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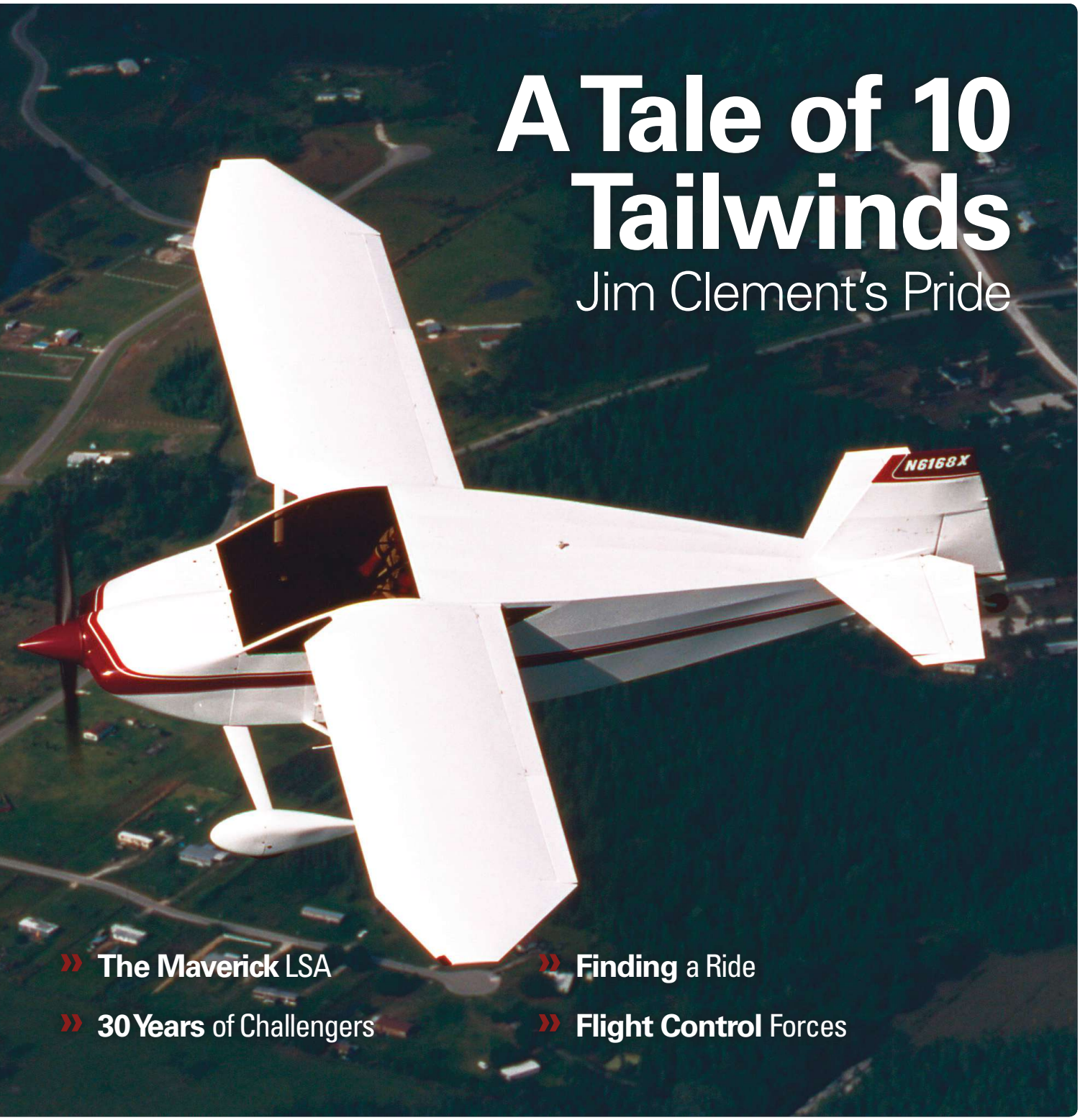

A Tale of 10 Tailwinds
Jim Clement's Pride

- **The Maverick** LSA
- **30 Years** of Challengers
- **Finding** a Ride
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EAA Tackles the Big Issues

By Jack J. Pelton

All segments of personal aviation will face major challenges over the coming years. At EAA we have programs in place to help resolve the biggest problems. We're not miracle workers, but by working together we can make a difference.

Shrinking Pilot Population: This is the No. 1 issue because when fewer people fly, the entire aviation activity—including airports and infrastructure—shrinks and becomes less available.

I believe our most important weapon to fight the pilot population decline is AirVenture Oshkosh. The World's Greatest Aviation Celebration shows more people more facets of aviation than any other. It's impossible to visit Oshkosh and not soak up the excitement and passion of flight. It also shows hundreds of thousands of people they, too, can be part of personal aviation.

In the longer term, our Young Eagles program introduces many thousands of youngsters to the thrill of flight every year. Those dividends will continue to pay off as the years go by. Our new Eagle Flights program is aimed at adults who have an interest in learning to fly but who haven't known how to become involved. This program shows them the way.

High Cost of Fuel: EAA has long been the leader in creating alternatives to lower fuel cost. It's been more than 25 years since EAA flight testing and research led to STCs authorizing the use of autogas in many standard category airplanes. And EAA continues to guard the right of airplane homebuilders to use any type of appropriate fuel in their airplanes.

A high priority for EAA is to help find a cost-effective way to store autogas at FBOs so it can be available to more pilots. Making autogas STCs possible was the crucial first step, and now we need to help create a distribution method.

EAA is participating closely with the aviation industry and other aviation associations to help identify and certify a lead-free replacement avgas. The key here is to find the unleaded fuel that works for all piston airplane owners with minimum transition costs and the least impact on airplane performance.

Medical Certification: EAA led the way in the creation of the sport pilot certificate that allows pilots to fly with a valid driver's license as evidence of medical qualification. Now we have joined with AOPA in petitioning the FAA to allow pilots to fly to the recreational standard using the same driver's license as medical qualification.

We believe that the third-class medical has become a deterrent for many pilots who want to fly basic airplanes under daytime VFR. Though it is possible to get a special issuance medical certificate in many health situations, the cost and complexity of the special issuance is a hindrance. This is especially true when expensive and often invasive medical tests must be repeated every year or two for the FAA, while normal medical practice does not require or even recommend the tests.

The FAA has not yet responded to our petition, but we and our colleagues at AOPA will do our best to keep the pressure on to find a solution. Sport pilot flying is building real-world evidence that the driver's license as medical works, and we will use that data to convince the FAA.

High Cost of New Airplanes: Airplane manufacturing costs are driven by many factors including small production runs and complex FAA certification rules. EAA is strongly supporting a revision of the FAA rules that govern small airplane certification. Simplification of those standards can reduce new airplane development costs. If costs can be brought down, production rates can increase, creating additional savings and lower prices.

EAA also advocates strongly for sensible maintenance and repair standards to keep older airplanes flying safely at reasonable costs. And we also work almost daily to be sure there is no infringement on the rights to fly all types of ultralight and other personal aircraft that offer the lowest cost entry into airplane ownership.

EAA worked hard to help create the LSA category, and though new LSA prices have turned out to be higher than we all hoped, the industry continues to evolve and develop. The greater level of freedom to innovate offered by the LSA rules makes possible some exciting concepts such as the Terrafugia Transition and the futuristic-looking Icon A5 amphib. As the LSA category matures I expect to see an entire range of airplane cost and performance offerings.

You can help EAA succeed in these crucial struggles by maintaining your membership and by purchasing a gift membership for friends. An EAA membership makes a perfect Christmas gift for anyone interested in aviation. You can see details of how to give a gift of membership at www.eaa.org/membership. I wish you all a Merry Christmas and happy holiday season. EAA

On the cover: The angular shape of the Wittman Tailwind is obvious in this overhead view. (Photography by Jim Koepnick)

EAA EXPERIMENTER

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William Wynne sharing his knowledge with some of the builders.

Learn, Build, Fly
Returning to school

By Charlie Becker

I had an opportunity to go back to school recently. Not a traditional school, but rather a "Corvair College." It was a three-day event in Barnwell, South Carolina, on how to adapt Corvair engines to power amateur-built aircraft. It did not follow the structured classes of my time at Marquette University, but it definitely transcended the normal how-to course.

William Wynne is the driving force behind Corvair conversions for homebuilts. He preaches the Corvair "gospel" at EAA AirVenture Oshkosh, on the web, and in his printed materials. He has devoted his life's work to teaching people how to adapt the Corvair engine for use in their aircraft. Over the course of the weekend, he often cited the EAA philosophy of "learn, build, fly." For him, a running engine is not the measure of success. He wants people to learn; not just about the engine and how to operate it, but some life lessons along the way. So, like my time at Marquette, you get a bit of logic and philosophy mixed along with the practical stuff.

There is a $79 registration fee that goes entirely to cover the cost of food. I had seven meals during the weekend, and each one was delicious. P.F. Beck and his fellow hosts really out did themselves. For me, getting grits with my eggs and sausage is a real treat and a rarity where I live. Barnwell is a terrific airport and worth a stop.

Vern Stephenson and Larry Webberking celebrate the successful start of Larry's Corvair engine.

The workshop is a fairly unstructured affair. There were 12 4-by-8-foot tables that two builders would share to use for engine work. I didn't count, but just about all the tables were filled with engines. You don't have to have an engine to attend, but reading the Corvair manuals beforehand is a big help.

Many attendees were like me, just coming to do research before making a decision. Many who already have finished their engine come back and volunteer to help other builders achieve success. This is important because there is only one William Wynne to go around, so having experienced builders to pitch in makes the whole thing work. The amazing part to me was how long into the night people would be working. I walked out completely exhausted at 10:30 p.m. on Saturday night while several people were still busily working on their engines.

The best part of the weekend is seeing the builders run their engines for the first time. William brings a test stand for ground running the engines. Once a builder is ready, he can break it in under the watchful eye of William. This is the one time during the weekend when you know you will have his undivided attention. The start-up of your engine only happens once William has reviewed your work and said it is ready. The fact that you have "the Corvair authority" looking over your shoulder when you first crank the engine makes troubleshooting much, much easier. To see the range of emotions on builders' faces as they go from "will this run" to "yes!" once it is running is the highlight of the weekend. It provides great inspiration to everyone in attendance.

