

GUY LEITCH | IMAGES: JUSTIN DE REUCK

# LANCAIR EVO



Lancair Evo is a true four-seater with jet performance but with the ability to fly from grass strips.



# THE EVOLUTION OF THE SPECIES:

Frikkie Greeff knew exactly what he wanted: a plane that could easily get in and out of his grass strip at Fort Beaufort and then fly four people faster than 250 knots for at least 1,000 nm in pressurised comfort. Oh, and it had to burn JetA1, as Avgas is not always available at the places he needs to get to. The only problem was – that plane just didn't exist.

**T**HE supposed solution to those performance requirements was one of the new breed of personal jets. But Cessna's Mustang, the Eclipse 550 or Phenom 100 do not

have the ability to operate out of his grass runway – or the ability to fly 1,000 nm non-stop carrying four people and baggage. The King Air 200 is just far too big and expensive for Frikkie who often flies alone, and the US\$2.5 million Piper Meridian has too little payload with full fuel, and won't easily do 250 knots in the cruise. The TMB 900 might – but it costs US\$4 million.

So Frikkie continued to hammer along, sucking oxygen at FL180, doing 210 knots in his Mooney Acclaim, and struggling with expensive Avgas supplies – until he heard about the Lancair Evo. He flew to the Lancair factory at Redmond, Oregon to check it out and get introductory flights, and came away knowing he just had to have one.

The problem was that he had to build it and then try to get it approved by the CAA.

Being based in the Eastern Cape, he knew exactly who to turn to – SA Mooney's

Pat Hanly at Port Alfred. Pat already had a long and fruitful relationship with Frikkie, having first maintained his C177 and Aztec, and then a string of Mooney's from the 201 to an Ovation and then a new Acclaim. Pat thought the Evo was a fantastic idea and reckoned he could assist Frikkie to build and finish it, and then accomplish that most difficult of all steps, getting it approved with the essential IFR Authority to Fly by the notoriously obdurate South African CAA.

The story of how Frikkie and Pat completed the Evo is told here separately, but after a two-year labour of passion, the plane was ready to fly at Pat's hangar. It may have looked a bit rough in its battleship grey base coat of paint, but was beautifully built and carefully checked from spinner to wingtips to tail.

The manufacturers of high performance personal aircraft have learned the hard way to make sure the pilots who fly their planes are properly trained and have not just had a 'quick conversion'. Cirrus, Eclipse and Lancair have developed intensive and demanding training programmes. Notably, the very first Evo to be imported into South Africa had a terrible first flight, from Lanseria to Wonderboom, when the still unfamiliar pilot switched off the fuel. Fortunately, he pulled off a very creditable

forced landing and that Evo is flying again.

However, it didn't make much sense for only Frikkie to do the factory supplied 17 hours of training in Redmond Oregon, as others also needed to be able to fly the Evo. So Frikkie sent the highly experienced instructor Les Daley of Westline Aviation to Oregon to get the factory instruction and then to properly train Frikkie and Pat Hanly on the specific demands of flying the Evo.

Finally in May last year, Frikkie's Evo, number 61, was ready to fly. As this was the very first Evolution to be built outside the USA, Lancair insisted on inspecting the aircraft before the first flight to ensure that it was built to their exacting standards. Lancair CEO Bob Wolstenholme flew out from Oregon to Port Elizabeth to inspect the (almost) finished plane and help with the test flight. It went perfectly, and Wolstenholme was impressed.

Then started the long battle with the CAA to get an IFR Authority to Fly. This took six months of hard negotiating and finally threats of legal action to accomplish. Once an initial 25 proving hours had been done, Frikkie was ready to fly the plane to Cape Town for Robin Coss to work his magic with a stunning paint finish.

Pat and Frikkie had hoped to have it ready in time for the 2016 AAD Expo in



Cockpit is designed around two 10 inch LCD displays of the G900X Primary Flight Display (PFD) and Multi-Function Display (MFD).



Beautifully finished side-stick with Chinese-hat pitch and yaw trim.



Excitement as the container arrives at Albany Air Park South Africa.

September, but you can't rush an artist. Frikkie wanted the paint job to be done just right. Finally ZU-EVO was finished and was flown back to Frikkie's hangar at Algoa Flying Club in Port Elizabeth.

