE in Australia over the safety and reliability of Jabiru engines and pending restrictions is seen by some to be precautionary but to those with actual experience with the engine it seems heavy handed and somewhat of a witch hunt. A superficial response to a number that seems too high without detailed analysis to support it is irresponsible for an agency with the influence to damage the reputation of a fine company and engine.

After CASA released its original proposal, RA-Aus issued a strongly worded response on November 21, in which it stated, "CASA has provided no specific failure data related to Jabiru engines to industry other than to suggest an increasing rate of engine failures. At no point has CASA published evidence or otherwise to substantiate its claims. RA-Aus and the aviation community have no evidence to suggest that the statements by CASA are made with any substance."

CASA met with Jabiru and RA-Aus officials and issued a revised document in which it emphasizes the precautionary nature of the proposed restrictions. "No conclusive determination has been made by CASA about the integrity of Jabiru engines, and no determinative findings have been made by CASA about Jabiru's ability and willingness to produce safe, sound and reliable aircraft engines," it states.

CASA also acknowledged Jabiru's good reputation for manufacturing safe and reliable engines, and that most Jabiru-manufactured engines continue to operate safely and reliably in Australia and abroad.

There are 1100 Jabiru engines operating in Australia with 90,000 Jabiru powered flights in 2014. Of those, 40 aging engines experienced problems in 2014. Less than .04% of the fleet.

Most 2200 engines are in training aircraft suffering abuse of student pilots. One school reported that it had a total of 13,000 hours on it's fleet of Jabiru engines with most making it to TBO which is 1000 hours for a Jabiru engine.

The 40 engines involved suffered full to partial power loss and in flight shut down. Rough running,oil leaks. No fatalities or injuries.

Jabiru issues service bulletins and engine upgrades as issues are identified. Engines at TBO are upgraded to latest revision.

Issues pertaining to through bolts, fly wheel bolts, valve train, pistons etc have been dealt with by Jabiru through service bulletins and mandatory upgrades to engines in the field.

I have first hand knowledge of this as I pranged my Jabiru 2200 powered Starlet in June of 2013 and suffered a major prop disintegration. In obtain-

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Electric Dreams

The Great Electric Flying Circus

Brian Steele

THE PROSPECT OF practical electric powered flight has caused a buzz (well- a quiet buzz) amongst many sport aircraft enthusiasts. A growing number of inquiries have been directed to the RAA relating to electric design, and in particular the feasibility of converting an existing IC (internal combustion) powered aircraft design to electric propulsion. Some conversions will provide acceptable- to-good performance, but most existing light aircraft are not suitable as "donor" airframes using electric propulsion.

Photo Credit: Antonio More

THE FOCUS OF THIS ARTICLE

is to serve as a primer of the elements that are necessary for successful E-flight. As such I will minimize the math that is necessary to determine suitable aerodynamics and issues relating to the Electric components that are available today. I will outline elements of a selection of electric aircraft and identify a few electric aircraft suitable for conversion. I have also included a spreadsheet that will allow you to do a bunch of "what-if's". This does require some mathematics –but this is done for you by the spreadsheet. It should provide a quick method to determine whether or not your "dream aircraft" is a viable candidate

Accurate data is key. Having spent forty years in science and engineering I found that two critical issues form the keystone of good design: (1) from computer programming-GIGO (garbage in-garbage out). If the data entered is not accurate-your outcome will be wrong. (2) In science we call it testing hypotheses- but it really means test.... but verify. Accept the outcome of your tests –and use this data for your design if it is consistent with your project's goals; if not discard and redesign.

Healthy skepticism is mandatory for good design outcomes. One pet peeve of mine is the lack of accuracy in the performance data that is published for some aircraft. What is the actual Vmax....what is the l/d-and at what airspeed...what are the ROC (rate of climb) and sink rate-and at what flying weight were these data recorded? These and other data are key to determining E-flight design elements. The other peeve is the mountain of hyperbole that surrounds electric flight. I read of a European prototype that has a range of 200 miles at 140 mph. Statements such as these require independent corroboration. A simple analysis will show that at the power required, the battery weight may exceed the design gross weight by several hundred pounds (unless this battery has a very much higher energy- density than NASA uses in today's designs). There are also well meaning folks who have "heard" of outstanding performance data or "solid" theories of E-design, and preach these claims like they are literally the gospel, when the information is factually incorrect. Sometimes, it really does seem like an "Amazing Circus". Test... but verify.

With all the limitations and caveats I present, one may think that I am not an E-flight fan. Not true. Since my first successful RC (Radio Control) flight over 45 years ago I have been involved in many projects including design of an ultra light aircraft and several electric vehicles. Many pilots who are also involved in RC (radio control) flight will note that the majority of RC aircraft at the flying field today are electric powered. Electric RC powered aircraft often outperform their IC (internal combustion) powered designs

Note: the following analysis is my own and I take full responsibility. For my article I have consulted and visited several leading designers and have verified their performance data. I have enjoyed forty years of electrical engineering as well as aero design, and have had this article vetted by electric designers, and I stand by it. If I have missed some battery technology that is greater than 140 watts per kilogram (LiPo 170/kg)-then I will redact my analysis. If there is a marketer of a two place E-powered aircraft that can fly at constant power at 130 mph and is capable of a 200 mile cross country flight (no recharge) then I will be delighted to visit this aircraft at my own expense, and report the tests in the RAA Magazine. Also note that the above does not relate to the Pipistrel Taurus Electric, which was designed in Europe and spends 90% of its flight time in glide or in thermals. I am referring only to non-thermal flight .

There are economies of scale that account for the spectacular performance of RC (radio control) models. In this case economy of scale means that weight and power requirements increase exponentially as the scale of the aircraft increases. For example: A 40% size RC Extra 300 may weigh 45 lbs and use a 12 hp engine. The 40% RC model is capable of performance that exceeds that of the 100% size aircraft, such as unlimited vertical climb. Most RC flights last only 10-12 minutes, and this means that a comparatively light weight battery will be pushed VERY hard and become nearly exhausted in this flight. By comparison, in a person carrying aircraft a 10-12 minute flight might buy you one circuit. Economies of scale and mission (flight duration) are very different goals as it relates to full size aircraft.

To be accurate: There is an Electric Long-Eze that has exceeded 200 mph and an Cri Cri that is very fast and can perform an aerobatic routine. These efforts should be celebrated. However these are purpose-mission aircraft. If you measure the motor power KW (kilowatts) and the battery in KWH (kilowatt hours) then plug these data into the spreadsheet, you will determine that a cross country flight with these aircraft would be measured in minutes. This is simply due to the factors that are outlined below. It really is all about battery energy-density.

The development of Lithium batteries and light weight, efficient brushless motors have made E-flight a possibility. This development was and is driven by RC, power tools, automobile manufacturers, and the lithium batteries in almost every electronic device, including the smartphone.

The RC model movement has become a mature industry. Today we can purchase model aircraft in which the correct motor...ESC (electric speed controller)...battery pack and propeller recommended for a specific RC model, are readily available. Similarly there are electric cars available today that are turn-key. In neither case is any technical knowledge required of the operator.

This is not the case for the full sized electric aircraft industry as it exists today. There is a dearth of turn-key aircraft on the market, and I am not aware of any supplier that can provide all the components as a package, for any existing aircraft that you wish to use as a donor. As a result, you must become your own "engineer" or technically proficient designer. I do encourage everyone to dream and experiment; just be aware that you may spend much time and money and you may encounter setbacks. Become aware of what elements are necessary to accomplish your goals. The window for successful E-flight today is quite narrow so you certainly don't want to pursue a design that produces disappointing results. Do not expect to become a passenger in an E-powered De Havilland Dash 8 in the near future, and perhaps never.

I will provide an example of a very successful turn-key single seat electric aircraft that is now available and a few examples of good candidates for E-conversion. Please look at the aircraft elements that are necessary to create a successful conversion. Chart 2 *(following page)* is the result of a spreadsheet that evaluates a Challenger II (long wing) as a prospective "donor". As I introduce data and aerodynamic terms please keep referring to the Challenger chart for comparison. Be aware that the data I entered was the most accurate I could obtain from factory sheets and from Challenger II owners. If the input data is not correct, then the results are not accurate.

Optimal performance for E-aircraft using current technology

I mentioned previously that there are few proven turn-key Electric aircraft on the market. Most of these aircraft are either motorgliders or self launch sailplanes. Competition sailplanes are the most efficient and elegant birds in our aviary to date. We will look at one very successful E-aircraft to highlight the elements that provide good-E-performance.

Allisport Silent II

I have selected the Allisport Silent II as a base line to which we may compare prospective E-conversions. I had an opportunity to watch a Silent II fly this winter in Florida, and interviewed the pilot/owner. The owner used a quick-build kit, which he stated was anything but quick to build; it took him 2 years to complete the aircraft. The kit quality was exceptional, and all the key structural elements were completed at the factory. He states that it is a joy to fly and 2-3 hour flights are common.