Corvair College No. 27 was a great experience. It left me feeling like I do after EAA AirVenture Oshkosh: totally exhausted but extremely fired up about homebuilding. If you're interested in the Corvair engine, by all means attend a Corvair College. It is fun, inspiring, and a tremendous learning experience. EAA

Photography by Charlie Becker

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EAA, AKIA Focus on Homebuilt Issues

Transition training and support for "orphan" homebuilt designs were among the leading topics for leaders of EAA and the Aircraft Kit Industry Association (AKIA) during a meeting at the EAA Aviation Center on Tuesday, November 12.

AKIA President Dick VanGrunsven of Van's Aircraft, along with John and Jeremy Monnett of Sonex Aircraft, met with EAA Chairman of the Board Jack Pelton, Vice President of Marketing Rick Larsen, Vice President of Advocacy and Safety Sean Elliott, and Homebuilt Community Manager Charlie Becker. Although there are continual discussions between airplane kit industry leaders and EAA officials, this meeting was the first to formally review mutual interests and goals since AKIA was formed during EAA AirVenture Oshkosh 2012.

"It is essential that EAA, as the organization for those who build, restore, and fly aircraft, and the homebuilt kit manufacturers represented by AKIA jointly focus on issues of importance for the homebuilt aircraft community," Pelton said.

The importance of transition training for pilots flying homebuilt aircraft, including increasing the awareness and use of angle of attack indicators, was among the top safety issues discussed. EAA and AKIA representatives also reviewed how to support orphan designs for which the kit manufacturer no longer exists, as well as the potential available in type clubs and within "teen flight" aircraft building projects.

VanGrunsven called the meeting productive and suggested an annual meeting between the groups might be beneficial.

Mark Forss Returns to EAA Staff

Mark Forss returned to the EAA staff in late September to again manage EAA's SportAir Workshops as well as the annual EAA AirVenture Oshkosh presentations and workshops. He returned after a one-year "sabbatical" to pursue his passion of assisting his fellow members and homebuilders in achieving their dreams of building and flying their own aircraft.

Mark can be reached via e-mail at mforss@eaa.org or by phone at 920-426-6588.

Photography by Jason Toney

FAA Sleep Apnea Policy Would Set a Dangerous Precedent

Acting swiftly on the heels of major opposition to a recently announced FAA aeromedical policy on obstructive sleep apnea (OSA), a bipartisan bill was introduced in the House of Representatives that would require the measure to undergo a formal rulemaking process with an opportunity for public comment before being implemented.

EAA joined other general aviation organizations urging an immediate and indefinite hold on the FAA's just-announced aeromedical guidelines on sleep apnea.

The protocol, announced by Federal Air Surgeon Dr. Fred Tilton, would initially require all applicants with a body mass index (BMI) of 40 or greater and a neck size of 17 inches or greater to be evaluated by a sleep specialist prior to receiving a medical certificate. Those who are diagnosed with OSA would need to be treated prior to issuance. Tilton said that OSA is "almost universal" among this group.

"The FAA has not presented nor have we seen any evidence of aeronautical hazards or threats based on sleep apnea in general aviation," said Sean Elliott, EAA vice president of Advocacy and Safety. "To enter into the realm of predictive medicine based on no safety threat or symptoms—at a significant cost to individual aviators and the GA community—is not only a reach beyond FAA's mission but a serious hurdle to those who enjoy recreational aviation…

"We are joining in the call for an immediate suspension of this policy and thorough review of its need and justification," Elliott said. "There has been no evidence of sleep apnea as a cause or factor in more than a decade of general aviation accidents…"

The new policy grew out of a 2009 National Transportation Safety Board recommendation that the FAA change the airman medical application to include questions about any previous diagnosis of obstructive sleep apnea as well as the presence of risk factors for the disorder.

EAA strongly supports the House bill and urges its quick passage. A measure subjecting a similar rule in the commercial trucking industry to rulemaking passed both chambers unanimously and was signed into law last month.

NTSB Supports Less Draconian ECi Cylinder AD

The National Transportation Safety Board (NTSB) has filed comments on a proposed AD that would require thousands of ECi cylinders on big-bore Continental engines to be retired from service before the end of their normal life. The NTSB told the FAA that the board has no data to support the proposed requirement that thousands of ECi cylinders with fewer than 500 hours or more than 1,000 hours time in service be removed.

The NTSB points out in its comments that the board has investigated and studied the failure history of ECi cylinders for many years. The NTSB issued a safety recommendation in February of this year that ECi cylinders produced between May 2003 and October 2009 be retired once the cylinders reach their normal recommended TBO life.

The proposed FAA AD and the NTSB's research divide affected ECi cylinders into two groups based on serial number. The NTSB notes that Group A cylinders are already flying under an ECi mandatory service bulletin that demands repetitive inspections for cracks every 50 flight hours after the cylinder accumulates 500 hours. The NTSB commented that cylinder head cracking in this group of cylinders could cause loss of compression but is unlikely to result in a cylinder head-to-barrel separation.

The FAA's proposed AD would affect many more cylinders than NTSB testing and data collection indicates is necessary.

Read the full NTSB comments on the proposed ECi AD.

Continued on Page 9

Machined Tail Wheel Assembly Now Standard in Sonex Kits

Sonex Aircraft is now including its new 4-inch machined tail wheel assembly, with wheel, as standard equipment in all new standard-gear-configured aircraft kits.

Sonex reports that the machined tail wheel assemblies, valued at $175, offer improved durability and ground clearance versus the standard welded tail wheel caster assemblies, especially on grass runways, the company stated. Built from machined and black-anodized billet aluminum with a zinc-plated steel steering arm, the assembly provides an additional inch of ground clearance.

An upgrade to the 6-inch machined tail wheel assembly with wheel is a $100 option. Learn more at www.SonexAircraft.com.

Beringer Offers Discount to EAA Chapter Members

Beringer Wheels & Brakes is offering discounts to Van's RV builders *who are also members of an EAA chapter*. Starting now, the first RV builder in each chapter to order a complete "Basic Kit" for his or her Van's RV will receive 30 percent off the catalog price. The Basic Kit includes two sets of master cylinders; brake fluid reservoirs, stainless-steel lines and fittings, Beringer's trademark red anodized main wheels, finned-caliper high-energy brakes, mounted and leak-tested tubeless tires, bolt-on axles, and even the patented hydraulic ALIR anti-skid system. This makes for a great Christmas present or winter project!

Contact Beringer Aero USA in Chicago directly via e-mail at us.sales@beringer-aero-usa.com

First Flight for Britain's e-Go

A new single-place European canard airplane called the e-Go made its first flight in late October in Norfolk, United Kingdom. The e-Go was designed to fill the gap between a microlight and a light aircraft, and it's the realization of a design that creator Giotto Castelli has been working on for the past decade.

"I believe the canard design can offer great maneuverability and efficient aerodynamics," Castelli said. "The e-Go adds to that an impressive field of view and a very compact airframe with simple lines, which the air likes as much as the eye does. This also allows the weight to be kept to an absolute minimum."

The aerodynamic podlike aircraft derives power from a state-of-the-art Wankel rotary engine, with electronic control unit and fuel injection producing speeds up to 110 mph. e-Go comes with a full-glass cockpit, integrated heating, ventilation and de-misting system, and integrated flight simulation system. The e-Go is currently priced at around $80,000.

"The aircraft embodies many novel features and benefits from the aviation authority in the U.K. relaxing its regulation on very light aircraft," said Malcolm Bird, e-Go executive chairman. "This has allowed e-Go aeroplanes to develop a completely new aircraft in a short time and with the minimum of red tape. It is good to be involved in the revival of a British aviation industry."

The company expects first deliveries in 2015. For more information, visit www.e-GoAeroplanes.com.

10th Annual U.S. Sport Aviation Expo Opens in January

January 16 to 19, 2014, marks the 10th annual U.S. Sport Aviation Expo at the Sebring Regional Airport in Sebring, Florida. The four-day event focuses on homebuilt and light sport aircraft, with more than 160 exhibitors signed up to participate in the event. A number of forums are also scheduled and demonstration flights are available throughout each day of the event.

Discounted tickets also are available now on the Expo website, along with merchandise such as caps, T-shirts, sweatshirts, and other souvenir items.

Learn more about the event at www.Sport-Aviation-Expo.com

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Order online at www.WicksAircraft.com or call 618-654-7447. Be sure to mention the special lighting price sale.

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VanGrunsven, Brown, Pasahow Join EAA Board of Directors

Dick VanGrunsven

Joe Brown

David Pasahow

Three aviators with extensive experience in diverse areas of the aviation community have joined the top leadership of the EAA as members of the EAA Board of Directors. Dick VanGrunsven, Joe Brown, and David Pasahow were invited to join the board during the group's meeting held November 14 to 15 in Oshkosh. As Class III directors, each will serve one-year renewable terms on the EAA board.

"Each of these three EAA members has a diverse aviation background, and more importantly, a longtime connection with our organization in multiple areas," said Jack Pelton, EAA chairman of the board. "We are grateful that each of them has stepped forward to represent our membership and help lead the association as we pursue our mission of growing participation in aviation."

VanGrunsven, EAA 3204, of Hillsboro, Oregon, is founder and CEO of Van's Aircraft, which has become one of the largest kit aircraft manufacturers in the world with more than 8,500 airplanes completed worldwide. An EAA member since 1964, VanGrunsven has received EAA's Freedom of Flight Award and Dr. August Raspet Memorial Award and is a member of the Society of Experimental Test Pilots. He is also a founding member of the Aircraft Kit Manufacturers Association.

Brown, EAA 795555, of Centerville, Ohio, is president of Hartzell Propeller and chief operating officer of Tailwind Technologies, a holding company that owns Hartzell Propeller and three other aviation businesses, including Hartzell Engine Technologies. Brown, a graduate of Middlebury College, is an instrument-rated pilot who flies diverse aircraft ranging from a Glasair Sportsman to a TBM 850.