The flight back showed just what this remarkable plane is capable of. At just 1,090 lbs of torque, the Evo was clocking a phenomenal 352 kt ground speed on just 33 gph. It may have been helped by a significant tailwind – but it still thrilled Frikkie.

At this magazine we had seen some sneak pics of the paint scheme and wanted to be the first to do this beautiful aerial hotrod justice with the best air-to-air pics. The most suitable camera ship was undoubtedly our Saratoga – which had enough speed to suit the Evo. So we flew the 'Toga south from Lanseria and met our ace photog, Justin de Reuck, who had flown in from Cape Town.

#### WALK AROUND

As the hangar doors rolled back, I was struck by how large the Evo is. I had thought it much the same size as the Lancair IV-P, which I had first flown some 20 years ago, but this is a much more substantial aircraft. And this is no experimental homebuilt. The fit and finish of the control surfaces and panels is better than factory built.

The Evolution is pretty much a clean-sheet design, specifically configured for pressurised, high-altitude flight and turbine power. It's a product of 21st century computer-aided design and manufacturing, with safety features such as a BRS parachute and 26-G energy absorbing seats. Other than a superficial resemblance, the Evo is not remotely like the Lancair IV. Lance Neibauer, father of the original Lancairs, had no input on the Evo.

A major benefit of carbon fibre construction, in addition to its primary attributes of light weight, strength and durability, is the ease of creating an airtight pressure vessel. Doors, floors and control runs are sealed with gaskets and inflatable door seals.

The Evolution uses a new aerofoil that's totally different from the wing on the IV-P. Lancair says it's a proprietary semi-elliptical profile, reminiscent of the Spitfire wing, designed to have that elusive combination of a benign stall yet still be capable of high speed cruise. As with all Lancairs, the aircraft's composite carbon-fibre construction results in a beautifully smooth wing and fuselage surface, with elegant compound curves and no rivet heads or overlapping panels to disturb airflow.

The cockpit is even more impressive, being dominated by the two 10 inch, sunlight readable, high definition LCD displays of the G900X Primary Flight Display (PFD) and Multi-Function Display (MFD). The 900X is Garmin's experimental version of the now industry standard G1000 and has all the capabilities, including the G1000's integral GFC700 autopilot. Frikkie chose not to take the optional input keypad as it does not have a qwerty keyboard – as the G3000 now has. It says a lot for Garmin's trust of the Evo that it is the only non-type certified aircraft approved by Garmin for this hugely capable autopilot.

It's easy to get comfortable, as the seats slide forward and back, putting the side stick at the end of your arm. Short people need not worry about reaching the rudder pedals, because they also adjust.

The cabin is surprisingly spacious, with plenty of leg and shoulder space for both the front and rear seaters. The rear seats are comfortable and have plenty of legroom. Unlike most four-place planes, the wide door makes it almost as easy to get in the back as the front. The rear seats have quick-release knobs that allow removal of one, or both, of the seats, should the owner want to carry cargo instead of passengers. But the baggage bay is already plenty commodious and has a generous 100 kg limit.

ZU-EVO has fairly standard equipment for this capability of aircraft and weighs 2,656 pounds empty, giving a 1,894 lb useful load. With the standard 168 gallons of Jet A in the wet wing, you can still put 752 lb in the cabin. That is full tanks, plus



4 people averaging 175 lbs plus 52 lbs of baggage. So yes – this is that rarity – a full tanks, full seats and practical baggage personal plane.

The seats are hand stitched leather and the windows are expansive, especially nice since it's an airframe pressurised to a not inconsiderable 6.5 psi, giving an 6,500 ft cabin at FL280. This is especially important to Frikkie as, unlike a professional pilot, his 'real' work starts after he has landed, and consequently he must be as fresh and relaxed as possible after a flight.

The first order of business was to get the air-to-air photos done before the light went grey from the incoming afternoon clouds. We took-off first in the Saratoga as the tower wouldn't give us a streamer departure. Frikkie in the Evo had to wait until we were well clear of the runway before he was cleared for takeoff, and yet he still easily caught us on the crosswind leg. We headed to the coastline and passed Stu Davidson's Seaview grass runway, where he bases his L-39 jet.

Pat, with heaps of formation flying experience, flew formo in the Evo from the right-hand seat, with Frikkie as safety pilot in the left seat. Pat had no problem keeping the Evo in place, a testament to its control harmony despite its mechanically disadvantaged sidestick, as we orbited the many wind farms that have sprung up

**ABOVE** - Long nose houses PT6A-135A limited to a max. 750 shp driving four-blade Hartzel prop. Is prop clearance a little low for grass strips?

