Flight Report – Pipestrel Aero Electro 23-0938.

I've been tracking the development of electric vehicles for many years. I've fantasised about an electric aircraft for aerobatics (my passion and sport), but in that sport – even more so than in general aviation - power-to-weight is everything. I've done some basic number crunching in my head for what it would take to convert my own aircraft – a 200hp Christen Eagle 2-seat aerobatic biplane – into an equivalent electric beast.

The 200hp (149kW) specification for the Lycoming engine in the plane is nominal at sea level and rarely reached in flight – typical cruise is around 65% power (96kW) and full throttle for aerobatics up to 3000'AGL might develop say 85% power (126kW). Hypothetically, if I put in a 100kW electric motor I'd need a 100kWH battery pack to fly it at a comparable power setting for only 1 hour without any reserve – such a pack in the Tesla S 100 weighs close to 600kg – which is more than the weight of my entire plane! (473kg).

I've seen a couple of experimental electric aircraft on the internet in the last 12 months. Extra – manufacturer of the most successful certified unlimited-class aerobatic machines has created an Extra 300LE electric powered version of one of their 2-seat aircraft, powered by some amazing Siemens hardware. The front passenger seat appears to be lost to the battery pack, which only gives it a flight time of 20 minutes. A very cool experiment, but that's what it is – an experiment, and I couldn't see it becoming a certified, purchasable machine for decades.

I had also seen some footage of a Pipestrel Electric Light Sport Aircraft. Manufactured in Slovenia, it has taken a different approach and targeted the Light Sport market. It had a flight time of up to an hour (fine for basic training and short joy flights) and seemed to have some potential. I too also assumed it would be a proof-of-concept experiment, and that it would be years before it would be something that the average person or pilot could learn to fly in with full endorsement from aviation regulators.

On Christmas Day 2016, my assumptions were soon proved to be completely wrong.

After leaving my family Christmas bash, I received an email from my father – an avid electric vehicle follower and member of the Australian Electric Vehicle Association (AEVA). He had sent me a link to an AEVA forum post describing an electric aircraft that had been shipped to Perth, and that had received approval to conduct Trial Introductory Flights to the public. I checked it out, and the post and company (Electro.Aero) seemed legitimate.

I have to admit, I was sceptical. Our Civil Aviation Safety Authority does not have a good reputation in the industry for being a streamlined bureaucracy on the leading edge (many would say I'm being diplomatic here!). But sure enough – there on the Pipestrel website, was a Special Certificate of Airworthiness from CASA specifically approving this model for private operations and flight training. I had to try it out! All other slots were full, so I grabbed the last remaining slot on their first day of operations – the 7am early morning one.

I arrived just in time on Saturday morning, bringing the girlfriend and parents (and dog) with me. I was introduced to Richard (Electro.Aero Finance Director) and my instructor Rob.

Rob gave us a walk-around "pre-flight" of the aircraft to check the condition of the aircraft and explain its systems. This is the first area where the differences and advantages of electric aircraft truly struck me.

The engine and its fuel supply are critical systems in aircraft – we have extensive checks that we have to do before, during and after flight; we are trained rigorously on what to do if we have an engine failure at any stage; and we're coached on how to look after the engine and fuel system to decrease the risk that you might have such a failure! During the pre-flight of a piston-powered light aircraft, we drain the bottom of the fuel system to check if any water has contaminated it. We dip the fuel tank to determine exactly how much fuel we have on board as there's significant distrust of mechanical fuel gauges. If we're low on fuel, we order a fuel truck or pump it out of drums or taxi the aircraft to a fuel bowser. When we do refuel, we should re-drain a

sample from the fuel system to double check for water contamination. We check the engine oil level and occasionally top it up (costing some $15 per quart/litre).

The Pipestrel was plugged in to a Supercharger when we arrived. It charges up the two 10kWH 70kg battery modules (one in the front of the aircraft and one in the back) in under an hour, using a standard electric vehicle charging plug. The pre-flight requires opening up a panel and looking at an LCD gauge on the battery pack to see its state of charge and overall condition. No fuel dipping, no messing around with hazardous hydrocarbons to refill it, and no topping up of engine oil.

The rest of the aircraft seemed typical of a modern Light Sport aircraft - carbon fibre construction, a high 30' wing, a tricycle landing gear with steerable nosewheel, adjustable rudder pedals – and a reassuring addition of a Ballistic Recovery System (a giant parachute for the entire aircraft!). Another thing I noted was the rather pointy aerodynamic cowl at the front end behind the propeller – it makes sense since there is no large boxer-style combustion engine that needs moulding around.