Look at the data for the Silent II *(chart 1)* and compare it to the data for the Challenger II *(chart 2)*. The Chal-

Antonio More

Chart 1 : Allisport Silent II

Wing Span	13.2 m (43.3 ft)
Planform	Elliptical (with winglets)
Wing area	8.9m² (95.8 ft²)
Aspect Ratio	20
Structural max takeoff/landing weight:	315 kg (694.5 lb)
Stall Speed V_S	<65km/hr (40mph)
Maximum L/D	40 at 90km/h (56mph)
Minimum sink rate:	0.60m/s (118ft/min) at 85km/h (53mph)
Motor Power:	19.0 kW
Powered climb rate:	~2,0,/s (~400ft/min)
Weight of batteries:	31.0 kg (68.3 lbs)
Battery Capacity:	4.3kWh
Standard charging time:	approx 150 min at 220V

Chart 2: Electric Aircraft Analysis Aircraft: Challenger II Long Wing

HP (per motor)	50	hp	motor(s) total power see cell C8	37.3	kw
Number of motors	1		motor weight (lbs/kw)	0.5	lb
Total Power Kw	37.3		Power (percentage)	30	%
Vmax (mph)	97	mph	cruise power (kw)	11.19	kw
VStall (flying weight)	37	mph	cruise speed at power setting	64.9	mph
Wing Span	31.5	ft	aspect ratio	5.6	:1
Wing Area (sq. ft)	177	sq. ft	Time: takeoff and climb to altitude	5	min
Wing Loading (flying wt)	4.88	lb/sq. ft	Energy Density - battery	135.00	watts/kg
Rate of Climb (flying wt)	500	fpm	Battery Pack capacity	15	kWh
L/D Ratio	11	:1	Battery Reserve	10	%
Sink Rate	400	fpm	ESC. + wiring + guages	25	lb
Gross Weight	960	lbs	Weight allowed for electric. system	384.00	lb
Useful Load	500	lbs	Cruise time at power setting	57.4	min
IC Motor Weight	69	lbs	Total time includes climb	62.4	min
Exhaust + Fuel Tank wt	15	lbs	Range with reserve	62.1	miles
Pilot weight	200	lbs	Battery Weight	244.4	lb
Battery Cost	480	$ per kw/h	Motor Weight	18.7	lb
Total Battery Cost	7200	$	Electric flying weight	864.09	lb

B. Steele March 2015

lenger data is the result of a spreadsheet that I created. Data is entered in the green cells and the requisite math is in calculated in the background and displays the outcomes for each change that you make. A guide for data entry is introduced in the text below.

To view the Silent II aircraft , google or enter into your internet browser "allisport II electric". There are also several good videos posted on Youtube. Chart 1 also displays the results of reducing drag to a minimum.

High L/D ratio (lift over drag), pronounced "elle over dee"- is one key element relating to long power off and/or low powered flights. Without a wind tunnel the drag component is very difficult to determine for a totally new design. Refer to Hiscocks' design manual to learn why this is so. For existing aircraft l/d can be tested based on the fact that for a given airspeed (in level flight) thrust=drag. To determine total drag, one must fly several level tests at speeds from slightly above Vstall to Vmax. Power and weight are used to convert power to thrust and from this you create a drag polar. Total drag is the sum of parasitic drag plus induced drag. Induced drag is a result of lift. At slow airspeeds, high induced drag is due to high Apha (angle of attack-in degrees) and induced drag is lowest at Vmax-since the wing is at its lowest alpha. Parasitic drag is the kind you feel when cycling into the wind (which seems like always). Parasitic drag is least at low airspeed and highest at Vmax. The drag polar looks like a "smiley face". At the point of least total drag we find the best l/d airspeed and we can perform further math to find the l/d ratio. This requires some testing and several steps of graphing and

Challenger II Long-Wing

"Many inquiries to the RAA relate to the E-conversion of fixed wing aircraft. The Lazair and Challenger II (long wing) are the conversions in which there is interest.

math-but ALL designers should provide the best l/d ratio and the airspeed at which it occurs. Best rate of climb is usually near best l/d speed.

The lift component is a result of several factors. Cl (Coefficient of lift) published in graphs you see –are wind Tunnel results that are 2D (two dimensional) - which means the wing is treated as being infinitely long. In the real world (3D) our spans have a finite length. Perhaps you recall from your studies that lift is due to differential pressures between the upper and lower surfaces of the wing. Physics tells us that air, which is treated like a fluid, seeks equilibrium. In this case the high pressure fluid on the lower surface seeks to travel to the lower pressure fluid on the upper surface. This happens at the wing tips, such that some lift is lost at the outer portions of the span. Aspect ratio (AR) is the ratio of span to chord, and low AR wings are more susceptible to this phenomenon. We can use Hoerner tips to mitigate some of this lift loss, but a sailplane wing planform is most efficient at reducing lift loss. Notice the AR of the Silent II and its elliptical LE planform. As a result the tip chord is very narrow and in addition to this, upswept winglets are incorporated at the wing tips (like the kind you see on most airline aircraft) This further reduces high pressure migration and as a result, sailplanes have a much higher Cl than most low AR aircraft. Cl is a dimensionless number that is key to several design calculations including Vstall.

For our purposes we can think of l/d as glide ratio. At 40:1 and one mile AGL altitude the silent II can reach a landing spot 40 miles away (zero wind factor). The wing loading of the Silent II is much higher than the Challenger II, but weight does not change the l/d ratio. If we increase weight (in a given aircraft) we must increase airspeed to reduce induced drag-due to a higher alpha- and allows us to remain on the same glide slope (angle).

The above also results in a lower sink rate (feet per second). Lowest sink rate is usually at a lower airspeed than best l/d. Low sink rate is useful when looking for thermals on a "low-lift" day. At 118 fpm the Silent has a long "loiter time" window to seek out thermals.

All of these aerodynamic elements allow the use of a fairly low power motor (19 KW) and a very small motor battery (4.3 KWH). The battery is split into two packs which weigh about 32 pounds each. Charging is straightforward-but 220 volts is standard in Europe. When we get to larger battery packs as we would have in the Challenger II (15 KWH means 244 lb) charging becomes more complex.

As a self launcher, the Silent II has 15 minutes of full power to achieve 3 climbs to 2000 ft. plus the glide/soaring time. By comparison if a Challenger II used 15 minutes of climb at full power, this would result in a glide duration that would be disappointing , due to this plane's low l/d and sink rate of 400+ fpm. The Challenger II is capable of thermal flight when it is very light, but at the gross weight of the E-aircraft, it would need a very good lift day which would be accompanied by turbulence, which may be an issue due to the light wing loading.

In summary: The most efficient E-aircraft today have minimal drag, a high l/d, low sink rate, and minimal weight. These aircraft are capable of

Chart 3: Aircraft: Challenger II

Power (percent)	20	30	40	50	60	70	80	90	100	
Airspeed (mph)	56.7	64.9	71.5	77	81.8	86.1	90	93.7	97	
Total Duration (min)	91	62	48	39	34	30	27	24.1	22	
Range (miles)	81.38	62.11	51.27	44.18	39.12	35.3	32.5	29.9	27.3	

Antonio More

soaring or cruising at relatively low power settings. This usually means a high AR, composite constructed motor glider or self launching sailplane. Composite construction has been highly developed. The structure is optimally engineered using fibreglass, carbon fibre, and Kevlar, and is constructed using CNC created moulds, and as a result these aircraft are expensive, and well beyond the capabilities of an amateur builder. The Silent II costs between U$ 100k and U$ 125k. The included trailer is also the hanger so you may save a few loonies and toonies for storage!

Existing candidates for Electric conversion

The aerodynamic elements listed above should be used as a guide, and successful E-conversion design should intrinsically retain some level of these design elements. Using economies of scale we can identify some very light aircraft that are capable of thermal flight and/or may be flown at a very low power setting, which results in an acceptable flight duration.

A high l/d is very desirable, but some aircraft with much lower l/d ratios can indeed soar. A powered parachute is a "drag bag" with a l/d of about 5:1. However it has a very low wing loading, low Vstall and a low Vcruise (about 28 mph). This results in a low-ish sink rate (200 fpm). Thus if we can find air rising at higher rate than 200 fpm, soaring is possible.

A few years ago I redesigned the SkyCycle for Matt Taber at Lookout Mountain Flight School in Georgia. This is an Ultralight trike (22hp Zenoah IC engine) which is capable of soaring using a hang glider wing. This is a self launching thermal capable aircraft intended for pilots who do not have access to a local mountain, a local tow plane, and for folks whose "hippy aged" legs are not suitable as hang glider landing gear these days. The production business has changed hands and I am not any part of the company, but you may view it if you Google fly-hard trikes. About five years ago I was asked by the company to create an electric powered version of the SkyCycle, but medical issues grounded me (quite literally) and I was unable to take on this task. There is still no Electric version of the SkyCycle, but the silver lining for me is that I would have used LiPo (lithium polymer) batteries which would have caused me endless grief (more on batteries below). Aerodynamics, weight and therefore wing loading, which impacts sink rate, are key to success for this type of aircraft.

The paradox relating to these aircraft is that they are a joy to fly in very light winds, but there will then be no thermals. When thermals abound the flight can be very turbulent, which requires a pilot who is skilled in handling these conditions. I never got to this point before I was grounded but I have observed several 2-3 hour flights with the SkyCycle by better pilots than myself. The l/d value depends on the selected wing but can be as high as 12:1. The weight of the airframe including engine is 95lb without wing. An electric version with a small battery would make a suitable E-conversion-since the Zenoah engine with exhaust and fuel weigh over 50 lbs.

Many inquiries to the RAA relate to the E-conversion of fixed wing aircraft. The Lazair and Challenger II (long wing) are the conversions in which there is interest. There is also interest in two place E-aircraft in general.

Lazair

You are likely aware that the Lazair was designed by a young Dale Kramer in the 1970's. It was a brilliant design and had much superior flight characteristics compared to any "FAR 103" Ultralights that I am aware of. The Lazair weighed under 200 lb dry, and this aircraft is usually registered as a Basic Ultralight in Canada. There were about 1200 kits sold and many still exist today.

In my opinion the Lazair is almost the perfect aircraft to convert to Electric. Dale is somewhat older today and has achieved much success in the area of innovative designs. Dale has experimented in E-flight conversion but he still has many business obligations. To anyone who is remotely interested in an electric aircraft conversion, I would recommend you Google RC Groups Lazair. This way you can get a flavour for the R&D and knowledge base that is necessary using today's technology, as well as availability of E-components.

I had the pleasure of watching Dale fly the amphibious Lazair at the Glenn Curtiss annual gathering. It was magnificent in the air, the hit of the day! I believe he has achieved flights of 1½ hours duration, in addition to many thermal/slope soaring flights. Dale recently communicated to me that he has not finalized the data (such as in the data chart for the Silent II) since he is still tweaking the design. Therefore I will not include data in this article, but I assure you that the Lazair has the correct elements for E-conversion. You may plug data from the gas version of the Lazair into the spreadsheet using the guidelines for the Challenger II.

If I were allowed to fly today, I would hope to purchase a turn-key Lazair or alternatively a "plug and play" kit, by which I mean a complete kit that could be retrofitted to a Lazair, without requiring design skills. Reinventing the wheel is time consuming, and you may well create an inferior wheel!