**BELOW** - Trailing-link main undercarriage for smooth landings, even on rough strips.



around the windy city.

We ate up the miles to Jeffrey's Bay until Justin was satisfied. Turning eastwards, we were blown back to the airport by the 30 knot westerly, fortunately straight down Runway 26.

Back on the ground, it was my turn. Frikkie had to fly left seat and unusually, the cabin door is on the left. So to get to the right seat I had to scrunch across, being careful to avoid the complex power lever quadrant and intrusive centre consol. This is not a cabin class plane.

Once seated, my first impression was of the comfort and spaciousness of the cockpit, particularly headroom and the great view out from the commanding seat position.

#### **FLYING THE EVOLUTION**

Starting the PT6 is simple. There are four 12 volt batteries, in two series of two for the 24 volt system. but they come alive with a single Master Switch.

Fuel pump on, ignitors on, starter engage and the big four-blade prop starts to turn. At 13% N1 bring the Condition Lever forward. The ITT remained well below limits, despite it being fired up again soon after shutdown. At 52% N1 release the starter and switch the generator on. It all happens in less than a minute and you are ready to go – no shaking run-ups.



**LEFT** - Commodious baggage space. The Evo can carry 52 lbs with full tanks and four pax.

**BOTTOM** - Large baggage door for easy access.

The cabin is air conditioned and pressurised and the system is easy to manage. Just dial in the required temperature and cabin altitude on the system's touch screen and forget about it.

The Pratt & Whitney PT6A-135A is limited to a max. 750 shp in flight and 550 shp for takeoff. The engine has a 3,600-hour TBO. Like most P&W PT6s, the -135A is never stressed, and it's reasonable to assume a well-treated engine will outlast the owner. Typical of the PT6, particularly when mated to a well-balanced prop, the Evolution's turbine makes any piston engine feel like a concrete mixer.

Even at its 4,550 lb max all up weight, the Evolution has a low power loading of 7.8 pounds/shp for takeoff. That gives you the get up and go to get you out of tight strips.

The Evo has a free-castering nosewheel and as usual with a new plane, getting the feel of the differential braking takes a few waddles. Taxiing with a 30 knot tailwind was no problem thanks to the ability to pull the prop in and out of Beta range.

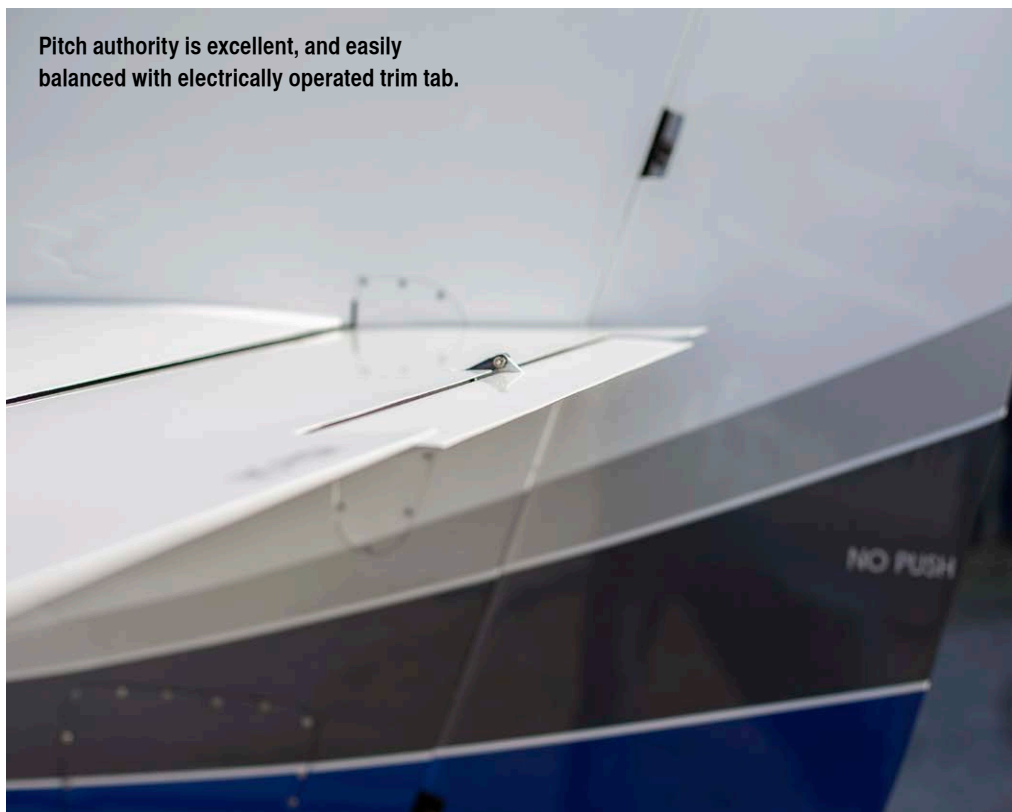
On the runway, Frikkie smoothly increased power to 1,200 pounds of torque and with near full right rudder we accelerated fast down the runway. Power is limited to 1,200 lbs/sq. inch on the takeoff roll because, with that much power, you will simply run out of rudder. With four on board and half tanks, the Evo flew itself off at 75 knots after less than 300 metres of ground run.