Pasahow, EAA 269376, of Dallas, Texas, is founder of Blue Line Advisors, an executive search and leadership firm focused on aerospace, transportation, and other selected sectors. An EAA member since 1986, Pasahow is a pilot and homebuilder who previously served on EAA's board from 1991 to 2009.

Photography courtesy of Jim Clement

A Tale of 10 Tailwinds ...and Counting

Jim Clement's love affair with square corners and high speeds

By Budd Davisson

Steve Wittman will forever be known as the master of low-dollar speed. He's the guy with the reputation for taking less and making it more. He will, however, never be known as a lover of compound curves and the complexity contained therein. Just about everything he ever built was flat, square, and comically simple and went like stink. And his Tailwind, which debuted along with the fledgling EAA in 1953, exemplified those traits. And it still does.

With many hundreds of Tailwinds having been built and the design's 60th anniversary celebrated in 2013, Tailwind fever is still with us today and for good reason: It would be difficult to build a two-place, side-by-side airplane that is as inexpensive as the Tailwind, goes as fast, or is as easy to build. These may be the reasons why Jim Clement of Baraboo, Wisconsin, has built 10 of them. That's right, 10 Tailwinds. All but one built completely from scratch.

Born and raised in Baraboo, northwest of Madison, Wisconsin, Jim was quick to discover aviation. "In high school, I flew U-control models and had friends whose fathers had airplanes, so the interest was always there," he said. "It was airplanes and cars. My dad had a car dealership with a body shop, and I was always hanging around that. So, I've been building stuff, including a Model A roadster hot rod, my entire life. In fact, I've waffled back and forth between cars and airplanes constantly.

"I started flying the summer I got out of high school and then went to airframe and powerplant (A&P) school. I started working at a small local airport, but I had made more money working part-time at a gas station in high school. So, I worked for a body shop for a few years before opening my own. And that's what I did until retiring. I was always pretty much a one-man show, but that let me be my own boss. And no one could complain about airplane parts being scattered around the shop.

"I got interested in homebuilding aircraft in '59, when I was only a couple years out of high school. A friend in town had built a Baby Ace from *Popular Mechanics* plans, and he showed me an article on Tom Cassutt and his little racer. So, a few years later, I ordered a set of plans and started building. When I finished and flew it, I only missed being the first plans-built Cassutt by one month. The first one has since been destroyed, so mine, which is now in Texas, is the oldest Cassutt racer flying. The owner has a little container in it holding his dad's ashes, so he's always flying with his father. That airplane sure taught me a lot about building airplanes."

Enter the Tailwind

"I was racing the Cassutt at Cleveland when I met Steve Wittman," Jim said. "He had brought a Tailwind down, and in talking with him, I realized that the two-place Tailwind was almost as fast as my racer and a lot more practical."

Like so many young homebuilders, Jim quickly found that as his personal life took off, including a wife and kids, aircraft became too expensive, so he drifted into building and racing midget race cars.

The Dietrichs are now the caretakers of this Tailwind that Jim built.

Photography courtesy of Jim Clement

"When I came back into aviation, I already had my sights set on building a Tailwind," said Jim. "I went to see Wittman, and he was just getting ready to bring out plans on his new version of the W-8, the W-10, but he hadn't drawn them up yet. So, he scribbled some notes on W-8 plans, and four of us in Baraboo bought plans and started building an airplane apiece."

The W-8 and the W-10 differ in seemingly minor details, but Jim said that on an airplane these little details really count. The fuselages are essentially the same except the longerons are different: The W-10's longerons are simpler and stouter, and the newer fuselage is 6 inches longer. Most of the increased length is actually the result of a bigger tail that is aerodynamically (not statically) balanced for lighter pressures.

The most noticeable thing the W-10 has is extended, trapezoidal wingtips that Jim said make a really big difference in approach. It glides better and is less critical, "softer" as Jim puts it, in the flare.

And Then the Building Began and Never Stopped

The Tailwind Jim had seen at Cleveland with Wittman was powered by a 145-hp Continental O-300, a six-cylinder that Wittman liked because it was so smooth, if somewhat heavy. And that's what Jim used in what was to be the first in a long line of Tailwinds (TWs).

TW No. 1 – "I built that airplane right to the plans," Jim said, "and I still say that people are far better off building the airplanes exactly the way Steve designed them. Too many builders think they're smarter than Steve Wittman, so they modify the airplane considerably. However, I have yet to meet the person who is actually smarter than Steve was."

TW No. 2 – Jim flew No. 1 for a few years before building another Continental-powered TW. "On this one I used the so-called flat bottom wing that was supposed to be faster. I was trying to outrun a friend with a Glasair and couldn't do it in the first airplane. This one came really, really close. It was doing a little more than 200 at top end and cruising at 175 mph on about 7-1/2 gallons. This is about the same as a Lycoming O-320 does in the same airframe."

TW No. 3 – "No. 3 was a W-8 project I picked up. It came with a converted GPU Lycoming, an O-290G that had been completely converted to aircraft specs. With 125 hp, it was nearly as fast as the earlier airplanes because it was a solid 45 pounds lighter. This really woke me up to the potential of Lycomings over the Continental. They were much lighter."

TW No. 4 – "I ran across a 160-hp Lycoming out of an Apache and had to build an airplane to put it on. This is the airplane the EAA used for the Café tests. It came in fairly light, 860 pounds, so it was a real runner. I'd planned on keeping it. But a guy wanted it worse than I did, so it went away." Here is that CAFE report.

TW No. 5 – "A clone of No. 4 but a different color."

TW No. 6 – "This was my effort at building a tri-gear Tailwind and it really worked well. I did it differently than 'Witt' did and mounted the main gear in a truss behind the seat. Anyone on the planet can make good takeoff and landings in it. The nose gear cost 7 mph in top speed, no surprise, but I've sold a lot of drawings to people for it."

Steve Wittman will forever be known as the master of low-dollar speed.

TW Nos. 7 and 8 – "By now I was really hitting my stride and did something crazy: I had been watching Jim Younkin restore Staggerwings on a semi-production line, and I thought I'd do two different Tailwinds in the same fashion. One was a 180-hp taildragger that was a real screamer with a wood prop. This was supposed to be my lifetime keeper, but again, a friend wanted it badly. The other airplane was a 160-hp tri-gear. I liked it, but I've always liked taildraggers better; so I didn't keep that one long. I will never do the two airplane thing again. It was incredibly monotonous!"

TW No. 9 – "This was my attempt at building a really pretty airplane around a 160-hp Lycoming, and I think it worked out well. Incidentally, every one of these airplanes has been the one I am going to keep, but then something happens and it goes away. Then, when the workshop is empty for more than a few weeks, I start to get nervous. An empty workshop is a pitiful thing. So, I do it again. At the time, I had some real nice Douglas fir spar material; so I built a pair of wings just because I had the material and plywood in stock. I had no intention at that time of building another Tailwind. But with a pair of wings built and almost enough tubing for a fuselage, and then the engine became available, No. 10 was born."

TW No. 10 – "This wasn't the first time I started an airplane just because I ran across the right engine. In this case it was a 180-hp XP-360 that had been in the back of a VariViggen that the pilot dropped in hard enough on the first flight that the airplane was destroyed and the engine and firewall just separated from the airplane. Zero damage

to anything in the engine compartment. So, it was essentially a new engine. I made him a bid before he put it on the Web, and I was off running on another 180-hp W-10. I have 100 hours on it now, and I'm certain that I'll never build a better airplane than this one. Plus it tops out around 220 mph, so I'm definitely not going to sell it."

Wait! Haven't we heard that before somewhere?

What hasn't been mentioned is that mixed in among all this building somewhere is a Hyperbipe project that Jim finished as well as a scratchbuilt clone of Wittman's lesser known design, the 1938 Buttercup that Wittman built as a proof-of-concept airplane for Fairchild to produce. Earl Luce puts out plans for that design (www.LuceAir.com).

Also mixed in with all of this airplane building was his day job of running what was essentially a one-man body shop, along with raising three kids, either one of which is a full-time job. He does, however, admit that much of the airplane work took place in the body shop, so we know what he did during his coffee breaks. Still, Jim makes the rest of us look like underachievers, doesn't he?

Then, as if that doesn't make us mere mortals feel bad enough, of the 10 Tailwinds he has built, five have won Bronze Lindys at Oshkosh, and the second tri-gear was Grand Champion Plans Built at the Sun 'n Fun Fly-In in 1998.

Jim, however, is quick to say that none of this would have happened had he married someone else. He said, "Donna and I have been married for 49 years, and she has put up with all this and also had full-time jobs after the kids were in school. If she wasn't such a good sport, I could not have done any of this and still be married."

The Tailwind: Simplicity Breeds Success

There are generally a lot of very basic reasons why one aircraft design is more successful than another. Today, in a world populated by quick, quicker, and quickest quick-build kits, success is almost always a combination of a good flying airplane, kits that go together both easily and quickly, and enthusiastic customer support—for example, Van's Aircraft. Eliminate any one of the foregoing, and the product will have lackluster sales. Scratchbuilding shares some of the same requirements but definitely not all of them.

Scratchbuilders, for the most part, are a much more independent breed, and problem solving is one of their real joys in life. They love working out ways of doing things. They don't need a customer service rep to tell them Tab A goes into Slot A. This is especially true since a scratchbuilder has to hand-make both the tab and the slot. That having been said, however, the simpler, more straightforward the structure or component, the easier it is for a garage craftsmen to make the part with no outside help. That alone guarantees more of a given type aircraft will be finished. And the more that are finished, the more good things that will be said about it via word of mouth. This, of course, assumes the finished products are good flying airplanes and give the builders something they can't get elsewhere for anywhere near the same price. This is why so many single-place Pitts and Hatz aircraft have been built. And this is why so many Tailwinds are flitting around: They were designed to be built in a single-car garage with a hacksaw, a welding torch, and a hand jigsaw. So, when a guy has any more tooling than that and his experience includes hands-on building, the Tailwind goes together relatively quickly.