Skypup

The Skypup is another ultralight from the past which has many elements that are necessary for E- conversion. The Skypup was a result of a group of engineers based in Wichita Kansas, and the final design was created by Stephen Wood. His goal was to design a fully engineered Ultralight (+6g), that was easy and inexpensive to build, and which would provide very good performance on low power. The aircraft has an l/d of 12:1, a Vstall of 26 mph and a sink rate of 260 fpm.

Dale Kramer's Lazair on floats

Skypup

The Skypup may be the easiest to build and lowest cost scratch built aircraft design for which there are still excellent plans available. The cantilever wings have no ailerons and may be detached from the centre section for transportation. A two axis aircraft configuration is certainly rare, but with careful design of controls and correct Polyhedral, this aircraft handles (in low winds) like an aileron equipped aircraft. Turn is affected by rudder yaw which causes one wing to increase in speed (more lift) while the other wing decreases in speed (less lift), and this results in roll.

The construction materials are wood and foam and you must build this aircraft from scratch. There is a good site: Google "home sky pup". This is an interesting site to visit even if you have no desire to build a Sky Pup. There is much construction information and photos, and all of the newsletters are archived along with information about how to purchase the plans from the designer's son-U$ 70.00

With a useful load of 205 lb it would be quite difficult to achieve the design gross weight (400 lb) but the original Cuyuna engine is very heavy compared to the replacement brushless electric motor. A 5 kWh battery is likely to weigh 80 lb, depending on energy-density. The original flew on 10 hp but a 12-15 kw electric would likely provide good performance. Thus the gross weight will need to be increased to at least 450 lb. I know that there are many Sky Pups that were built "heavy" due to larger engines and excess finish paint. With a 220 lb pilot their gross weight would be close to 500 lb. This would lower the 6g design limit, and you would need to determine if this is acceptably safe. As always, extra weigh decreases the ROC and increases the sink-rate.

I have read many pilot reports that conclude that this aircraft is a ``low-wind conditions`` design. Without ailerons a crosswind landing cannot be slipped in, nor can it be crabbed since to use rudder control for alignment to runway touchdown, the wrong wing will also dip due to the yaw/roll component. Some Skypup flyers, withoutaccess to a suitable field, just land into the wind (across runway) since in elevated winds the groundspeed approaches zero.

In my opinion, thermal flight in a Skypup could be dicey due to the turbulence. However a quick calculation indicates that flight is sustainable at 30% power, about 4-5 KW. With an airspeed of 45 mph and one 4 minute climb to about 1500ft, a Skypup could be useful .The total time of the flight would be about an hour, resulting in a pleasant morning or evening flight. As with the Lazair, you would need to use accurate data and the process outlined below for the Challenger.

E-Gull

Mark Beierle, designer of Thunder Gull, has demonstrated several iterations of the E-Gull at Airventure for the past few years. His most recent version uses the power train of the ZERO motorcycle. Located in California, ZERO is the largest manufacturer of electric motorcycles in the world. These are arguably the best and quickest E-Motorcycles on the market. Mark essentially took their stock drive system - motor, battery, and controller - then added a Rotax B-box reduction, and mounted this system into his Soaring Gull 2000. This is the closest to a system of "plug and play" that I'm aware of. The following information is independently corroborated.

The IC engine version of the Thunder gull weighs 254 lb, is very clean aerodynamically (no struts) and is known to be a fairly good thermal aircraft. Mark was able to purchase the components from ZERO Motorcycles and he is considering marketing a production E-Gull/retrofit E-system. He plans to replace the Rotax Gearbox with a lighter belt redrive system.

The current performance is quite good; google "Electric Gull youtube". The take-off is spectacular, and at 2000 ft he throttles back to cruise power for an honest one hour long flight. The Soaring Gull has all the attributes necessary for a light E-plane. The motor is 40 kw (about the same HP as a 503) and the E-Gull uses a 71" prop turning at 1300 rpm. The redrive and prop explain the STOL and ROC. The battery is 11.4 KWH and weighs 170 lb. I would watch this and subsequent iterations closely since battery management is not an issue, and the ESC (controller) is matched and wired both to the motor and battery, plus gauges. The battery is rated and proven for 3000 charges, so the total cost including charge and battery replacement is $4.00 per hour.

When I interviewed Mark (April 2015), He said he is looking to market a two place E-Gull but the technology is not where he needs it to be—but it is getting closer.

Despite all the hype, the Pipistrel WATTsUP is the only 2 place trainer that is flying in Europe. He is aware of prototype tests, but is not aware of any production models on the market yet. Mark made me aware that he thinks that a 2 place trainer will be marketed, but flying technique will need to be modified. He thinks that 100% power would only be used to about 200 feet, then cut back significantly. Climb to altitude would be gentle, and the altitude might well be less than 1000 feet. Then we will need an aircraft with a high L/D such that we can fly half the circuit, power off. It sounds to me like power management and sailplane piloting skills will be the key.

Exploring the outer Limits of Economies of scale

I earlier alluded to the fact that much more power is required as scale (mass) increases. This means that the battery weight (due to low energy density) increases to point that reasonable performance electric flight is not feasible. Several inquiries were related to the possibility of practical 2 place E-aircraft using current technology. We will examine what is required to convert a Challenger II Long Wing, since it offers good performance using a 50hp IC engine and has a relatively low empty weight.

Note: there are two place production aircraft that I am aware of. One is the Pipistrel Taurus Electro (price: 100k-Euro). The Taurus shares many of the attributes of the Silent II (above). Its 40 kw motor uses a 130 lb battery to launch it to 6500 ft at 600 fpm, or several lower altitude launches, until the battery is exhausted. At 600 fpm ROC this is a total of an 11 minute motor run at less than full power as full power will overload the motor (see the Pipistrel data on the net). Compare this to the data outcomes for the Challenger II. Like the Silent II, the Pipistrel Taurus is essentially a self launching sailplane with a very short motor run. It is a world class aircraft.


Mark Beierle's E-Gull

Pipistrel has also designed and is marketing a "green" electric aircraft called the WATTsUP; it is powered by a 50 KW Siemens electric motor that turns the prop at 2200 rpm. They appear to employ a redrive so that a large diameter, efficient propeller can be used. The WattsUP ROC is great since a full 50 kw of power is available, but then cruise speed and range are significantly reduced due to all the low energy-density battery issues. The standard 14 KWH battery weighs 277 lb. They claim the WATTsUP to be a flight trainer but I have not been able to find a single review of the aircraft, and I find the data on two factory pages to be ambiguous. For these data, when the aircraft is operated as trainer I calculate that six 2 minute take/off climbs to 1000 feet will consume most of the battery, leaving only 18 minutes left to fly 6 circuits. Total flight time (with 6 climbs) is 30 minutes. Something is wrong here. I would not break into my piggy bank for $150k just yet.

Turnkey aircraft have all the electric elements designed to work in concert. Currently I do not know of any systems on the market that you can simply mount into the aircraft you may wish to convert. So let us look at the process required to identify and find products- and evaluate projected performance. You must design and interconnect the entire Electric system.

Refer to the (chart 2) as we progress through the steps. Input is entered via green cells....output data appears in the "sand" coloured cells. The electric system consists of a motor, battery, electronic motor controller and some ancillary devices. As we examine the analysis for an E-system, I will provide guidelines for data input. The spreadsheet-in this case applies to the Challenger long wing.

You must have absolutely accurate data gleaned from the gas version of your project, in this case the Challenger II. Enter all the data that is published, or which you know is based on test data of an operational aircraft.

Terminology

A battery consists of one or more cells, and the voltage per cell is dependent on the cell chemistry. Each battery is identified –as a minimum- by voltage and amp-hour rating, one C is the amp-hour rating, and maximum discharge rate is also identified. The discharge rating is the maximum limit in amps that the battery may be safely discharged at. For example a battery rated at 8 amp hours (1C) and is discharge rated at 30C-this means the maximum current is 30*8=240 amps.

Since voltage is always decreasing during a flight then Power is always decreasing. Power in watts is determined by the formula, P=V*A (Power= volts* amps). We use KWH (Kilowatt – hours) to identify battery capacity and also to calculate performance data. The electric company keeps track of your electric bill at home, so if you leave ten 100 watt bulbs on for one hour then you have consumed 1000 watt-hours or 1 KWH (kilowatt hour) . At home, AC voltage is relatively stable but our E-Flight battery's voltage continues to decline throughout discharge, which reduces current and thus power. I will demonstrate using simple examples of how we deal with this.

Motor

I would not recommend using any brushed DC motor for E-flight. For the same power brushless DC motors are much lighter, and far more efficient. Brushless motors are available in Outrunner and In-runner configurations. Many articles on the internet will identify the technical differences. In general in-runners weigh slightly less, while it is easier to achieve a lower motor kv using the out-runner configuration. Both motor versions use rare earth magnets, are well designed and close to 90% efficient, and either motor will work well for E-flight applications.

When you enter the HP in the spreadsheet-the equal electric (KW) power is calculated for you. Reliable electric brushless motors that have all the parameters we require have been difficult to source. Lower power projects have used RC (radio control) motors to mixed reviews. These motors frequently cannot produce the published power for a sustained period. Often the maximum and the continuous power ratings are given, but RC models use maximum power only during short bursts of15-20 seconds. By comparison a full size electric aircraft must use maximum power for several minutes to climb to the desired altitude. These RC motors are very light, and some claim 15kw @ 4.5 lb. One could expect a great deal of heat and perhaps motor winding destruction at this continuous power. Certainly the E-Gull with its ZERO power system illuminates future trends.

I selected a 37 kw motor for the Challenger II, and I have guessed at 1 lb per KW, but enter the value you have for your selected motor (enter lbs per KW). For flight this motor must produce power at the RPM we wish for efficient propeller speed. Motors have many parameters (volts amps etc.) but we are also very interested in kv. The rpm of a motor is determined by the product of kv*volts. Therefore we must determine the voltage necessary for our battery pack. The kv of a motor is the rpm per volt a of a motor's "no-load" state. Motors are typically loaded-by the propellers- typically to about 80% of the no-load rpm. We will need to determine whether we can use this motor with a direct drive propeller, or if we must use a redrive. For the Challenger we want to use the maximum diameter that provides clearance. Suppose that we have selected a 150 volt battery system. This would mean we would need about 250 amps to provide 37 KV of power. If desired prop rpm is 2400 (max power) then we would need a motor kv of 20. (kv=Prpm/v*1.25). If it is the case that we cannot find a motor where the kv is correct to provide the required rpm for our motor and propeller, we may need to utilize a redrive of the proper ratio. I specifically chose a motor kv that would provide 2400 rpm –under load. Since the E-motor produces the same power as the Rotax 503, perhaps the same propeller could be used.