Once airborne, power was increased to around 1,700 lbs (max. engine torque is 1,940 lbs), depending on whether ITT or Torque limit is reached first, and we accelerated to 180 knots while still climbing at almost 3,000 feet per minute. The climb was almost instantly over as we levelled at 1,500 ft and accelerated to 220 knots indicated.

For a typical high altitude mission, aim the nose well above the horizon, climbing at  $V_y$ , so all you can see out front is sky, and the comparatively big wing provides jet like climb of 4,000 fpm from sea level. If you'd rather see where you're going, you can lower the nose to hold 170 knots and still get an easy 2,000 to 2,500 fpm. If you're in a hurry to reach the flight levels, keep advancing the thrust to maintain max. climb and you'll get to FL240, the optimum



**Pitch authority is excellent, and easily balanced with electrically operated trim tab.**



cruise altitude, in well under 10 minutes.

Frikkie says that he divides the climb into three segments: takeoff to FL100 he flies at 160 KIAS at 3,000 fpm, FL100 to FL200 he flies at 150 KIAS at 2,000 fpm, and FL200 to FL280 he flies at 145 KIAS at 1,200 fpm. Remember that these are indicated speeds so you are heading to where you want to go at an increasing ground speed. The PT6-135 is happiest at FL240, so it does not justify RVSM certification and limits the Evo to FL280.

Back to our low-level test flight: Out from under the Port Elizabeth CTR, Frikkie hands control over to me and I roll into a 45-degree bank turn to the left, which went okay, but when I reversed to the right, I battled to get the long nose in the right place on the horizon and inevitably, with that much power, found I had climbed 300 ft – sloppy flying.

Control responsiveness from a short side control stick for a two tonne plane is better than you might expect, partially because of the balanced Frise ailerons. Roll rate is good, although the stick force is solid. Pitch authority is excellent. This is not one of those planes deliberately designed with insufficient elevator to get into a full stall. There is electric trim for both roll and pitch via a conical Chinese Hat switch on the sidestick.

The stall clean came at 68 knots and with flaps and gear at around 60 knots; we were not at gross weight and did not want to push it at a relatively low altitude. The Evo was not keen to drop its nose and even less interested in dropping a wing. This makes it a nice stable platform that, despite its speed, shouldn't give a dozy pilot any nasty surprises in the demands of single pilot IMC.

With a fat four-blade Hartzell propeller, coming down is even easier than going up. The Evo doesn't need speed brakes for descent. Pull the thrust lever to idle, hold the speed, and the plane will drop at 3,000 fpm. Emergency descent can be done at 160 kt indicated, 25 degrees of flap, idle power and 6,000 fpm descent. The universal rule with turbines is to stay as high as possible for as long as possible, and the huge paddle blades make simultaneously going down and slowing down easy.

With the 30-knot wind and unfamiliar ATC procedures (local knowledge is important at PE), I was happy to let Frikkie do the approach and landing. The flaps have a colossal 48 degrees setting for extra drag, as though the prop doesn't provide enough. I was reminded of the complexities of this 'homebuilt' by the gradual misting up of the cockpit windows in the moist coastal air. The air conditioning filters may have become blocked with dust from the paint process and it wasn't demisting as it should have, but visibility out was still fine to land. Such are the considerations of a hermitically sealed cockpit with four adults, pressurisation and air conditioning.