Jim said, "I can build up the basic fuselage cage, including welding, in something less than 60 hours. Granted, this isn't my first time, but it's an incredibly simple structure, and Witt had an ingenious way of eliminating jigs almost entirely.

"You tack up the sides in the typical, flat-board-with-blocks fashion, but when you stand the sides up to add the cross pieces, you don't build a complex jig. First, you lay the sides on top one another. Then you run a short weld bead, a heavy tack, really, at the rear end that holds the two longerons together at the rudderpost station. Then you stand the sides up on a table that has a centerline on it. Spread the sides apart and insert the piece of tubing that is the rear spar carry-through, center it with a plumb bob, and lightly tack it. So, now you have a fuselage standing up, but the firewall station is far too wide. Then, and this is the secret, making no effort to heat-bend anything, you tack the front/main spar carry-through in place. To do that, you have to pull the longerons in to meet the main spar carry-through. A ratchet strap or a piece of twisted wire with a stick through it will pull them in. When you do that, the longerons *behind* the rear carry-through that you have already installed take on a very symmetrical, pleasing curve all the way to the tail post.

"Once the basic form is established, you spend some time making sure the front and rear spar carry-throughs are parallel and perfectly square. Generally, the tail post station will stay right on centerline. Then you just measure where the top and bottom cross pieces and diagonals in the aft fuselage should be, cut and fit them, and tack them into position. Super precision isn't necessary because everything in the aft fuselage is just along for

Photography courtesy of Jim Clement

Jim Clement with his latest (last?) Tailwind, N168WH.

the ride. Precision isn't called for until you begin to mount the tail surfaces.

"This is an airplane that you establish the critical points exactly, like the wing and tail attachments, and build the airplane around those. You can't trust all of the dimensions in the plans enough to build complete components and expect them to bolt together. If it's a critical fit, you do it on assembly, not on the workbench."

As part of Wittman's keep-it-simple approach, many components, such as the rudder pedals, are welded in place. Once installed, they're in to stay. That's one of several things Jim changed.

"The rudders and brake pedals mount to a cross piece that's usually welded in place," said Jim. "I bolt that cross member in, which makes sandblasting, painting, and lubing the pedal assemblies much easier and cleaner."

Jim also modified the shape of the doors, which were originally difficult to climb through because the rear edge was too far forward. With Wittman's input, he moved the rear wing spar carry-through back 3 inches and triangulated it. This opened up the cabin roof while at the same time allowing the edge of the door to move back. This is another of the plans addendums that he sells to builders.

"The wings are incredibly easy to build," Jim said. "Very, very simple, and if you use Okoume ply rather than aircraft mahogany, like a lot of the aerobatic guys do, and Douglas fir spars, they are cheap to build. I get my spar material from a lumber yard that carries cabinet-grade materials. At places like that, you have a lot of wood to sort through, and it's not hard to find straight grain pieces with very little to no grain run-out."

When it comes to painting an airplane, Jim is old school for good reasons. "I've done a couple in urethane, but I really prefer Randolph butyrate dope," he said. "It's easy to do, nonlethal, easy to repair, and cheaper. Besides, I just like it better."

Is Another Tailwind in the Wind?

Jim has been finishing a house and flying his current Tailwind, but his new workshop is empty. While talking to him about it, he said he's not likely to build again; airplanes have become too expensive. But he does have several sets of finished wings racked up in the new shop. And there's all of that extra leftover tubing. And the tools are just sitting there. Anyone want to make bets that his shop won't be empty long? EAA

Budd Davisson is an aeronautical engineer, has flown more than 300 different aircraft types, and published four books and more than 4,000 articles. He is editor-in-chief of *Flight Journal* magazine and a flight instructor primarily in Pitts/tailwheel aircraft. Visit him at www.Airbum.com.

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Photography by Greg Sutter, Sutter Photography

Aerial view on Saturday.

Challenger Aircraft
h Anniversary Fly-In

Honoring Quad City Aircraft Corp.

By Dan Grunloh

A welcome greeting on the flightline.

Five Canadian amphibious floatplanes from Ottawa.

Dazzling Challenger LSS owned by 92-year-old David Fullgraf.

Owners of Quad City Aircraft Challengers from all over North America converged on Erie Airpark in northwestern Illinois on September 20 to 22, 2013, to celebrate the 30th anniversary of the Challenger design. It was one of many new light planes introduced in the early 1980s as designers began to realize the flying public wanted an ultralight that was a "proper little airplane" with conventional controls, a full enclosure, and tricycle landing gear. The Challenger and other designs were quickly expanded to offer two-place aircraft and amateur-built kits as the advantages of light airframes coupled with two-stroke engines became evident.

The History

In 1981 Dave Goulet scratchbuilt and flew a Mitchell Wing U-2. In late 1982 he met Chuck Hamilton, who was then flying an Easy Riser. They both loved building and flying airplanes, and Dave had some engineering training. So in late 1982 they teamed up to create the Challenger ultralight. The prototype was seen at the Sun 'n Fun Fly-In in 1983, and it was flown at Oshkosh that summer. By late 1983 Quad City Aircraft had been established, and kits were ready to ship. A two-place tandem version came next.

Later Chuck Hamilton went his own way, and in 1991 he designed the Genesis and started the company that became SlipStream International. Chuck lost his life in a flying accident, but Dave continued marketing the Challenger and eventually became president and CEO of the company. Thirty years later 4,000 Challengers have been built and flown worldwide. It has become so popular that 52 Challengers showed up at Erie Airpark to celebrate its birthday. Other aircraft that flew into the event brought the total attendance to about 70. No other amateur-built light plane in its class could produce as many copies at a single gathering. It could be called the most successful amateur-built "ultralight-like" light plane of our time.

Quad City Aircraft took a different approach than many other manufacturers. It stuck to one design for three decades but constantly made improvements, many of them significant. A 2013 Challenger XL-65 may look similar to the original, but it's a much different airplane when it comes to performance, payload, and more. Quad City followed a conservative business plan and relied on an extensive dealer network to help with product support. The company never had to declare bankruptcy and never sold out to new owners. It's been the same people and same management providing a popular kit-built light plane for 30 years.

Challengers are built from aluminum tubing, gussets, blind rivets, and aircraft hardware with fabric coverings of resin-coated Dacron sailcloth or painted aircraft fabric.

The fuselage, wings, and flight controls are already built in the kit, which can be completed in as little as 300 hours. Quad City Aircraft offers six different models comprised of single- and two-seat models in long- and short-wing versions. A single-seat FAR 103 ultralight version flies with a Hirth F33 engine, but examples are rare. The newest models—the Light Sport XS and XL—represent a major reworking of the design intended to optimize performance for the light-sport aircraft category and incorporate many new features. Challengers are popular in Canada, with 600 in service, thanks to their ability to quickly change from wheels to floats or skis. The Canadian distributor maintains an extensive website loaded with photos and detailed information. Check it out at www.Challenger.ca.

A Little Bit of Heaven

The Erie Airpark (3H5) situated along the scenic Rock River in northwestern Illinois began as Earl's Airpark in 1972. The owner, Jerry, a retired commercial pilot, became a Challenger dealer in 1983 when the design was first introduced. From that time onward, Erie Airpark has been a haven and a little bit of heaven for ultralight and light plane enthusiasts, especially for the Challenger design. The factory is a short distance away in Moline, Illinois. A club was formed called the Illowa Sport Flyers that became EAA Ultralight Chapter 188. Jim and Sue Robinson took over the airport about 15 years ago. Jim originally had learned to fly from Jerry, and when the opportunity came to purchase the airport, Jim made an offer, moved in, and became an instructor. Jim and Sue continue to promote the airport and the club, which has grown to more than 80 members. Around 27 airplanes currently "live" in the hangars on the field. The airport features a pavilion and place for a bonfire at the far end of the runway for parties and music under the stars.

"Suddenly I Was Looking at a Wall of Water"

On Friday, September 20, the first day of the 30th anniversary fly-in, a long line of rain showers associated with a cold front straddled the entire upper Midwest, moving slowly southeast. Pilots from Illinois, Missouri, and Indiana flew toward Erie Airpark, encountering steadily worsening weather and low ceilings. Challenger pilots reported making precautionary landings on private airstrips, and in one case, an emergency downwind landing on a farm road to wait out the weather. That pilot said, "Suddenly I was looking at a wall of water." The same system blocked arrivals from the north. Some, including the Canadians, had to wait until the rain moved out of the Great Lakes region.

A walk among the rows of Challengers shows why it is advantageous to build and fly a widely adopted aircraft

New pilot Renee Dubois on her first long cross-country flight.

Jim Robinson's Challenger has been flown more than 2,000 hours.

AirVenture 2013 Gold Lindy–winning Challenger XL-65 is the top model.

design. A builder could walk these rows and get endless inspiration from the many examples of originality in various options and paint schemes. Patriotic or military themes are obviously popular. The workmanship can be award winning, as evidenced by the top three EAA AirVenture Oshkosh 2013 lightplane judging winners (all Challengers) that were also in attendance at Erie. The Grand Champion was N140TR, Mike Riley's XL-65 model that was displayed inside the Challenger tent at AirVenture. The Reserve Grand Champion was Harold Goellner's N138NA. An Honorable Mention went to Tom Scully's blue Challenger, N380TS, shown on floats at AirVenture but on wheels at Erie.

A group of seven Challenger pilots from Wisconsin led by Challenger dealer Greg Klemp Sr., including female pilot Renee Dubois, flew in for the festivities. Aviation adventures are coming quick and fast for Renee, who flew 340 miles to get to Erie, her longest trip to date. She earned her private pilot certificate in December 2012; in March 2013 she earned a seaplane rating and then by April had found a Challenger with the help of Greg. Her husband flies with her and is fully supportive, but he could not make this trip. Worried about flying with such a large group with so little experience, she arranged to fly with another pilot as a pair about 15 minutes behind the main group.