We unplug the aircraft and drag it out, take a few million photos and hop in. The windscreen, canopy and side windows/doors are all relatively huge – but the wing, despite being mounted at the top of the aircraft – is quite low. I needed to duck under the wing, sit backwards on the seat, and then swing my legs up and rotate to get into the aircraft. Once I was in it was really quite comfortable, with more than enough room for my 6'1 frame and instructor. The harness was a 2-point combined lap-belt with some shoulder straps. The front panel was almost all electric, with some very cool combined analog/electric gauges for airspeed and altimeter and a full Garmin touch-screen navigation system.

Since I was an experienced pilot, Rob was going to let me be in control for the entire flight and would just talk me through the requirements for this particular model, aiding where necessary. I start running through a generic mental checklist I've created over the years that fits most of the aircraft I've flown, and once again I'm struck about how needless many of these checks are in an electric aircraft.

Most aircraft have a fuel selector to pick which tank the engine will draw its fuel from and can shut off the fuel when required. Not required in this aircraft – flick a switch and the machine is powered on.

Starting a piston engine is now laughably retro. In the 21st century, most light aircraft still require the pilot to manually set the mixture to rich, prime the engine with fuel, crack the throttle, activate the magnetos and then engage a starter motor. Carburettor engines require management of "carburettor heat" to remove any frozen water that can be created from its venturi effect. None of this is required in Pipestrel – you flick 2 switches with the "throttle" at idle and the prop starts turning.

When the prop starts turning, another revelation hits me – the noise (or rather, the absence of it). In my aircraft, the background rumble of the engine is almost deafening. To have a conversation with my passenger, I need to close the canopy and engage the intercom system – headsets are an absolute must. I need to turn the volume of the radio all the way to maximum to hear the intercom and radio transmissions, and adjust the squelch to a point where conversation and not engine noise is transmitted through the intercom or radio. Headset manufacturers advertise and sell active noise reduction units for hundreds if not thousands of dollars.

In the Pipestrel, throughout the entire flight, there is almost nothing but some wind from the prop. There was no rumble or roar from the motor at any throttle position resulting from thousands of combustion cycles every minute. After almost two decades of flying, I can almost tell the RPM of the engine and how well its running just from the sound that's been pounded into my ears – none of that translates to the electric powered aircraft.

I make the radio calls required to get us going at Jandakot and start moving off, setting the throttle to

around “6kW” and reducing it as required. Rob even demonstrated that completely closing the throttle can make the engine and propeller stop – something that usually raises concern in piston powered aircraft! We taxi along to the holding point for Runway 12 and pass a designated run-up bay straight to the holding point for the runway.

At the runup bay is another aircraft performing run-up checks. Typically, the piston-engine pilot would need to wait until the engine comes up to a minimum operating temperature. They’d then run the engine up to a good power-making RPM and check the oil temperatures and pressures, amongst other systems. They would purposely de-activate each of the 2 magnetos in turn to check that they are functioning and that there is an acceptable RPM drop and difference between the two. They would check the idle speed and a bunch of other things to satisfy the pilot that the engine isn’t going to quit during or after take-off.

Again, all of that is unnecessary in the Electro. We glance at the battery charge gauge, set flaps for take off, make our radio call, and line up on the runway. I move the throttle full forward to “60KW” and the aircraft leaps forward, keeping it straight on the runway with slight rudder pedal movements. At what seemed like 40 knots indicated airspeed, the aircraft starts lifting off the runway of its own accord and we climb up at what feels like quite a steep angle considering where I’ve pointed the nose!

After take off, the pilot checks oil temperatures and pressures – again, neither required. We glance at the performance of the battery pack (which does have a temperature gauge) and then raise the flaps. To conserve battery juice, we reduce the power to around 40kW to continue the climb, turning onto the downwind leg and tracking outbound for Fremantle.

At straight and level, we reduce power to “20kW” – some third of the engines maximum power output. This really surprised me – one third of my typical manifold pressure in the Christen Eagle would be less than 10” of mercury, and one third of my maximum RPM would be only around 900RPM – neither of which would be able to keep me airborne! The 20kW setting seemed to give cruise speeds around 80 knots, and is what is required to extract the maximum 1-hour endurance without touching the additional 30 minute reserve quoted by the manufacture. Any prolonged power settings above this can significantly reduce the time and range – with a caveat.