We flew down final at 90 knots and crossed the fence at 80 knots. Over the numbers at 76 knots, and touchdown was past the intersection of runway 26/17 and smooth, thanks to the large trailing link landing gear. Frikkie selected the robust landing gear option from the factory to cope with his grass strip. This uses tyres from the Northrop F-5E fighter jet – but then I suppose it's appropriate to use fighter tyres on this hot ship.

The great thing about a turboprop is that you can pull the prop into Beta or even a bit of reverse and get stopped in a breath-taking short distance. Just brief the pax first. The EVO can easily takeoff and land within 300 metres. We let it roll out to

the mid-runway intersection back to the terminal and GA area.

## CONCLUSION

There are a lot of good reasons to want the cruise, range and runway performance that Frikkie Greeff needed. The Evo uniquely does it all, and has low enough operating costs to use with a clear conscience (and happy shareholders) as a personal plane.

Runway, speed and range is what the Evo is all about. It'll keep up with the fastest production turboprop (the TBM 930), with a max. cruise of 300 knots at its optimum altitude of FL240. Frikkie takes it easy and typically cruises at 250 kts burning around 30 gph. This gets near the magic fuel measure of 1 g for every 10 nm, that both my C182 and Saratoga struggle to make (130 kt on 13 gph and 165 kt at 17 gph respectively). At this burn, the Evolution has an easy 4.5 hours of endurance, plus alternate, plus IFR reserve for a range comfortably over 1,000 nm in four hours. And the Evo burns Jet A, at almost half the cost of Avgas. So you can go really fast yet more economically than a piston.


As you might imagine, a turbine-powered, four-seat, pressurised single doesn't come cheap, even a non-type certified one. The kit costs US\$657,500 with the ballistic parachute option, and a

new P&W engine costs US\$510,000. The firewall forward kit for the engine: US\$86,000, and prop: US\$34600. That is US\$1,288,000 before freight, building, paint and interior. The latter could run to another US\$200,000. A new Evo ready to fly at US\$1,488,000 is pretty accurate. Lancair says that if you choose a smaller mid-time PT6A, such as a -21, you could build an Evolution for somewhat less, but with much reduced performance. (You can also build the Evolution with a piston engine, the electronically controlled 350 hp Lycoming TIO-540A). While US\$1.488 million isn't exactly spare change, it still won't get you flying. You still have to build the plane. In this age of quick-build kits, construction time is estimated at 2,400 to 3,000 hours for the airframe, plus another 200 hours for the panel and engine mount. It is not recommended to tackle this project as a typical home-build and the involvement of a professional building team is essential. In order to satisfy the 51% owner-built rule that the FAA has for non-type certified aircraft, Lancair offers a two-week build programme for the owner which completes the more critical airframe construction tasks by factory technicians and introduces you to the

basics of composite construction.

It's a sizeable investment of both time and money, but it produces a plane with performance well above anything imaginable in the non-type certified world a few years ago. The Evolution is one of a new generation of non-type certified aircraft, designed to compete head-on with the highest-performance production models of the 21st century.

You may think an aircraft as complex as the Evo doesn't belong in the amateur-built world. But the concept makes total sense as the Evolution is designed to Part 23 certification procedures. Even though its notionally a 'homebuilt' production plane, it isn't cheap. But the build quality is to the standard of factory built planes costing twice as much – and with a lot less performance.

If you don't have the time, or don't trust your ability to build your own, you can get Pat Hanly to do it for you. 

## SPECIFICATIONS

**Crew: one**

**Capacity: three passengers**

**Length: 30 ft (9.1 m)**

**Wingspan: 37 ft (11 m)**

**Height: 10 ft (3.0 m)**

**Wing area: 132 sq ft (12.3 m<sup>2</sup>)**

**Empty weight: 2,350 lb (1,066 kg)**

**Gross weight: 4,350 lb (1,973 kg)**

**Fuel capacity: 168 US gallons**

**Powerplant: 1 × Pratt & Whitney PT6A-135A turboprop aircraft engine, 750 hp (560 kW)**

### PERFORMANCE

**Maximum speed: 190 KIAS**

**Cruising speed: 300 KTAS**

**Stall speed (So): 61 KIAS**

**Never exceed speed: 256 KIAS**

**Range: 1,133 nm (2,098 km) at maximum cruise speed**

**Service ceiling: 28,000 ft limited by RVSM**

**Rate of climb: 4,000 ft/min**

**Wing loading: 33.0 lb/sq ft (161 kg/m<sup>2</sup>)**

Sleek lines thanks to carbon-fibre construction. Runway, speed and range is what the Evo is all about.