Don Zank's modified 1992 Patriot, designed by Quad City.

Jim Robinson on guitar and Greg Sutter on banjo at the Saturday night bonfire.

Eight Challenger floatplanes led by Canadian Challenger distributor Brian Quickmeire started out from the Ottawa, Ontario area. One dropped out early. Two others had mechanical problems, resulting in forced landings. One of those landings was in very heavy swells on Lake Michigan and succeeded thanks to a mixture of luck and skill. Fortunately, the winds blew the plane to the shore. Both pilots had friends circling overhead, and both continued the trip in ground vehicles while repairs (including a crankshaft replacement) were made to enable their return flights.

That group was delayed by the swath of storms moving through the upper Midwest that had affected so many other arrivals. The five remaining floatplanes from Ottawa spent Friday night at Oshkosh and arrived at Erie Airpark Saturday afternoon with much anticipation and excitement. Another Canadian, Mike Hughes of Edmonton, Alberta, flew the longest distance at 2,045 miles. It took him eight days. A glance at a map of North America gives a fuller appreciation of how far these pilots flew to attend the event.

Tribute to Veteran Pilot

The People's Choice Award at the 30th anniversary fly-in was given to a new Challenger LSS owned by 92-year-old David Fullgraf from Hermann, Missouri. It was the clear winner and the talk of the fly-in. David, a former B-24 Liberator pilot who served in the Pacific theater, had the help of his granddaughter, Christine, and master builder George Hurt of Vinita, Oklahoma. George started building Challengers 20 years ago and this is his 21st airplane. Motivated in part by the story of David's service to our country in that war, George put everything he knew into the airplane. It's a flying tribute to one of the few living pilots of that era.

George used the nontoxic and nonflammable Stewart Systems to cover and paint the airplane because of his increased sensitivity to the MEK solvent found in other products. He said the results can be excellent if builders follow directions carefully, use a better spray gun such as a DeVilbiss FinishLine 3 or 4 HVLP gun, and get the excellent six-DVD set from Stewart Systems that covers the entire process. Christine, who works in the graphic

Quad City Aircraft took a different approach than many other manufacturers. It stuck to one design for three decades but constantly made improvements, many of them significant.

arts, designed the trim scheme, which included the use of graphite cloth both as a glare shield and as a trim element. She had an accurate image of her grandfather's bomber reproduced on the tail. The leather seats were carefully styled to match the seats of a B-24 Liberator.

The most obvious modification to the airframe was a lowering of the side rails to facilitate entry into the cockpit for David. Sheet metal and bridging was added to reinforce the lower fuselage. New, larger doors cover the now wider opening. A folding rudder pedal and folding control stick reduced the knee-bending requirement. The fuselage closure below the engine was also refined. Cabin heat, sourced from engine coolant, was installed, and the list of modifications goes on and on. George has a popular website of building tips that catalogs the many customizations possible on the Challenger. See www.Challengers101.com. David made his first flight in the Challenger at Erie Airpark with George in the front seat, and he said the performance and visibility were impressive.

The Patriot Is Coming?

The Patriot is a tandem low wing built and flown by Quad City Aircraft in 1992 that was never produced as a kit. Only one aircraft was built. A big step up from the Challenger, it offered speed, a bubble canopy, and a roll rate of 180 degrees per second. Construction was square aluminum tube and angle, fastened with gussets and blind rivets and covered with fabric. The wing uses a built-up aluminum spar and D-cell. Challenger dealer Don Zank (from Zanklites of Bloomer, Wisconsin) liked it from the start, but for a variety of reasons the Patriot was never developed and marketed. He finally talked Dave Goulet into selling the airplane to him in 2002. Don upgraded the engine from a Hirth to a Rotax 912 and changed the tail to what he called an "RV style." The new tail lowered stall speed and increased top speed. It falls within the light-sport aircraft limits and can cruise at 120 mph and stall at 35 mph with two on board. Don's website indicates he hopes to offer kits for the Patriot, but a Quad City spokesman said there would be no kits.

Some of the other aircraft at Erie included a U.S. Light Aircraft Hornet, Greg Sutter's Titan Tornado, a rare Capella XS side-by-side two-place, a Zenith CH 750, a Van's RV-8A, a Van's RV-4 from Elwood, Wisconsin, and a few contemporary and classic general aviation airplanes. Frank Beagle's two-place Challenger was ferried over from Kankakee, Illinois, and it has been sold. Frank was a 30-year volunteer at AirVenture and long-time ultralight announcer who passed away this spring. He was the 2013 EAA Ultralight Hall of Fame inductee.

Erie Airpark features a pavilion at the far end of the runway and provisions for an evening bonfire, which is a standard feature at their fly-ins. The friendly social nature of the Challenger community continues into the evening, with hot dogs and marshmallows accompanied by homegrown music. It is at these moments that you see Jim Robinson doing what he does all day from sunrise to sunset. He visits and talks with people, making sure they are having a good time and know they are welcome guests. There is little doubt that he and others like him are what make sport aviation work. I ended my visit to Erie with a delightful early Sunday morning dawn flight over ground fog along the Rock River in the front seat of Jim's Challenger. With more than 2,000 hours on the airframe, Jim said he has more time in the backseat than the front. We flew with the doors off. It was fabulous. EAA

Dan Grunloh, EAA 173888, is a retired scientist who began flying ultralights and light planes in 1982. He won the 2002 and 2004 U.S. National Microlight Championships in a trike and flew with the U.S. World Team in two FAI World Microlight Championships. Please send your comments and suggestions to dgrunloh@illicom.net.

Challenger XL-65 Data Sheet

Engine: 65-hp Rotax 582
Wingspan: 29.5 feet
Gross weight: 1,060 pounds
Max zero fuel weight: 960 pounds
Empty weight wheels/skis: 475 pounds
Empty weight amphib floats: 585 pounds
Payload wheels/skis: 585 pounds
Payload amphib floats: 475 pounds
Stall speed: 32 mph
Max cruise: 90 mph
V_{ne}: 100 mph
Endurance: 5 to 7 hours
Range with wing tanks: 400 to 500 miles
Baggage compartment capacity: 100 pounds
Price: Quickbuild kits range from $10,000 to $16,000 depending on model.

Photography by Bruce Moore

The Maverick Light-Sport Aircraft

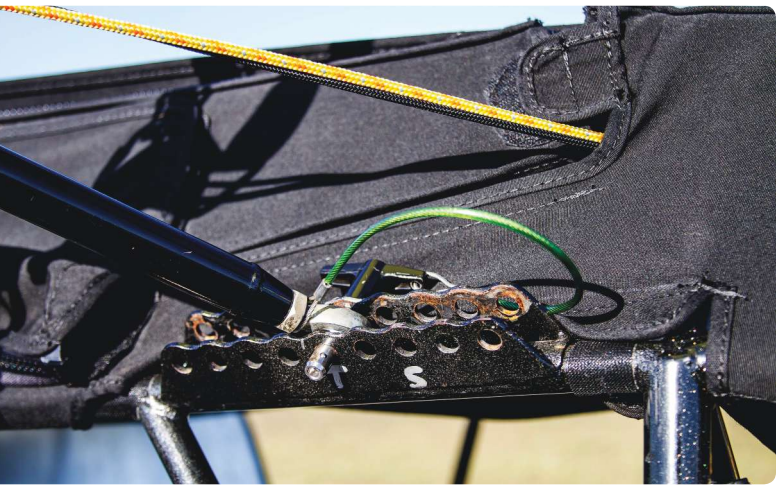
A roadable powered parachute

By Bruce Moore

Forget any preconceived notions you may have about powered parachutes. The Maverick is a fully roadable, two-person "dune buggy" that flies! Other powered parachutes I have seen were cumbersome and needed large clear spaces and smooth ground to launch and recover, and the cart was a minimal structure only sufficient to hold the engine and people. With the Maverick, you can travel any paved road at highway speeds, negotiate a backcountry trail like a Jeep, then in ten minutes rig your wing and jump over jungle and rivers to the next clearing. All the restrictions and inconveniences of a traditional powered parachute have been carefully analyzed and eliminated.

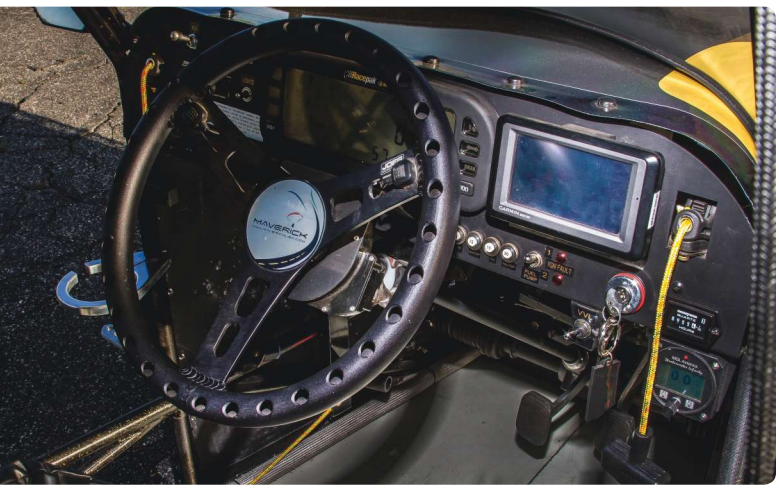
"Ingenious" is the word I keep wanting to use while describing the Maverick and the engineering and problem solving that went into its design. The mast and boom system for the wing is ingenious. The use of electric servos controlled by the steering wheel for operating the wing brakes is ingenious. The switchable drive shaft coupler that routes the engine power to the rear axle or the five-blade composite propeller is ingenious. Maverick even has a line controller on the right side of the cockpit that gathers the slack out of the parachute lines before takeoff to keep them clear of the propeller until the weight of the car straightens the lines.

The Maverick is built by the Beyond Roads division of the Indigenous People's Technology and Education Center (I-TEC) at the Dunnellon Airport in Florida. While there I got to tour the Maverick assembly facility and fly with the CEO and design engineer, Troy Townsend. Troy wears many hats



When rigging the support lines, multiple attach holes are provided to ensure that the cart's CG is correct in accordance with the weight of the pilot/passenger.