The engine and propeller in this aircraft has been engineered to provide a power re-generation system. When the aircraft is descending at low throttle positions, the force of the air hitting the propeller causes a windmill effect which the motor can use to re-generate power – topping up the battery pack. In a piston powered plane with a fixed-pitch propeller, the pilot needs to carefully watch the RPM when descending as the windmill effect can cause it to rapidly increase RPM to the red-line – in Pipestrel it would be as if AVGAS magically materialized out of thin air and topped up my fuel tanks! With the giant wingspan, light weight and regeneration capacity, the Pipestrel has a glide ratio of over 15:1 – Rob said that we could glide in all the way in to Jandakot from Fremantle at 1500’. If I lose engine power in the Eagle, I need to pick somewhere to land almost immediately below me!

This regeneration capability makes this aircraft perfect for circuit training. The burst of power used to climb up to height and fly a circuit is partially regenerated as the pilot descends back down to land on the runway. Rob reckons that for every 5 ‘touch and go’s’, enough energy is re-generated to power another complete circuit.

The flight out to Scarborough up the coast and back was beautiful, and is one of my favourite scenic flights to give people. The sky was clear, the air was calm, the spacious canopy gave a great view, and the aircraft performed pretty much like any other aircraft. The low cruise speed however meant that the angle of drift to compensate for the easterly wind was quite high – I was pointing the aircraft what felt like 20 degrees off the heading I wanted! Apart from the scenery, airspeed, and altimeter, the only gauges I really looked at was battery temperature and % remaining. I definitely had a twinge of range anxiety, and didn’t

want to be the first and only person to have to pull the Ballistic Parachute!

We turned around just before Scarborough and headed back in. Coming back in from the Powerhouse and Adventure world, I ask to do a circuit – and Rob is happy to oblige. I set up a straight in approach to Runway 12 and call a 3 mile final. When the throttle is closed for descent, the prop slows, the tone changes slightly, and I look at the power meter – sure enough it is reading "-3kW"!

We came in from a long approach, only needing the first stage of flap (15 degrees) when below 70 knots and reducing to under 60 knots on short final. The visibility and controllability was excellent, compared to my own tailwheel aircraft that comes tearing down at 80 odd knots slipped sideways just so I can see what I'm doing. Not used the handling and judgement required, the first landing was bounced but easily recovered. Once we got it settled and went to full-throttle – the torque and near instantaneous engine response quickly caused the plane to leap back into the air!

The second circuit was a full stop, and the landing better than the first. We came in steeper and needed the second stage of flap (25 degrees) this time, the aircraft seemed to like it and maintained a nice 55 to 60 knot final – reducing a bit on short final. As we rolled out and pulled off the runway, the Jandakot tower activated so we called in for permission to taxi back to the central apron.

Shutting the aircraft down is another simple affair – close the throttle and flick 4 switches to the off position. To 'refuel', we simply plug it back into the charger which will give it a full battery charge in around 45 minutes – just in time for the next paying customer.

Throughout the entire experience, I had been mentally estimating costs and potential savings. Aviation is still an expensive pursuit. For a similar aircraft to mine, I'll burn (in 2017 prices) around $80 an hour just in AVGAS alone. For that hour, I should also budget a few dollars for oil consumption, and if I wanted to be sensible I'd put aside around $40 for an engine rebuild at around the 1000-hour engine life mark (yes, aircraft engines that haven't changed much since the 1950's cost some AUD$40k to rebuild – and aerobatics tend to degrade the typical engine "Time Before Overhaul"). Aviation being what it is, we could suffer a major mechanical malfunction tomorrow and need that $40k to get flying again. Additionally, there is also a mandatory service required every 100 hours and/or every year which costs thousands of dollars.

The Pipestrel needs some $3 to $6 per flight hour in electricity when sources from the WA grid, depending on times and tariff rates. There's no oil to worry about, the servicing is extremely simple due to the lack of mechanical engines and other moving parts, and with the remarkable drop in electric motor and battery prices I seriously doubt the replacement budget will be anywhere near what the equivalent combustion engine is. When you do have to replace the battery, there's every chance it'll come with a significant increase in power density.

Even now while writing this days after the flight, I'm amazed at how quickly the electric vehicle revolution has snuck up on the aviation industry. Here we have a perfectly suitable and viable product for ab-initio pilot training and flights of up to an hour – the length of some 'pareto' majority of all flights in their target market. Granted, the limited range means long cross-country flights are out of the question until more aircraft recharging infrastructure is built or the power density of batteries increase. Richard tells me they'll likely have a 2-seat machine with 2-hour endurance and 120kt cruise speed in the next few years, which will almost fill that remaining gap.

Maybe my dreams of an electric powered aerobatic monster will arrive soon after that.