# BUILDING THE EVO

To meet the American FAA's awkward, but still effective, 51% owner-build rule, purchase of an Evolution kit includes a highly structured, two-week supervised build programme at their factory in Redmond, Oregon.



Brendan Samuel and Dave Smith at the Lancair factory in Redmond, Oregon.

**A**FTER the two weeks, you come away with at least a fuselage, horizontal stabilizer and wings that are closed out and structurally sound. The fuselage halves are joined and doors and windows are in, but the aircraft is an empty shell.

At the end of this build programme, you will have satisfied the 51% rule, and now you can enlist the help of a professional builder like SA Mooney to finish the project. In the case of ZU-EVO, the project was tackled by veteran builder Dave Smith of SA Mooney, who was physically involved with the build from the initial two weeks at the Redmond factory up to its initial test flight and beyond.

The factory claims (perhaps optimistically) that most Evos take about a year to complete. This depends entirely on the level of previous experience the professional builder has with an Evo and is something the owner should discuss at length with his builder of

choice. It's essential that the owner has realistic expectations regarding the build process, costs and duration, for his own as well as the build-shop's sanity! Good communication between the build-shop and the owner, as well as regular and structured project meetings, will make the process run smoothly.

In dividing tasks between the manufacturer, 'professional helper' and owner/builder, the Evolution Aircraft Company (formerly Lancair) focused on assigning jobs to the builder that are least critical to the safety of flight. The two week build at the factory is a good example of this: The critical structural components are manufactured and mounted in a strictly controlled environment and the factory can therefore be certain of the integrity of these parts. The engine and fuel installation is done with a firewall forward kit sold by the factory, containing everything needed to mate a PT6A-135A with the fuselage.

The builder purchases and receives a bare engine from Pratt and Whitney in a box, and has to proceed from there.



The rear fuselage showing the many components shoe horned under the floor boards.

Typically (and highly recommended!) you would use a specialist from P&W for final fuel set ups and first start. "The number-one leading cause of amateur-built accidents is improper engine and fuel setup, usually occurring in the first five hours of the airplane's life," says The Evolution Aircraft Company. It also helps to remember that the engine is probably the single most expensive individual component you will be purchasing, so it makes very good sense to make sure its installation and setup is 100%.

The basic aircraft kit costs US\$595,000 and this excludes engine, firewall forward kit and propeller, which may also be



The fuselage recently delivered from the USA being moved to the new hangar in Port Alfred.

supplied by the factory. The choices for interior design, paint and creature comforts are limitless. When it's finished, an Evolution should cost the customer somewhere around US\$1.5 million.

Pat Hanly sent two of the engineers from his AMO to do the two week first build. Arriving at the factory, the owner-builder will find that The Evolution Company



provides a very detailed step-by-step build manual, and every part you need is presented in a beautifully organised matter. You are provided trays of screws and rivets, nuts and bolts, all labelled with the procedure and page the procedure is found on. In addition to the manual and parts, you are provided with two full-time employees that have done this before. The composite parts of the kit are all composed of prepreg carbon fibre, subject to a detailed build up and quality control programme. All parts are serialised and traceable throughout

the entire process, and all of that tracking information goes with every plane.

When Dave Smith and Brendan Samuel left Oregon, the two halves of the fuselage were joined, the wings and horizontal stabilizers were closed out, the windows were installed (another critical step due to pressurisation) and the cabin and baggage doors were assembled and fitted. ZU-EVO arrived at Port Alfred in a container, as a bare shell with nothing inside at all. There the wings and horizontal stabilizer had to be fitted and then the long labour to create a beautiful aircraft from a bewildering array of parts of love started (see photograph of condition of kit on arrival).

You can't get any closer to a factory

**LEFT** - The rear baggage door showing the intricate function of the locking mechanism and the door seal pressurising components.

**BELOW** - With the engine in place the project now looks like it is going somewhere.

built aeroplane and still call it homebuilt. The Evolution Company has worked diligently to interpret and manipulate the 50.1% rule for the safety and reliability of their kits. ✈️