Mast and leading-edge spar system eliminates the need to "kite the wing." The single mast allows the wing to "weather vane" so no load is put on the mast, avoiding tipping forces and allowing crosswind takeoffs by keeping the wing overhead and not allowing it to drift downwind, creating sideways lift.



Handles on each side of the instrument panel that look like lawn mower pull-start handles are "trimmers" that adjust the trailing edge of the wingtips, just like the steering controls.

In addition to his duties at I-TEC overseeing the Maverick facility, Troy is also a designated pilot examiner for powered parachutes and an instrument-rated fixed-wing private pilot and sport pilot CFI.

As Troy explained, the Maverick was not designed to be a commercial product but was developed by the I-TEC missionary organization to meet the unique needs of its jungle operations. I-TEC needed a way to transport people and goods over South American jungles lacking in roads and airstrips. They had some success using traditional powered parachutes but had trouble transporting them on the ground, and the rough-hewn clearings were tearing up the nylon canopies. Troy and his team set out to eliminate the problem areas, and after six years of development, the finished product is the Maverick. Now this successfully certificated craft is also being offered for commercial sale with the proceeds being used to offset I-TEC's charitable missions.

As a fixed-wing pilot who had seen powered parachutes buzzing around but had never flown one, I was curious about control and performance. As Troy explained to me, a powered parachute has only one speed. That speed is determined by the size and shape of the parachute, which is really an inflatable wing, and the weight of the "cart." For the Maverick, which is heavier than most and is designed to fly faster than lighter craft, this speed is 40 mph. The Maverick takes off at 40 mph, climbs at 40, cruises at 40, glides at 40, and by now you can guess at what speed it lands.

To take off, you open the throttle, accelerating quickly until you reach 40 mph, where the Maverick lifts off and starts climbing. The amount of throttle determines how fast it climbs, and when you want to level off, you simply retard the throttle until the climb stops. To descend, you reduce the throttle some more. For turns, you can use the traditional foot pedals that operate the control lines to the "wing brakes," which are the trailing edges of each wingtip. Push the right pedal and the Maverick turns right; push the left pedal and it turns left.

What is unique about the Maverick is the electric interconnect between the steering wheel and the steering lines. When driving over the ground, the steering wheel works the front wheels, and when in flight mode, turning the wheel energizes servos that work the steering lines to the parachute, just like the foot pedals. Steer with the wheel on the ground, steer with the wheel in the air…what a great idea; no new control system and muscle-memory to learn, plus transitions during takeoff from ground steering to flight steering and then back again to ground steering on landing are seamless.

So now that we're in the air, how do we land the Maverick? For a powered landing, you establish your descent

Photography by Bruce Moore

by reducing power and adjusting the throttle to get the sink rate you want, and when you get close to the ground, you add just enough throttle to slow the descent and skim across the ground, feeling for the surface with the rear wheels. Once you touch the ground, close the throttle and you have landed. It looks easy when the winds are calm but becomes trickier when it is gusty or you have convective conditions. Naturally most powered parachute pilots only fly early in the morning or in the evening when the winds are light (and that's when I prefer to fly fixed wing, too).

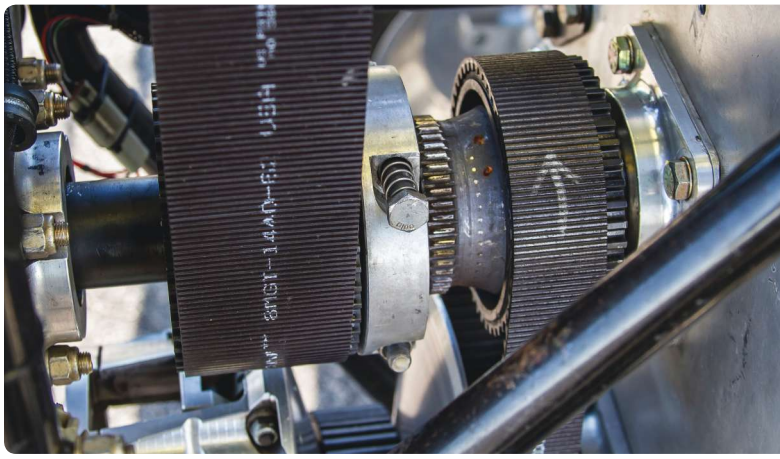
What happens if the engine quits? Well, you are flying a parachute after all; you can still turn and maneuver with a 6-to-1 glide ratio, and you can use both steering pedals simultaneously to brake and flare your descent. With practice, making soft power-off landings becomes routine. Troy has flight-tested the Maverick with no-flare landings—the power off the sink rate is 600 fpm. And he said the arrival was firm, but the 9-inch independent shock struts on all four wheels handled the touchdown just fine.

We drove the Maverick out to the Dunnellon Airport at sunrise, skirting around the perimeter road to a closed runway. The Maverick starts and drives like any car, with the same layout of steering wheel, accelerator, and brake. It has an automatic transmission with the gearshift located on the floor to the driver's right. With its 190-hp Subaru engine, it will really step out if you lay on the gas.

In the cool morning air, Troy had the Maverick converted into flying mode in less than fifteen minutes. I know I slowed the rigging time with my questions and requests for him to pause while I took pictures. The wing is an elliptical ram-air parachute and attaches to the cart by suspension lines and risers, attaching with mount arms that lock into one of nine holes located atop the cart frame. Which hole to use is determined by the pilot's weight. The pilot sits forward of the CG, while the rear seat and fuel tank are on the CG, and weight there does not change the CG.

Instead of laying the deflated wing out on the ground behind the cart at launch like a traditional powered parachute, the Maverick has a 30-foot carbon-fiber mast that holds the wing aloft on a lightweight fiberglass boom. This way, the wing never scrapes over the ground as it kites up for inflation and is protected from damage on takeoff and landing. The wing is also free to pivot with the wind, the mast stabilizing the wing and minimizing the horizontal component of lift. This allows crosswind takeoffs by keeping the wing overhead and not allowing it to drift downwind and tip the cart. Once the wing inflates on the takeoff run, the weight of the cart is totally supported by the traditional risers and suspension lines, but the mast and boom does give the rig some

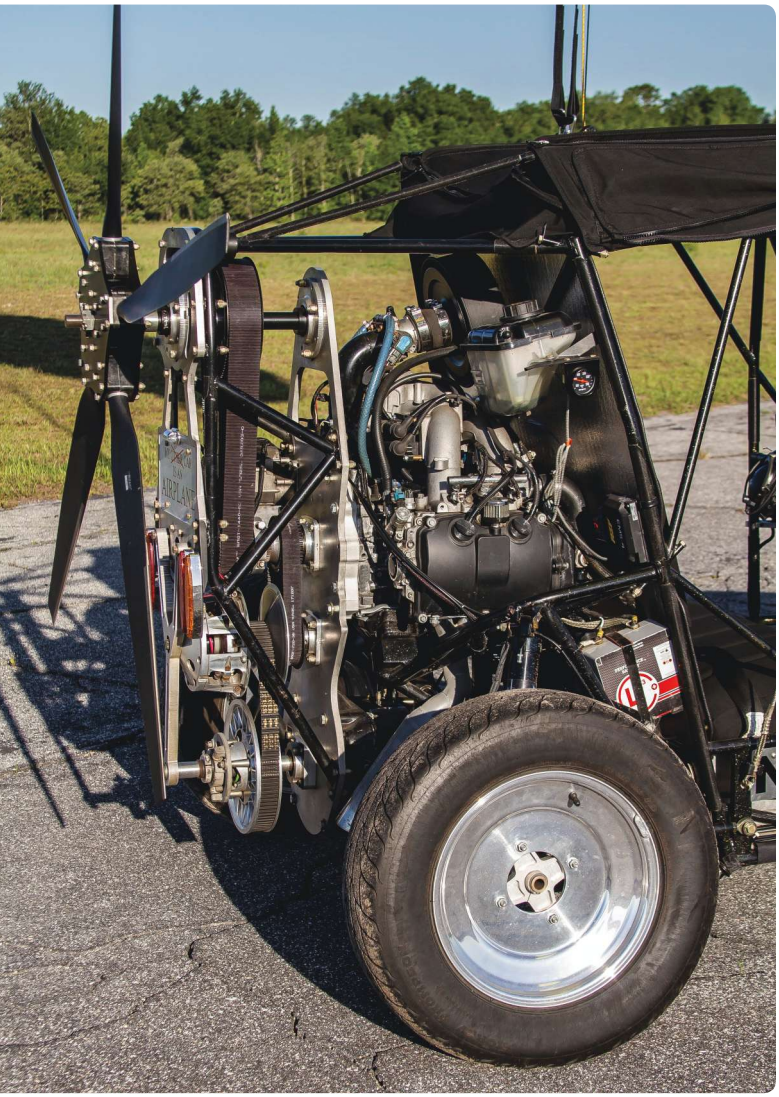
Wing and wing mount arms showing risers, suspension lines, and trim and steering lines.



Pressing in on the two locking bolts on the drive coupler allows the collar to be moved forward to engage the rear drive wheels, or to the rear to engage the propeller.

The 40-by-60-foot primary Maverick assembly hangar at the Dunnellon Airport.

The welding jigs were designed and built as a school project by students at LeTourneau University's mechanical engineering program in Longview, Texas.



The Maverick propeller is made by Warp Drive; it's a five-blade composite, ground adjustable.

added stability in turbulence by dampening oscillations. The demonstrator instrument panel consists of Racepak and Garmin LCDs for engine and flight information. On either side of the panel are T-handles attached to trimming lines. These look like the pull-starter on a lawn mower but instead are used to adjust the trailing edge of the wingtips, similar to the action of the steering lines.