Propellers and Efficiency

The task of a propeller is to absorb the power produced by the motor and to convert this into efficient thrust. The main elements that determine how this power is absorbed by the propeller are: diameter...pitch...blade chord... rpm. By efficient: I mean a propeller that "loads" the motor to its full power at the rpm and pitch that are correct for your aircraft..

Propeller diameter for "low speed-draggish" aircraft should be the maximum that will provide clearance while keeping tip speed below a maximum tip speed of 0.85 Mach. A larger diameter propeller (in this instance) will provide a shorter take-off run and better ROC. This statement causes almost more "hangar-fights" than Bernoulli (lift) and downwind turn debates. I have spent much time learning NACA propeller/thrust analysis and have quantified these data by writing computer programs. Three examples (independent from mine) corroborate NACA: (1) My interview with Chris Heintz revealed that he knows of not even one successful direct drive 2180cc VW powered STOL CH701. However there are several known 2180cc 2:1 ratio-drive 701's that provide performance similar the 80 hp Rotax variants. (2) I interviewed Aero Engineer Robert Bob Baslee who is the designer of WWI Airdrome Aeroplanes. He states that a direct drive 2180 cc VW will not fly any of his 100% scale fighters-while a redrive 2180cc VW provides a good (500 fpm) ROC. His 75-80% scale aircraft, when using a redrive and compared to a direct drive, uses half the take-off distance while ROC increases from 400 fpm to 650-800 fpm. (3) When Challenger switched from to a 2.2:1 to a 2.6:1 ratio re-drive they were able to switch from a 54" prop to a 60" prop since gear ratios are torque multipliers. A larger diameter slower turning propeller is more efficient when used with aircraft in this category. As a result, the 60" prop is quieter, improves ROC by 15% and provides a much shorter take-off run. A battery has a low energy-density and thus we must be careful to not waste precious electrons.

Efficient propulsion also means that Geometric pitch (the number on the prop) is correct to provide a desirable helical pitch (how far the aircraft actually moves forward for each revolution). Ground adjustable propellers have a purpose, as when used for different motors/airframes. However: If the prop you have selected does not load the motor to full power, for example if it loads the motor to 32kw instead of 37kw (in the Challenger example), you can increase the pitch and indeed it will provide a greater load to the motor. However the pitch is now excessive and thus not efficient. You need a larger diameter prop, or more blade chord, or to add a blade.

There are higher RPM short propeller equipped aircraft that perform well, like the Sonex, but mission and aerodynamics are very different from the examples we are examining. No one can argue that the Lazair does not perform well. The Lazair used 2 engines, each with a direct drive prop, which I suspect is a positive factor due to the combined prop disk area. RPM limitations (tip speed) means that diameter was limited to (about) 34". Two disks of 34" diameter provides more thrust than one motor would with the same power as the two motors combined, using a wider chord 34" propeller. Thrust as a result of disk area, compared to equivalent blade area, is not equivalent but the explanation is outside the scope of this article. The E-Silent II also uses a one metre diameter, direct drive folding propeller. This works well despite the fact that a shorter diameter prop will provide less initial (static) thrust for initial acceleration. This is a testament to using a high L/D (40:1) for such aircraft, since the Silent II slices through parasitic drag. After rotation, thrust is called propulsive thrust and is calculated differently from static thrust. At higher airspeed and high L/D, prop diameter becomes less of an issue. During climb the induced drag is less (compared to low L/D aircraft) and sink rate of the Silent II is just 118 fpm, so ROC is good at 500 fpm. I would not select a short diameter high rpm prop for a single motor aircraft, as in the case of the Challenger II. The Challenger is a slow-ish aircraft with a lower L/D and higher sink rate. If a redrive is necessary, then you will likely need to design and build it. This means there will also be some additional weight penalty and costs associated with adding a redrive.

The good news is: change in speed is not linear with power... I ride at 67% full speed using 35% of full power.

Battery

The energy source (battery) remains the Achilles heel for successful electric flight. To be certain, there have been vast improvements in technology since I used eight 800 MAH Ni-cad (nickel cadmium) cells to power my first electric sailplane 45 years ago. I will identify battery issues as well as providing a guide for using the batteries we have available to us today.

As previously mentioned, a battery is composed of one or more cells, and the voltage of the battery depends on the type of chemistry used and the number of cells connected in series, for example, your car battery. Inside the casing are 6 cells wired in series and each cell is constructed using lead acid chemistry. Lead acid produces 2 volts per cell, thus our car battery is 12 volts DC (Direct current). Other cells like alkaline cells produce 1.5 volts per cell due to the alkaline chemistry. There are "deep discharge" lead acid based batteries that are used for golf carts and tow motors. Some folks use them for (full size) electric car conversions, but these batteries are very heavy and are not practical for use in E-flight applications.

Lithium Batteries for E-flight

Lithium based batteries are used for RC models, most cameras, lap top computers, power tools and an increasing number of electronic devices. The radio control industry uses mostly Li-Po (lithium polymer) chemistry while computers, power tools, and most electric cars use Li-ion (lithium Ion) chemistry.

Lithium Poly cells have higher energy density, but Lithium Ion cells are a close second. Energy-density is measured in watts per kilogram. The best Li-Po cells can provide 170 watts per kg. while the latest Li-ion can provide 140 watts per kg. The initial voltage for Li-Po is slightly higher than Li-ion but the AVERAGE voltage for the latest technology for both Li-Po and Li-ion- is about the same at 3.7-3.8 volts per cell. Every cell used today begins at its highest initial voltage and this voltage value decreases as the battery is discharged. For example: Each Li-Po cell begins at 4.2 volts and discharges safely to 3.0 volts per cell. Since the average voltage for either Li-Po or Li-ion is nearly identical, the LiPo battery has a slight weight advantage.

Battery Matrix

Almost every battery used for 100% scale E-flight must be wired in a series/parallel matrix-and you will need to design a large matrix of batteries-since you will not find a battery (pre-wired) available commercially, that is suited to your project. Thus you will need to calculate the voltage required and current in AH (amp-hours) then select the applicable cells and then wire/connect everything together. I have become interested in Electric land vehicles since I became grounded. I have built several E-bikes and designed E-automobile systems for a few friends. My first bike was an off the shelf turnkey electric bike which was next to unusable in terms of performance.

My latest bike is capable of a 67 kph top speed burst, or a 40 km ride at 40 kph. The simple matrix is identified on the back of the bike-it consists of 4 packets-2 wired in series and 2 packets wired in parallel. So we really have batteries within the battery. We have a small battery consisting of cells, which we call a packet, and these packets are then configured into the battery for the aircraft. In this case, each packet consists of a battery made up of 6 series cells. Each packet is rated at 8 AH and 22.2 volts, and when wired in series/parallel-this pack is rated at 44.4 volts @16 AH. Since the battery is rated in AH (amp hours) we can calculate the KWH rating for this pack by calculating the product of volts times amps (in AH) thus 22.2*16=710 WH or .7104 KWH. This is close to one HP since 746 watts = 1 hp. Since my motor can produce 2 KW power-at full throttle we would exhaust this battery by dividing KWH rating of my battery by the Power produced (KW) and thus time (duration) would be .7104/2 =0.3552 hours. To convert this to minutes we multiply 60 thus .0.3352*60=21.3 minutes. A ride at this speed is not fun or safe or legal (traffic and road conditions). I live in a quiet area so on a very good stretch of road with no traffic I sometimes test Vmax for about 1 km. OK it is fun…

The good news is that a change in speed is NOT linear with power change. Speed change is the result of the cube root of power change. Thus I am able to ride at 40 kph using about 750 watts for a 35 km ride. This means that in this case I ride at 67% full speed using just 35% of full power. My bike has a cruise control which adjusts current as the voltage is dropping, to maintain the power(KW) that sustains my speed. At lower power settings there is no time in the 40km ride that the power drops below 750 watts, so I have constant speed-40 kph for 35 km- and no pedaling.

Safety Cautions

You will need to design your system, purchase cells or packets to configure your battery, and make many high quality solder joints using quality connectors. I mention a 150 volt system for the Challenger. It is generally better to use higher voltage since the current will be lower at a higher voltage than at a lower voltage, and there will be lower

Gas-Electric hybrid Zigolo

losses due to resistance. Be aware that if you select any voltage over 70 volts you will likely feel a tingle if you simultaneously touch the positive and negative terminals. A voltage of 120 or higher can absolutely be fatal if you accidentally grab a terminal in each hand and your heart becomes part of the circuit. High voltage packs as in the Silent II can be used safely by non technical people since the power is modular, preassembled and has a power connector that is user friendly, the same safety concept as your plug-equipped 220 volt electric stove.

Challenger II Battery Matrix

In the case of the Challenger II: The power is 37.3 KW and we calculate the size of the battery such that our E-conversion does not exceed Gross Weight including the desired pilot weight. In this case I have chosen a 15 KW Battery which weighs 244lbs. This is equivalent to a 244 lb passenger, which means that this two place aircraft immediately becomes a single place. This high battery weight is due to the low energy density of batteries compared to gasoline. As an example, with all efficiencies factored in, a 50 hp Rotax engine will fly the Challenger further and faster using 4 US gallons (weight 24 lb) than an E-Challenger using a 244lb battery. A Challenger II can be only a single seat aircraft when powered by batteries.