With me in the double-wide backseat, Troy opened the throttle, and the five-bladed prop accelerated us down the runway. In a surprisingly short run, the nose of the Maverick tipped up, and the rumble of the wheels was gone as we rose into the cool pink and blue morning sky. Troy flew effortless figure eights, low passes, and touch-and-goes. Our Maverick did not have the optional side panels, so I could lean out into the wind with my camera to capture photos and video of the magic morning. Even sitting directly in front of the propeller and 2.5-liter engine, Troy and I were able to converse easily over the built-in intercom. It had been windy all week and this day was no exception. Powered parachutes can be a handful in high-wind conditions, but with the quick power response of the Subaru and the heavier weight of the Maverick, we continued flying long after other powered parachutes would have been stuffed into their trailers. After some runway touch-and-goes, Troy demonstrated some rough terrain landings in the uneven sod, and the long shock struts and large tires handled the gusty touchdowns with ease.

After flying we converted back to auto mode, with the wing, rigging lines, mast and boom all packing away into the roof storage on the Maverick. The engine coupler was slid into wheel drive, and we drove back to the Maverick final assembly hangar for a tour of the manufacturing facility.

The Beyond Roads facility at the Dunnellon Airport consists of two hangars; a 40-by-60-foot hangar is the Maverick assembly building, and the larger hangar contains offices, machine and welding shops, and a large main bay that is used for A&P and builder assist programs. In addition to building Mavericks, Beyond Roads specializes in builder assist programs for RVs and Zeniths. A new 10,000-square-foot hangar is under construction that will be tall enough so that final rigging of the Maverick wing suspension and steering lines can be done inside.

The Maverick was designed in-house; however, much of the component construction is outsourced for economic and quality control reasons. The Maverick is built with 4130 steel tubing, cut and formed by Cartesian Tube of Stratford, Ontario, and shipped to Dunnellon for tungsten-inert-gas welding. The nose cowl and mast are made from carbon fiber. The 460-square-foot rip-stop nylon, elliptical ram-air wing is custom made by APCO Aviation in Israel and

Photography by Bruce Moore

uses high-strength "Spectra" lines. The fuselage covering and side panels are made from waterproof, zero-porosity Sunbrella fabric. The custom-modified Subaru engines are remanufactured to Maverick specs with balanced cranks, rods, and pistons, and for improved reliability, the cylinders are rebored for greater piston clearance. These engines are liquid cooled with the radiator in the nose and a thermostatically controlled electric radiator fan, just like a traditional car. All engines are test-run and inspected before being shipped to Maverick. To dampen piston impulses to the propeller, Maverick designed a cushioned-drive flywheel with the six prop attach bolts mounted in rubber dampening bushings. During initial testing, the engines and drive trains were torn down and inspected every 30 hours, with no defects discovered. The higher-time Mavericks now have more than 400 engine hours logged without issues. When spec'ing out their Maverick, customers can choose the color of the frame and fuselage paint and have a choice of Sunbrella fabric and parachute colors.

The Beyond Roads facility is operated by a mixture of full-time employees and interns. The nonprofit I-TEC works closely with other groups and universities. For example, the welding jigs for the Maverick were designed and built as a school project by students in LeTourneau University's mechanical engineering program, and in the summer I-TEC hosts groups of engineering students at their Dunnellon facility.

In 2010 the FAA issued the Maverick a special light-sport aircraft (S-LSA) airworthiness certificate. The Maverick also can be built and certificated as an experimental light-sport aircraft (E-LSA). Due to the extra equipment necessary to operate on the highway, the FAA granted a gross weight exemption for the Maverick in 2011, allowing a light-sport aircraft (LSA) gross weight of 1,430 pounds. The Maverick also can be certificated as an experimental amateur-built (E-AB) aircraft, and then LSA weight limits do not apply. (However, if the builder certificates his Maverick with a gross weight of more than 1,430 pounds, it must then be flown by a pilot holding a private pilot certificate or higher.)

The Maverick can be purchased as a completed S-LSA, or customers can come to Dunnellon and work with the factory under an FAA-approved 51-percent builder assist program. (Maverick was the first to get FAA approval for builder assist for powered parachutes and helped the FAA write the program checklist.) When aircraft are certificated in the E-LSA category, the 51 percent rule does not apply.

With its light weight and 190 horses, the Maverick is a real kick to drive on the road. I drove it without side panels and enjoyed the "dune buggy" feel. Steering is positive and acceleration will push you back in your seat. With the engine and propeller drive in back precluding any rear

Troy Townsend

From left to right: Carl Smithson, Steve Beuer (shop manager), Robby Wallis (mechanical engineer), Jim Massengill, and Troy Townsend

Maverick has a line controller on the right side of the cockpit that gathers the slack out of the parachute wing lines before takeoff to keep them clear of the propeller until the weight of the car straightens the lines.

window, special care must be taken to compensate for the lack of visibility to the rear, and you quickly learn to use the streamlined side mirrors. There is no traditional speedometer; the Garmin GPS display is switched to ground mode, and your ground speed is read there. The Maverick has two throttles, the automotive accelerator pedal and the aircraft throttle mounted on the floor next to the gear shift. I found that for highway driving you could set the aircraft throttle like a flat-road version of cruise control. The Maverick is licensed in most states under "kit car" rules, exempting it from many Environmental Protection Agency and Department of Transportation regulations. Not only is it a lot of fun to drive, but two Maverick demonstrators drove all the way from Florida to Oshkosh for EAA AirVenture Oshkosh 2011, proving their reliability.

The Maverick people see their creation as the "ultimate roadable, all-terrain, aerial vehicle." It was originally built for the specific mission of backcountry transportation in undeveloped areas; a similar market is ranchers who need a way to survey a fence line or check on their herds. The Maverick can take off and land anywhere at a fraction of the cost (and flight training) of a helicopter. Beyond Roads does not advertise the Maverick, relying on its website, word of mouth, and displays at a few events such as AirVenture, the Sun 'n Fun International Fly-In & Expo in Lakeland, Florida, and the U.S. Sport Aviation Expo in Sebring, Florida. As this was written, customers own five completed Mavericks, and the factory maintains two demonstrators. As the Maverick is one of the most fun and capable powered parachute available, it is attracting a wide variety of customers, and these numbers are sure to grow.

Specifications

Base price: $94,000
Engine: 2.5-liter Subaru, 190 hp, fuel injected
Dual drive: Transaxle/propeller
Fuel capacity: 17 gallons (87 octane unleaded gasoline)
Airspeed: 40 mph
Rate of climb: 600 fpm at gross, 1,200 fpm solo
Range: 3 hours (+/-)
Takeoff distance: 300 feet
Landing distance: 300 feet
Service ceiling: 10,000 feet
Mast and boom wing deployment system: Ram-air wing, 460 square feet with 48-foot span
Propeller: Warp or Powerfin five-blade composite
LSA gross weight: 1,430 pounds (per exemption)
Useful load: 450 pounds
Avionics options:
P.S. Engineering PM1000 intercom
Garmin SL40 communication radio
Icom portable communication radio

Nicki Paden provides friendly curb service at Sonic drive-up restaurant when Troy Townsend takes the Maverick for a burger.

Garmin Aera 500 GPS (with air and ground modes)
Emergency Locator Transmitter
FAA certificated as S-LSA, E-LSA, or E-AB

Car specifications

Highway speed: 0-100 mph/0-60 mph in 4 seconds (+/-)
MPG: 25 to 30 highway
Range: 450 miles (+/-)
Continuously variable transmission (CVT)
Four disc brakes

Other options

Sunbrella side panels with vinyl side windows ("tuxedo") – custom colors
High-speed tires on aluminum rims
Fenders – custom colors available
Custom colors – powder-coated frame paint and painted hood
Rosen sun visors

For more information

Beyond Roads LLC (a division of I-TEC)
10575 SW 147th Circle, Building #2
Dunnellon, FL 34432
352-489-4456
www.MaverickLSA.com
www.ITECusa.org

Enjoy this video of the Maverick in flight. EAA

Bruce Moore is an ATP and CFI with 17,000 hours and specializes in aerobatic, tailwheel, and antique aircraft.

Photography by Bruce Moore


Standard Category | Vintage | Aerobatics | LSA | Homebuilts | Warbirds | Seaplanes | Powered Parachutes & Trikes | Gliders | Helicopters
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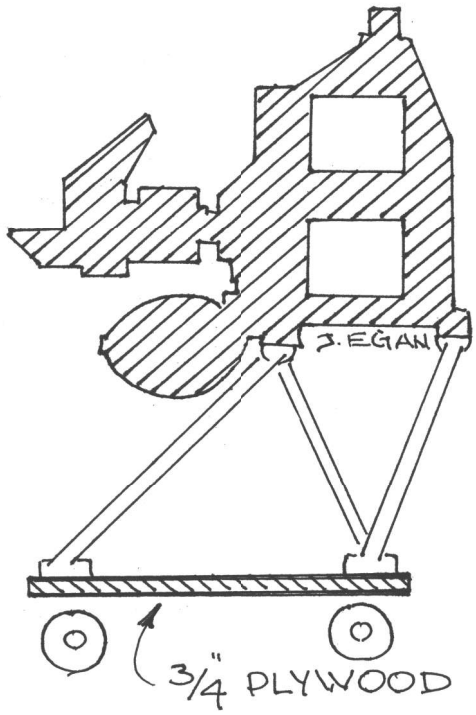
Revised Engine Stand

By Michiel Bouwens, EAA 553701

After reading last month's hint about a simple engine stand, member Michiel Bouwens, EAA 553701, offered this caution:

"After doing maintenance and repairs on GA aircraft for more than 25 years I have seen a number of damaged engine mount frames. All these frames were damaged by placing the engine on the shop floor in the same way the article on page 29 (November issue) suggests. The lack of fixed points at the firewall connections will cause the 'legs' of the truss to slip outward and may even cause the engine to fall over without warning. Putting it on wheels will make it worse. Engine mounts are not intended for this and will be overstressed and deform or crack.

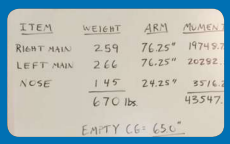
However, you can store your engine like this but only by [mounting the engine] a piece of plywood of at least



¾-inch thickness connecting all the firewall ends together. Use the proper bolt diameter. Feel free to put it on castoring wheels far enough apart to make it stable." EAA

Hints for Homebuilders Videos

Here are more of the nearly 400 Hints for Homebuilders videos that are available online here.