It is your task to determine how many series packets (of cells) you will need to produce 150 volts, and also how many parallel packets you require to provide 15 KWH (the battery I chose). The number of series of cells is determined by dividing battery voltage by average cell voltage (3.7v). This is: 150/3.7 =40 cells (rounded down). To determine the current needed we divide power (watts) by voltage: 15000/150= 100 amps since A=P/V (ohms law). If you could purchase prewired packets of 10 cells in series that were rated at 10AH per packet, then you would need 4 series packets and 10 parallel columns. This is 40 packets or 400 individual cells. You will likely want to separate a 244 lb battery into sub modules, for ease of handling. This facilitates ease of charging since you can charge each module separately using multiple chargers, then re-connect the modules to fly. You must have a BMS (battery management system) system that ensures you will not destroy a pack that may cost several thousands of dollars. A 100 amp service, as in your house, can provide a total of 12 KWA (120v*100a). So you can see the challenge in "fast charging" the 15 KWA battery in our example.

Lithium Polymer cells

My bike uses LiPos but the matrix is so small (2 parallel packets) that I can split the battery into two series packets and charge in series. LiPo cells are very sensitive to over and under voltage of just a few tenths of a volt. Each packet has a balancing wire connected to every cell and this is connected to a charger which keeps the voltage of each cell in balance. I have experimented with parallel charging of LiPo cells but this resulted in poor outcomes. I have investigated 3 ultralights and several E-vehicles that used parallel charging of LiPo cells in a large parallel matrix. Even when using a BMS, in each case I saw premature cell destruction. For example: if you charge 4 cells in parallel and connect the balance cable to the same buss (all in parallel) then the voltage you read will be the average of all 4 cells. This means individual cells may be higher or lower voltage than the expected 4.2 v/cell when the battery is fully charged. I find Lipo cells great for RC since they are inexpensive, readily available in many configurations-and seldom charged in parallel. However, I cannot recommend LiPo battery cells for large series/parallel matrix E-flight battery packs. Note: there are turnkey aircraft suppliers that claim that they use LiPo batteries and have developed BMS chargers to balance each cell. I have not yet seen this claim having been corroborated. As a scratch system designer you will need to develop your own BMS system, a daunting task.

Lithium ION cells

Li-ion is the type of chemistry that is often used in large KWH battery matrix systems. I have experience using smaller Li-ion cells but each was only 2.3 AH each. These cells are called A123 cells and are very robust. I charged without balancing each cell with no problems. However, I needed to wire (solder) EVERY cell which would mean several hundred cells for a 15 KWA battery. Li-ion are far more tolerant to balance than LiPo cells and provide many more charge cycles (1000+). In my view, the future is the development of cells that have very large AH capacity. This would mean zero or very few parallel cells for the battery Matrix. There is much competition in the development of better Li-ion cells that provide very large AH values per cell, but I have no

A THEME THROUGHOUT my article is that companies with large budgets and state of the art Design and R&D departments have located reliable motors, controllers, batteries and BMS (Battery management systems, but their R&D is not public domain at this point. Their aircraft cost well over $100K but there is hope: I know of several very gifted designers who are developing and testing affordable E-flight systems that cost less than $20k. I obviously cannot reveal these projects, since they have asked me not to publish anything relating to their research and products. They will publish when they are satisfied, and that is good science.

I can give you a short list of motors that have proven to be successful. Early RC motors were not sufficiently robust to output Watts Max for an extended time. Manufacturers that produced large RC motors are now developing much larger motors. One motor that has been used successfully is the European Plettenberg Predator. The newest version is the Predator 37 which is rated at 15 KW or 20 hp. There is also a Schultze electronic motor controller capable of 400 amps MAX. This motor is to be mounted on the EMG 6 motor glider. They intend to use 3short blades in direct drive. My calculations indicate a huge thrust increase using a Re-drive and a large prop, but perhaps they will prove me wrong.

Another interesting motor from Plettenberg is the Nova 30. This is a 30 kw (40 hp) motor but the shaft spins at 3300 rpm. With direct drive this just MAY work for the Challenger II Long Wing when being flown as a single place, and it could use a slightly smaller battery. This would draw less current but ROC would drop, and since it would be lighter and have less drag, the sink rate would improve.

Just a thought. There is a motor manufacturer from California called JOBY. I know of two installations using their 10kw motors that worked well, and a Thundergull has been flown successfully using a 20KW Joby. It performs very well but unfortunately at this writing I do not know of a battery or BMS that I could recommend for it.

Most of the successful systems are integrated into aircraft, as in the Silent II and the Pipstrel WATTsUP. The good news is that right now very capable designers are testing new component systems. We may have answers very soon, but I would not commit $5k-7k hard-earned dollars to bet on the systems available today. One exception is the ZERO motorcycle package that powers the E-Gull. The cost for this system is about US $13k and this may work well for your project. As for the Siemens motor used by Pipistrel, I cannot determine whether it was contracted by Pipistrel and it might be proprietary. You should not think that anything that is leading edge will be inexpensive.

experience with these cells. I do believe however that Lithium Ion cells are the best choice for electric flight, given existing technology.

Motor control

An ESC (electronic speed control) is necessary to complete the electric system. There are ESCs available for RC models which will handle 15 KW. New motors and controllers are constantly being developed to match the continuous demand for more performance. Modern ESCs are computer controlled and must handle the voltage, amps and thus the power for your system application. These controllers produce a plethora of data including volts, current, power, amp hours, rpm, and these data can be viewed on a panel display. Voltage is the primary fuel gauge rather than amp hours, since voltage will indicate if there are defective cells. Using RC controllers, voltage is low enough (less than 70 volts) such that electric shocks are not an issue, should you grasp the wrong connection . The first Electric PPG flown in Canada used an RC ESC and RC motor with a custom redrive to provide sufficient thrust. Such a system may work for a SkyPup. Newer motors and ESCs are currently being produced and marketed, in response to demand of the RC enthusiasts. For larger systems (30+kw) I find there is also a dearth of products. Thus you must find a brushless controller that will handle the power of your specific system. This means maximum volt and current rating for your system.

Summary

If you have digested the entire article you will be able to determine what type of aircraft is friendly to E-flight. You should also have an understanding of component selection, availability and caveats. You should also understand that there is a considerable design component and technical knowledge necessary to create a successful electric aircraft using the technology that is available today. The spreadsheet may be made downloadable by the RAA. It is a simple sheet but allows you to input several parameters including the energy density of your selected battery. Several issues are not calculated such as efficiencies, and total drag as it varies with weight; for instance if you want to fly at the same airspeed with a heavier aircraft you will need to increase ALPHA (AOA) since the Ci must be higher to produce the lift required. The spreadsheet function should allow you to conduct endless "what-ifs" that will quickly rule out some aircraft configurations and alternatively help you "tweak" the key parameters of a design that shows promise. Note: the spreadsheet is to be used only as a guide. If you do not download the spread sheet (chart 3) shows outcomes at various power setting for the Challenger II.

The good news is: Practical person-carrying electric flight has indeed arrived, but it is in its infancy. I would not have imagined the advances in Electric RC flight when I launched my first aircraft 45 years ago. Electric RC is a very mature industry, due to demand. There is also a very focused development in the electric auto industry, which is also due to increasing demand. I hope that one day the light aircraft will see a selection of systems that are well developed and easily assembled in "plug and play`` configurations. There is much competition to develop more efficient battery cells, but without some quantum leap we will have a huge disparity between the energy density of batteries and the energy-density of gasoline. Thus I have attempted to demonstrate what is achievable today. We know what type of aerodynamics works best. Motors are very efficient but there is just not sufficient choice yet, and we also must observe economies of scale which means makes a 2 place true cross-country aircraft a future goal. Still, at the lower price end of aviation there are some very light aircraft that have the characteristics, identified above, that would make good conversions. I have contacted designers who are creating and testing inexpensive very light primary glider type aircraft. These aircraft meet the economies of scale factor and work well using low power and a light battery. One such aircraft is a motor glider that is based on a Mike Sandlin design. A gas powered version is marketed today and the electric version was flown last summer but is not for sale yet, Google Aeromarine LSA Electric Zigolo MG12. The second electric motor glider is configured like a Basic Glider design. It looks interesting but it is difficult to determine if it is even close to production status, Google EMG6 electric motor glider. I chose not to report on these aircraft since they are not fully developed and are not on the market.

If you should pursue an E-aircraft conversion project you must select accurate data, and then test… but verify. Good luck .

Curious about your own electric dreams? Check out this spreadsheet and plug in your own numbers to answer the "what ifs". http://on-the-net.ca/challenger.xlsx

Brian Steele *is a longtime RAA technical resource, frequently consulting on aerodynamics, airfoils, and propellers.*

In my opinion the failures seen on aging engines likely is the result of less than meticulous maintenance

Starlet / continued from page 23

ing parts for the bulk strip and crank replacement, mandated by Jabiru policy, I discovered that I will end up with an upgraded engine when completed. Bulk strip does not zero time the engine but I only had 11 hours on it anyway.

My experience with Jabiru has been that they are very picky about maintenance details and checking of bolt torques and valve tappet clearances and all aspects of proper care and feeding of a Jabiru engine. In my opinion the failures seen on aging engines likely is the result of less than meticulous maintenance or unauthorized modifications and fiddling.

When all the facts are considered without bias it will be seen that the failure rate of Jabiru engines is no worse than any other certified engine.

The Jabiru engine underwent an extensive and meticulous evaluation by the LAA and PFA to gain acceptance for use in the United Kingdom. See the article by Francis Donaldson Chief Engineer PFA published in Recreational Flyer Sept/Oct 2003 page 24.

The Jabiru engine came to be after Jabiru's aircraft then powered by a KFM 112 and was certified with that engine. KFM stopped production so Jabiru built its own engine starting with the 1600 engine in 1993. Engine development continued through 1998 ending up with the 2200A engine that I have in my Starlet. It is an upgrade to the 1600 to solve issues with cooling and head warpage that resulted in oil leaks. All perfectly normal growing pains for a new engine. Any engine with aluminum heads will have this issue even the 5300 V8 in my GMC 4X4. That is why we have torque specs and maintenance intervals to check these things. Those who do not must pay the piper.

With a Corby Starlet, which by the way is an Australian design by Aeronautical Engineer John Corby, the engine weight cannot exceed 160 lbs so even small Continentals and Lycoming engines are out of the question at 200 lbs plus. The design first flew with an Augusta 2 cylinder engine of 42 HP. Subsequent aircraft used various VW conversions that weighed from 150 to 160 lbs. A 2180 VW conversion is said to be 168lbs and several Starlets use this engine with success. Since the advent of the Jabiru 2200 engine it has been the engine of choice due to its light weight of 132 lbs that includes all accessories including muffler. At 80 HP at 3500 RPM it turns a Starlet with gross weight of 800 lbs into a rocket ship. I'm still prying the grin off my face and first flight was in 2011! See the video at http://youtu.be/mshFCmsgULo and you will see what I mean.

Any aircraft engine takes a beating. With care and diligence they can be maintained and provide many years of service. Even the traditional aircraft engines have been known to eat a valve, blow a jug or leak some oil. Magnetos can fail, coils burn up, that's why there are two.

It would be a shame for irreparable damage to be done to the reputation of a fine engine and company like Jabiru Aircraft PTY LTD due to fear mongering from lobbyists trying to make inroads in the aircraft engine business.

Risk management is the fancy lingo but for this country aviator it's just common sense.

Stan McClure *is an expert in wood, and has scratchbuilt a Corby Starlet. His current project is the rebuild of a VW-powered Parasol. Stan is a member of the London-St. Thomas RAA Chapter.*

RAA Chapters and Meetings Across Canada

The following is a list of active RAA Chapters. New members and other interested people are encouraged to contact chapter presidents to confirm meetings as places and times may vary.

ATLANTIC REGION

HAVELOCK NB: Weekly Sunday morning get together year round, all aviation enthusiasts welcome. Havelock Flying Club - 25 mi west of Moncton. Contact Sterling Goddard 506-856-2211 sterling_goddard@hotmail.com

QUEBEC REGION

COTE NORD (BAIE COMEAU): Meeting times to be advised. Contact Pres.Gabriel Chouinard, 418-296-6180.

LES AILES FERMONTOISES (FERMONT): First Sunday 7:30 pm at 24 Iberville, Fermont. Contact Pres. Serge Mihelic, 418-287-3340.

MONTREAL (LONGUEUIL): Chapter 415, Meeting in French second Wednesday at 8 pm, at CEGEP Edouard Montpetit 5555 Place de la Savane, St. Hubert, PQ. Contact president Normand Rioux at NRIOUX@lapresse.ca

OUATOUAIS/GATINEAU: Every Saturday 9:00 am to noon at the restaurant l9Aileron in the airport terminal. Contact Ms N.C. Kroft, Gatineau Airport, 819-669-0164.

ASSOC DES CONSTRUCTUERS D'AVIONS EXPERIMENTAUX DE QUEBEC (QUEBEC): Third Monday 7:30 pm at Les Ailes Quebecoises, Quebec City Airport.

ASSOC AEROSPORTIVE DE RIMOUSKI: First Saturday at 9:00 am, La Cage aux Sports, Rimouski. Contact Pres. Bruno Albert, 418-735-5324.

ASSOC DES PILOTES ET CONSTRUCTEURS DU SAGUENAY-LAC ST JEAN: Third Wednesday 7:00 pm at Exact Air, St Honore Airport, CYRC. Contact Marc Tremblay, 418-548-3660

SHERBROOKE LES FAUCHEURS de MARGUERITES. Contact Real Paquette 819-878-3998 lesfaucheurs@hotmail.com

ONTARIO

BARRIE/ORILLIA CHAPTER 4th Monday of the month at 6:00 PM at the Lake Simcoe Regional Airport for the months of June, July & August (BBQ nights) For other months contact Dave Evans at david.evans2@sympatico.ca or 705 728 8742

COBDEN: Third Thursday of the month at the Cobden airfield clubhouse 20:00 hrs. President - Grantley Este 613 432 0797 este@compmore.net

COLLINGWOOD AND DISTRICT; The Collingwood and District RAA, Chapter 4904, meets every first Thursday of every. month, at 7:30 PM except July and August, at the Collingwood Airport or at off-site locations as projects dictate. The January meeting is a club banquet held at a local establishment. For more information contact Pres. George Elliott gaelliott@sympatico.ca 705-445-7054

EXETER: Second Monday 7:30 pm at Summers-Sexsmith Airfield, Winters-Exeter Legion. Contact Pres. Ron Helm, ron.helm@sympatico.ca 519 235-2644

FLAMBOROUGH: Second Thursday 8:00 pm at Flamborough Airpark. Contact Pres. Karl Wettlaufer 905 876-2551 or lazyk-farm@sympatico.ca

KENT FLYING MACHINES: First Tuesday 7:00 pm at various locations. Contact President Paul Perry 519-351-6251 pkperry@teksavvy.com

KITCHENER-WATERLOO. KW-RAA meets the second Tuesday of each month at 7:30 pm at the Air Cadet Building at CYKF. In summer months we have fly-ins instead of meetings. Please contact President Dan Oldridge at oldridge@golden.net .

LONDON/ST. THOMAS: First Tuesday 7:30 p.m. At the Air Force Association building at the London Airport. Contact President Phil Hicks p.hicks@tvdsb.on.ca 519-452-0986

MIDLAND/HURONIA

Meeting: First Tuesday, 19:30 pm at the terminal building Midland/Huronia airport (CYEE) . Contacts: President Robert Gow, 705-549-2894, Secretary Ray McNally 705-717-2399

E-mail – raa.midland@gmail.com .

NIAGARA REGION: Second Monday at 5:30 pm in the orange hangar at Niagara Central Airport June to September. Contact Pres. Elizabeth Murphy at murphage@cogeco.ca , www.raaniagara.ca

OSHAWA DISTRICT: Last Monday at 7:30 PM at the Oshawa Airport, South side, 420 Wing RCAF Assoc. Contact President: Jim Morrison ,905 434 5638 jamesmorrison190@msn.com

OTTAWA/RIDEAU: Kars, Ont. 1st Tuesday. Contact: Secretary, Bill Reed 613-858-7333 bill@ncf.ca

SAUGEEN: Third Saturday for breakfast at Hanover Airport. President: Barry Tschirhart P.O. Box 1238 27 Ridout Street Walkerton, Ontario. Home: 519-881-0305 Cell: 519-881-6020. Meetings are held every second Tuesday evening, at 7:30pm. Location(s) Saugeen Municipal Airport, Kincardine or Port Elgin. All interested pilots are welcome. Email: barry.tschirhart@bell.net

YQG AMATEUR AVIATION GROUP (WINDSOR): Forth Monday, 7:30 pm Windsor Flying Club, Airport Road, Contact: Kris Browne e_kris_browne@hotmail.com

SCARBOROUGH/MARKHAM: Third Thursday 7:30 pm Buttonville Airport, Buttonville Flying Clubhouse. Contact Bob Stobie 416-497-2808 bstobie@pathcom.com

TORONTO: First Monday 7:30 pm at Hangar 41 on north end of Brampton Airport. Contact: President Fred Grootarz - Tel: (905) 212-9333, Cell: (647) 290-9170; e-mail: fred@acronav.com

TORONTO ROTORCRAFT CLUB: Meets 3rd. Friday except July, August, December and holiday weekends at 7:30 pm Etobicoke Civic Centre, 399 The West Mall (at Burnhamthorpe), Toronto. Contact Jerry Forest, Pres. 416 244-4122 or gyro_jerry@hotmail.com.

WIARTON: Bruce Peninsula Chapter #51 breakfast meetings start at 8:30am on the second Saturday of each month in the Gallery of Early CanadianFlight/Roof Top Cafe at Wiarton-Keppel Airport. As there are sometime changes, contact Brian Reis at 519-534-4090 or earlycanflight@symptico.ca

MANITOBA

BRANDON: Brandon Chapter RAA meets on the second Monday of each month at the Commonwealth Air Training Plan Museum at 7:30 PM except in the months of July and August. Contact Pres. John Robinson 204-728-1240.

WINNIPEG: Winnipeg Area Chapter: Third Thursday, 7:30 pm RAA Hangar, Lyncrest Airport or other location as arranged. Contact President Ben Toenders at 204-895-8779 or email raa@mts.net. No meetings June, July & Aug. RAA Winnipeg info also available at Springfield Flying Center website at http://www.lyncrest.org/sfcraac.html.

SASKATCHEWAN

Chapter 4901 North Saskatchewan. Meetings: Second Tuesday of the month 7:30pm Prairie Partners Aero Club Martensville, Sk. info at www.raa4901.com. Brian Caithcart is the chapter president. Contact email: president@raa4901.com.

ALBERTA

CALGARY chapter meets every 4th Monday each month with exception of holiday Mondays and July & August. Meetings from 19:00-22:00 are held at the Southern Alberta Institute of Technologies (SAIT) Training Hangar at the Calgary Airport. Join us for builder discussions, site visits, tech. tips, fly out weekends and more. Contact President Bob White 403-472-1035 pittsflyer111b@gmail.com

EDMONTON HOMEBUILT AIRCRAFT ASSOCIATION: Meetings, Second Monday, 19:30 at the Aviation Museum. Contact: President Roger Smeland (780) 466-9196 or Jim Gallinger (780) 242-5424 . Website - http://www.ehaa.ca/

GRANDE PRAIRIE: Third Tuesday, (September to April), 7:30, 2nd floor boardroom of the Grande Prairie Terminal Building. Summer events on an informal schedule. For more information contact Lee Merlo at 780-518-4254 or e-mail arniesusanmeyer@gmail.com

BRITISH COLUMBIA

ABBOTSFORD: Third Wednesday 7:30 pm Abbotsford Flying Club, Abbotsford Airport. Contact President, John Vlake 604-820-9088 email javlakeca@yahoo.ca

DUNCAN: Second Tuesday 7 pm members homes (rotating basis). Contact Pres. Howard Rolston, 250-246-3756.

OKANAGAN VALLEY: First Thursday of every month except July and August (no meetings) at the Mekong Restaurant.1030 Harvey Ave. Dinner at 6:00pm, meeting at 7:30pm Contact President, Cameron Bottrill 250-558-5551 moneypit@uniserve.net

QUESNEL: First Monday/Month 7:00 p.m. at Old Terminal Building, CYQZ Airport. Contact President Jerry Van Halderen 250-249-5151 email: jjwvanhalderen@shaw.ca

SUNCOAST RAA CHAPTER 580: Second Sunday 13:30 pm Sechelt Airport Clubhouse, sometimes members homes. Contact Pres. Gene Hogan, 604-886-7645

CHAPTER 85 RAA (DELTA): First Tuesday 7:30pm, Delta Heritage Airpark RAA Clubhouse. 4103-104th Street, Delta. Contact President Peter Whittaker pwhitt@telus.net Website www.raa85.ca.

VANCOUVER ISLAND AVIATION SOCIETY (VICTORIA): Third Monday 7:30 pm Victoria Flying Club Lounge. Contact Pres. Roger Damico, 250-744-7472.

THOMPSON VALLEY SPORT AIRCRAFT CLUB: Second Thursday of the month 7:30 pm Knutsford Club, contact President Wally Walcer 250-578-7343

ALASKA HIGHWAY: meetings held every third Thursday of every month (except July & August) at the Taylor Fire Hall at 7:30 p.m. For more information call Gerry at 250-782-4707 or Heath at 250-785-4758.

Chapter executives, please advise of changes as they occur. For further information regarding chapter activities contact RAA Canada, Waterloo Airport, Breslau ON N0B 1M0 Telephone: 519-648-3030 Member's Toll Free line: 1-800-387-1028

Emails can be sent to President Gary Wolf at: **garywolf@rogers.com** *and George Gregory at* **gregdesign@telus.net.**

Classifieds

To submit or delete a classified ad, please send to raa@raa.ca and place "RAA ad" in the subject line.

The Recreational Flyer is pleased to offer you colour advertising within the magazine. Previously limited to the back cover, we have added 4 new colour pages which will be available with limited space for your advertising needs. Our rates for both black and white and colour ads remain very competitive and you reach a captive and qualified audience. Emails can be sent to President Gary Wolf at: garywolf@rogers.com and George Gregory at gregdesign@telus.net

Deadline for submissions is the first of the month preceding date of issue.
Artwork: Rates apply to camera ready artwork. Digital files are preferred and should be sent as email and in .txt format, PDF, JPEG, MS WORD, Photoshop or other common file types. Advertising is payable prior to printing of magazine unless other arrangements have been made. Payment is in Canadian funds. 10% Discount applies to one year (6 issues) insertion paid in advance. Commercial Classified ad rates 1/8 page minimum.
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Recreational Aircraft Association Canada
President: Gary Wolf / Treasurer: Wayne Hadath

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WANTED: CONTINENTAL A65 PARTS: Pistons, cylinders, carb, magnetos, rocker covers, spyder, cams, etc. Also interested in complete engines up to C90. Email Chris at cphorsten@yahoo.ca or call 416-918-6569.

Hangar For Sale at Sundridge Ontario, beside CPE6 airpark. Hangar is a wood framed building with steel siding, roof, and doors, with a gravel floor. 40x40x10 on 7.5 acres. Taxes last year were $352. Asking $50,000. Phone 705-386-9080. Email whiteheadbj@msn.com

RV6 for sale $69,900 440 hrs TT Lycoming A1A 180 hp Sensenich Fixed Pitch Propeller JPI Fuel Flow Gauge Dynon D10A and autopilot servos Dynon Heated Pitot Kannad 406 ELT GPS Garmin Aera 560 Transponder KT76A Odessey Battery Bell Tailwheel Yoke Stereo Intercom PM3000 Garmin SL30 ADF KR87 Certified for IFR until September 2016 Annual due June 2014 Call George at 647 588 8544

4 Pietenpol lift struts for sale.They are brand new and are made from 4130 streamline tubing bought from Aircraft Spruce Part # 03-00192. Wall thickness 0.065. major axis 2.697", minor axis 1.143"
These have been epoxy primed and painted black -price: $1500. pjb@ornithopter-pilot.com Ontario

1946 Luscombe 8E, 2755TT 90 Cont. 1108 S.M.O.H., Alternator, Val Radio, Skis, Paint and interior good, $24000. firm.
Also a Benson Gyro with McCutcheon Blades. Also a partially Pietenpol project. Best offer.
306-645-4320. Rocanville, Sask.

0-290-D Lycoming Engine with newly overhauled carb, 6 Bolt prop extension
Newly reconditioned 80 amp light weight alternator. Starter. 80 amp gel-cell battery. Cooling plenum. Log book and maintenance manual Asking $8,000 OBO ontact Norm at graham110@rogers.com

Engine sump for Lycoming 150/160 hp with intake tubes and oil pickup tube. Removed from Grumman Traveller. $250 OBO. 519-925-3712 flybobbriggs@bell.net

BOWERS FLY-BABY FOR SALE. Cont. 65 H.P. T.T.E. 1,577.6 Hrs. S.M.O.H. 2.9 Hrs. Air Frame T.T.S.N. 29.8 McCauley Metal Prop. 302.7 Hrs. T.T. As is and where is. Shipping and Tax extra. $10,000 for Aircraft, $5,000 for just the Air Frame. mustangbc@outlook.com

1947 Stinson 108-2 Voyager w/float fittings, no floats, restoration started by retired AME. Sandblasted and zinc chromate, all new bearings, pulleys, cables etc. All logs and tags included. $7,500 / OBO. 705-653-4525. davidcarlaw@prototyperesearch.com

Dakota Hawk (Fisher Flying Products) Amateur Built, with Cont C-85 (711.3TTSN) with Warpdrive ground adjustable prop.Full VFR panel including Icom IC-A200 comm, Garmin GTX327 xpdr, AVMap EKP-V GPS. Based in Brampton.Was factory demo plane for Fisher Flying Products. $32,000 OBO For more info paulried@rogers.com or call 416-358-6941 and ask for Paul

Private Aviation Art Prints, by well known Artists, for sale. Contact mustangbc@outlook.com

Stinson 108-1 with Franklin engine. This certified aircraft is in nice condition and has been in storage with the wings removed. $15K OBO. Walkerton ON 519-881-1685

Completed RV9 tail section (empennage). Interior parts all painted with rust inhibiting primer. Comes complete with fibreglass wingtips. Can be seen in London, Ontario. Price $1200 CDN. New price from Vans is $1795 US. rebel56@rogers.com 226-777-4155

Zenith 100 Mono Z, the first example of the series and built by Gerry Boudreau. This historic aircraft is in good condition but the VW engine has an oil leak and should be dismantled before flight. $8000 204-261-1007 jill.oakes@umanitoba.ca

Continental A65 Firewall forward setup. 90 SMOH Removed and stored indoors on Engine stand. No Engine Logs, Non certified. Dual Slick Magneto (only 90 hours since new) Carburetor overhauled by AME. Includes exhaust system. $4500 OBO Or Will consider partnership in Aircraft. Darren Pond, Cambridge Ontario 519-241-4242 pilotpond@rogers.com

Project aircraft, complete. Very good value! Began as a 1955 TriPacer, in process of converting to 'Colt' configuration. Lycoming 0-235 (X)0SMOH, Sensenich prop, SMOH (Hope Aero). Fuse blasted, epoxy primed, new sealed struts (Univair), new Cleveland wheels/brakes, new spinner, windshield. All materials to finish. MDRA inspected for 51% (2004). Please contact for more detail, photos. No cylinders for engine (were stolen!). New radio, intercom, instruments. New firewall, panel, boot cowls. Must sell and move on. Asking 22K, will break up. Make me an offer that will get this aircraft back in the air. Close to ready for cover. dnorris@rosedaleunited.org 416-927-9713

Wanted – A-65 cylinders in good condition. 204-261-1007 jill.oakes@umanitoba.ca

Looking for 2 MTV blades 195-30A or a complete MTV14B/195-30A or MTV14D/195-30A propeller.
May look at other MTV props for a Lycoming flange including MTV-16 4 blade or MTV-9 3 blade.
Must be capable of handling 350HP. No metal propeller blades. macmaz@xplornet.ca

Mini Max. Rotax 447. TTSN220. TSEO40. ICOM Navcom. Header and wing tanks. Shape 9/10. Always hangared. Medical forces sale. Skis available. $7900.00 OBO Contact by phone Alberta 780-460-6841 or cell 780-945-0411.

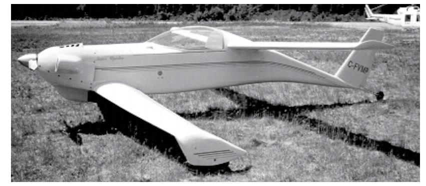
Rutan Long-EZ, first flight Aug. 30, 1986. Total time 961hrs., engine overhauled at 542 hrs.Light weight starter installed. Prince PT prop. New ELT awaiting installation.
Terra 720 com., Collins VOR available. Removed as planning GPS installation. Loss of licence due to medical issue.$30,000. Phone (403) 5279571, balewis@telus.net Medicine Hat AB

CONTINENTAL C85-12 engine, 165 hr SMOH, with accessories: M-S carb, Slick mags, D-R starter, pull start, generator, spin-on oil filter. This engine was in a certified C-140 that suffered wind damage, and i was then installed in an amateur aircraft project. This engine has been filled with oil and fogged. $7800. mohne40@yahoo.ca, 905.878.4017 Ontario

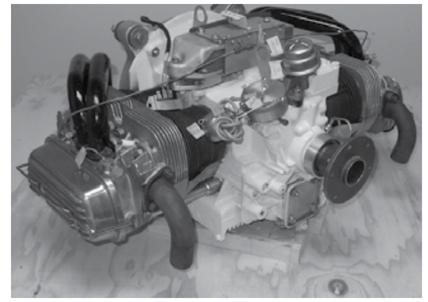
1946 Aeronca Champ 7 A/C. Very good condition. Wings rebuilt in 2002 with new spars in right wing. Hanlon Wilson exhaust. Good glass. New floor boards and skid plates. Front seat rebuilt with new padding and leather cover. 406 ELT. About 2600TT airframe, 1100 SMOH engine. Like new tires and new wheel bearings. ICOM. Radio. Original aluminium wheel pants. Asking 27900.00 OBO, or some trades.
tinymiller@sympatico.cae

Czech Zenith straight 950 floats. These are brand new, not even drilled for fittings. $3000 Cambridge Ontario 519-648-3030 garywolf@rogers.com

Piel Beryl/Emeraude parts and plans for sale. All 26 wing ribs, rudder, elevator etc. with a/c grade unused plywood, also one piece Sitka spruce 12 ft 3in long x 7.5 in wide x 2 in deep, West System epoxy glue and hardener with pumps. Offers. Contact Nigel at (705) 429-3449



Flying Super Quickie 52 hp Rotax, 349 pounds empty weight and 660 gross. This plane is agile and fast, but not for faint of heart. $6000 OBO. I also have a complete Q200 kit with carbon spars. Never started. $6000 OBO. Email dkeats@tbaytel.net



Great Planes 2180 Engine complete with 190 Hrs, dual Ignition, Starter, Alternator, Intake and Exhaust System, Force one Hub, 58x34 Wood Prop, Spinner, plus spare parts. Removed from flying Homebuilt aircraft. Asking $3250 OBO. Contact: Erwin Hornemann 905 457 3716 erwinhornemann@bell.net

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RAA Scarborough Markham

At our February meeting, we began to watch the series Warbirds Over The Trenches described above. It began with Episode 1 involving Learning to Fly. A lot of very early aviation had to do with balloons. Abraham Lincoln was well aware of the strategic advantage of using observation balloons for spotting in the American Civil War; Custer was an early advocate. The achievements of Wilbur and Orville Wright were discussed at some length. They and Otto Lilienthal were well-acquainted with notions about lift and control by wing-warping. Engine power was a key need. The bicycle mechanic Charlie Taylor built a 14 HP engine used in the Wright Flyer. Orville won the coin toss to make the first flight of 12 seconds, followed by Wilbur's flight of 58 seconds covering 850 feet in 1903. Much of the movie was narrated by Dr. Janet Bednarek, an expert from the University of Dayton. Aircraft improved rapidly during the next 10 years on both sides of the Atlantic. Major contributions were made by Anthony Fokker and Igor Sikorsky; the latter built and flew the first large four-engine aircraft in 1913. Of course, WWI provided a major impetus. By 1918, there were about 2 million pilots world wide. Unfortunately, the Buttonville Flying Club room was very cold on a very cold night, so the viewing was cut short.

At our March meeting, we continued to watch the series Warbirds Over The Trenches. It is a five-part look at aerial combat in WWI. The five parts are: 1. The Great Air Battles; 2. The Great Combat Aces; 3. The Great Zeppelins; 4. Fighter Plane Advances; 5. The Birth of the Giant Bomber. On this occasion, we saw Episode 3 which began with the birth of the Royal Flying Corps. Aircraft were first used for reconnaissance over the trenches. Some of the material is discussed by Dr. Janet Bednarek, an expert from the University of Dayton. She describes the problems of mounting guns on the aircraft for the first time. Aircraft with pusher props provided the early answer to firing forward, but pusher props are less efficient than tractor mounts. This led to clever designs of interrupter gears so the guns could fire through the propeller arc; one of the first was due to the Dutchman, Anthony Fokker. The Germans enjoyed air superiority in 1915, but the British flyers like Albert Ball (VC, a squadron leader at age 19) had caught up by 1916 at the Battle of the Somme. However, the life expectancy of a new pilot was about 2 weeks; the incidence of "nervous breakdowns" was high. By 1917, fighter aircraft still had open cockpits, but could reach 8-9,000 feet AGL with typical speeds of 100 mph (70-90 knots). Admiral Ramsay was an early pioneer of the use of aircraft at sea. By 1917, aircraft could be launched from the decks of ships using a steam catapult. Previously, they operated from the surface of the water involving the use of a shipboard crane. Episode 4 introduced the subject of dirigibles pioneered by Ferdinand Graf von Zeppelin, and were used to bomb London and Paris before the development of heavy bombers like the twin-engine Gotha. These dirigibles had metal frames of rings and longerons with a fabric cover. They had typical speeds of 50 mph; later versions could reach 16,000 feet. Episode 4 ended with the entry of the United States into WWI.


Al Mahon of MD-RA talked to the London-St Thomas chapter about the history of the MD-RA and its future direction at the January meeting

RAA London - St. Thomas

The March meeting of the London - St. Thomas RAA was a huge success. Dave Hertner hosted us at the home of Fisher Flying Products. The aircraft factory provided a great backdrop for the meeting. The smell of cut wood, the light coating of saw-dust on much of the free surfaces in the factory, and the large tables used for kit assembly added a very real aircraft atmosphere to the proceedings. Dave gave us a quick tour of the factory and then a live demonstration of his CNC wood cutting table. Easy to see just where all the saw-dust is coming from. It is great to see that Fisher Flying Products is back in business and is a going concern. Thank you Dave!

Josh Peg from Brant Aero crammed what must have been a full day's content into about 45 minutes. Josh spoke about some of the many electrical and avionics issues that he comes across in his work at Brant Aero. Josh made regular reference to chapter 11 of the FAA AC - 43.13 1B/2B - Acceptable Methods, Techniques and Practices of Aircraft Inspection and Repair, which governs all things electrical in our aircraft. I am sure many of you have copies of AC – 43.13. Like most things these days, it is also available on the Internet at http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC43.13-1b.pdf. I was particularly interested in the discussion on the correct methods for mounting communication and navigation antennas and their associated grounding plates. Josh finished the presentation with a question and answer period that answered many questions around radios and avionics. Josh and Brant Aero provide services to both general aviation and the homebuilt community.


Director Eric Muntzer (L) and President Peter Whittaker at Chapter 85's 2014 fly-in.

Vancouver Chapter 85

The first quarter of 2015 is almost over and there are a few Chapter 85 activities that I would like to review. In particular, there are two substantial developments underway. One is the airpark operating licence renewal and the other is the decision to pursue a club homebuilt aircraft project to replace the Turbi, more on these items below.

This year will see the operating licence for Delta Heritage Airpark come due for renewal. This takes place at the end of June and the renewal process has started with GVRD (Greater Vancouver Regional District) Parks Board. Discussions for renewal began in mid-January and also involve DAPCOM (Delta Airpark Committee) which is the airpark operating subcommittee of RAA Chapter 85. Discussions with GVRD Parks Board indicated that they are satisfied with how the airpark runs and at the same time, maintaining access for the public to non-airfield areas. The licence renewal will be for another period of five years. This creates a unique operating model for an active airfield within a public park. The airfield is also unique within Greater Vancouver since it maintains a grass airstrip and is a NORDO (No Radio) airfield.

The second Sunday in January saw the first "fly-in" pancake breakfast of 2015, although the weather cancelled any flying so it was all "drive-in". The turn-out was low although the breakfast broke even and came out a few dollars to the good. It was still a good event for catching up with friends after the Christmas and New Year's season. The next Chapter 85 pancake breakfast is the second Sunday in April.

Chapter 85 meetings, which take place on the second Tuesday of every month at 7:30pm, have had three excellent guest speakers thanks to the efforts of Sebastien Seykora, our Program Chairman. In January, Peter Murphy and Geoff Guest from Transport Canada reviewed the failure analysis findings from the collapse of the Turbi landing gear. This failure event took place late in 2013 at Delta Airpark on a landing. The Transport Canada investigation showed that fine fractures at a weld led to corrosion which further weakened the weld over the years. The weakened weld finally let go on what was an otherwise uneventful landing with no injuries and minimal damage to the rest of the Turbi. The Turbi has since been sold to an RAA member in Brandon, Manitoba.

In February, Nick Hill from Air Traffic Control at Vancouver Centre gave a very hands-on and practical talk about flying in the Lower Mainland and procedures for transiting Vancouver airspace as a light aircraft. His presentation gave a good overview of how incoming commercial traffic is collected and sequenced for arrivals in "the bowl". The rush hour periods were described and it seemed like this was essentially all of the time. The March speaker was our own Sebastien Seykora who described flying in the Canadian Arctic.

A decision was reached in January, by the membership on what approach was to be taken for replacing the Turbi which had served as the club airplane for the last 4 decades. The option to pursue buying a used certified aircraft was dropped in favour of seeking a homebuilt project. At this point, a Builders Group has been formed and several kit aircraft options have been considered. A high wing, all metal, 2 place aircraft is the type considered best suited for club flying activities and different models of Zenith Aircraft are currently under closer consideration.

CARAC / continued from page 17

years. The industry is so concerned with this that the Director General of Civil Aviation, Martin Eley spoke to this issue at the last ATAC Conference in Vancouver. This proposed NPA will require significant involvement of Transport Canada staff. Where will these resources come from? Will the Minister commit to hiring additional personal with the relevant training and experience to administer this program, at a time when the Federal Government is hinting at budget cuts? Will resources be siphoned off from other parts of Transport Canada, thereby further eroding the quality and timeliness of service? Or will this proposed NPA cause airport developments to "die on the vine" due to service delays in implementing it running months to years? The funding and management of the proposed NPA needs very careful planning and a very long term commitment from Transport Canada if it is to be further considered.

Airports of all shapes and sizes are the cornerstone of aviation in Canada. And they are disappearing at a much faster rate than they are being created. In British Columbia alone we have lost 4 airstrips and one airport in this year alone. This phenomenon is not restricted to small private airstrips either. Edmonton Municipal is gone, and Buttonville is going. The financial and logistical hurdles to creating a new airport are already almost insurmountable and for this reason they are not being replaced at anywhere near the rate that they are disappearing. This proposed NPA will do nothing to help the situation and will certainly exacerbate the problem. The proposed NPA concerns me more than any others I have seen in years for three reasons. Firstly, it formalizes a process that gives an increasing voice to those least knowledgeable and often most opposed to the development of airports. More troubling, is that once implemented, it will be very difficult if not impossible to restrict or rescind at a later date if needed. Lastly, and perhaps most troubling for other branches of the Federal Government, is that it sets a precedent. It is not hard to imagine that if adopted, other groups opposed to other types of development, will use this proposed legislation as an example in the legal arena as to why their voice should carry greater weight.

Transport Canada has the jurisdiction and responsibility to regulate and promote aviation in Canada for the benefit of all Canadians. This proposal as initially envisioned, for the six reasons I have detailed, will have the exact opposite effect. I strongly urge a very careful and sober second look at this proposed NPA, especially with respect to the issues raised in this letter.

Yours Truly,
Kevin Maher, B.A.Sc., ATPL.
Duncan Flying Club.


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