Weight and Balance
Part 1 of 7-part series on weight and balance. EAA Flight Advisor and Technical Counselor Joe Norris discusses the datum and locations that require an arm measurement used to establish a weight and balance document.

Drill Alignment Jig
Fred Stadler demonstrates use of a simple alignment jig designed by EAA's master craftsman Bauken Noack. This jig is especially useful to ensure precise installation of a wing's drag/anti-drag wires.

Wood Wing Rib Jig Construction
Dave Clark shares some tips on making a wood wing rib jig. At the time, Dave and other members of Chapter 1311 were helping Paul Poberezny construct a replica of a *Mechanix Illustrated* Baby Ace, which is now being completed by EAA Chapter 640 in Wausau, Wisconsin.

Solenoids: Master Relay and Starter Relay
Dick Koehler discusses the operation and installation of the relays. Dick is a Technical Counselor for Chapter 186, A&P aircraft mechanic with Inspection Authorization (IA), and SportAir Workshop instructor.

Pre-order Your AirVenture 2014 Collector Mug & Save.

Handcrafted by master potters from Neenah, Wisconsin, the AirVenture 2014 Collector Series Mug is the perfect addition to any Oshkosh collection. Each 14 oz. mug features a midnight black glaze topped with a posh metallic silver and ripples on the inside that were left by the potter's fingers. To order, visit **ShopEAA.com** or call toll-free, 800-564-6322.

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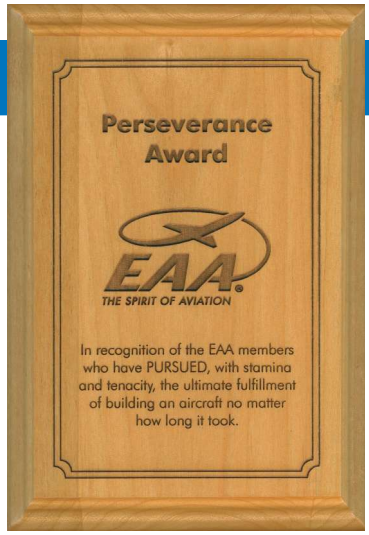


More First Appearances at Oshkosh

2013 Perseverance Award Winners

This month we're bringing you the last of the photos of aircraft that received Perseverance Awards for making their first appearance at EAA AirVenture after being completed. This award recognizes the work that every builder invests to complete a homebuilt project. The award was started by Doc and Buddy Brokaw (now deceased), who built and flew the Brokaw Bullet and wanted to acknowledge the perseverance needed to finish a project like building an airplane. Sixty-three aircraft received that award this year; unfortunately, we were not able to locate and photograph all of them, but we congratulate all the builders on their accomplishment. … Mary Jones

CH 750/N750MJ

Rick George, EAA 139662, of Holman, Wisconsin, completed this Zenith CH 750 in April 2013. It's powered by a Rotax 912S. Rick built the aircraft over 1.8 years. He has 70 hours in it.

Photography by Jim Raeder

CH 750/N750 PW

Larry Oswell, EAA 530393, of St. Cloud, MN, took 2.5 years to build this CH 750 that's powered by a 100-hp Continental engine. He completed it in October 2012 and has logged 85 hours in it.

RV-12 N328KL

Kyle and Don Lewis, EAA 1007644 and EAA 663812, of Jackson, Ohio, took two years to build this RV-12. It's powered by Rotax 912ULS. They completed it in July 2012 and they've flown it for 55 hours.

RV-12, N112KK

Kim Kusch, EAA 178056, of Lennox, South Dakota, completed this RV-12 in June 2013 after three years of construction. He's logged 18 hours in it.

RV-7A/N567PK

Paul Kovalak, EAA 741522, Comstock Park, Michigan, spent six years building this RV-7A. He's logged 45 hours in it. It's powered by an ECI IO-360 engine.

Pipistrel Sinus 912/N54PK

Paul Kuntz, EAA 79169, Sequim, Washington, completed this Pipistrel Sinus in November 2012, after five years of construction time. It's powered by an 80-hp Rotax 912, and Paul has logged 70 hours in it.

Harmon Rocket II

Ryan Berndure, EAA 341735, of Brighton, Colorado, built this 250-hp IO540-EB5 powered Harmon Rocket over a four-year period. He completed it in November 2012 and has logged 50 hours in it. EAA

EAA staffers are currently installing the control system on the Zenith CH 750 that employees are building. We will bring you further updates on this project in an upcoming issue of Experimenter.

Flight Control Forces
Breakout and Friction

By Ed Kolano

An airplane's flight control system is the physical connection between the pilot and the plane. It provides the mechanism to maneuver the plane while constantly communicating with the pilot through forces and displacements. This tactile feedback has a major influence on the pilot's opinion of the airplane. Heavy control forces make the plane feel stiff while light forces can give the impression of oversensitivity. A similar argument can be made for control displacements, but pilots rely more on control forces (unless displacements are large) when judging an airplane's responsiveness.

Most of us fly planes with reversible control systems. Move the elevator during your walkaround, and the stick moves—reversible. That's why you have to exert a force on the stick to deflect the elevator away from its trimmed position. Dynamic pressure exerts a force on the deflected elevator that creates a hinge moment, which becomes the force you feel on the stick. Some flight control systems employ springs, which create a stick force when the stick is displaced. Some have bob weights, which create a stick force when the plane is flown at other than 1*g*. Some have dampeners that create a force proportional to how fast the stick is moved. Servo and anti-servo tabs also augment the stick force. Flight control system gizmos abound.

And there's friction. There's always friction.

Friction

Friction is the resistance encountered when two objects in contact move or attempt to move relative to each other. To overcome this resistance, the force applied must be greater than the opposing friction force, and friction always opposes the applied force. This relative motion can be sliding, such as dragging a chair across the floor. It can be rolling, such as, well, rolling a bowling ball down the lane. Flight control system friction sources include bearings, cables in pulley channels, pushrods through guides, cable–bell crank connections, and control surface hinges.

Zero friction is impossible, but the less friction, the better. Before a flight control surface can be deflected, the pilot must apply enough force to the cockpit control to overcome any friction. As the control is moving, friction must still be overpowered by the pilot in addition to the force of the air load on the surface and any other force-producing components such as springs in the system. Friction always adds to the required cockpit control force, and it works in both directions.

Friction causes a hysteresis effect. Let's say there's a constant 2 pounds of friction in the elevator system. The pilot begins pulling the stick back; but nothing will happen until his pull force exceeds 2 pounds, then the elevator begins to move. So now let's say the pilot has 3 pounds of stick-pull applied to maintain the

deflected elevator. As he relaxes his pull, nothing will happen until his pull decreases below one pound. This is because the friction is still "applying" 2 pounds of resistance (in the opposite direction now) against the restoring force caused by the air load on the deflected elevator. The friction can prevent the stick and elevator from returning to their pre-displaced positions, leaving the airplane out of trim. Beginning to see how friction complicates precision and pilot workload?

We could talk for pages about the ramifications of friction while maneuvering, but for now let's focus on friction's effect during the initial control displacement.

Breakout

Control system breakout is the cockpit control force needed to deflect the control surface from its trimmed position. It's the initial force necessary to just get the surface moving. Because friction is present whenever the control system is exercised, any measurement of breakout always includes friction. Hence the phrase "breakout plus friction."

While friction alone can be measured while flying off-trim, such as during static stability testing, breakout plus friction can't be separated. It's measured simply by slowly applying a force—let's say a pull force to the stick—and noting how much force is applied when the airplane first responds; that is, pitches nose-up in this case. Do pilots care about the numerical value of breakout plus friction? Probably not, but the effect on airplane handling qualities can be huge.

Analogy time. Go to the fridge, get a gallon jug of milk, and place it on a table. Using one hand, move it exactly one-quarter inch. Too much breakout plus friction makes small, precise inputs difficult. Try the same thing with a marble. Too little breakout plus friction can lead to overcontrolling.

Breakout can be added to a control system in a variety of ways. Preloaded springs is one example. No control motion will occur until the force of the spring preload is overcome. Mechanical cam arrangements can provide breakout using springs without the penalty of increasing the force requirement as stick displacement increases.

A little breakout is usually desirable. Without it, the pilot might have trouble finding the trimmed stick position, especially with friction present. Having a tactile reference for the trimmed stick position is handy (okay, bad pun). Imagine if you had to visually check stick position after every input.

Too much breakout makes small control inputs difficult, particularly if the control force gradient beyond the breakout is shallow. For example, let's say this airplane has a breakout (breakout plus friction, actually) of 5 pounds, so it takes 5 pounds of stick pull to move the elevator. If that same airplane requires only 6 pounds of stick pull to maintain level flight in a 30-degree bank, altitude control could be a challenge as the pilot attempts to target that 6-pound pull when nothing happens for the first 5 pounds of exertion. Of course, we don't think in terms of pounds of this and that, but this situation will likely result in the pilot pulling and pulling, then getting too much airplane response. That's when we creative adapters start reverting to workarounds, such as trimming for small temporary changes instead.

The right amount of breakout plus friction is enough to preclude making inadvertent control inputs but not so much as to make small control inputs difficult in any axis.

The relative magnitudes of stick forces in the pitch and roll axes is called control stick harmony. For the past 70 years or so, it's been generally accepted that the best ratio between roll and pitch is 1:2. Breakout plus friction in pitch that's about twice of what it is in roll feels right to most pilots. Ever watch a plane come into the flare and exhibit a wing rock for no apparent reason? Could be the too-low roll breakout plus friction resulted in the pilot making an inadvertent lateral stick input as he pulled back to flare. Then the rocking occurred because he then had to find wings-level while overcontrolling the tiny roll forces while applying increasing pitch control force to complete the flare.

Okay, I've wandered a bit from pure control system breakout and friction, but this mechanical characteristic is just one ingredient of the control system stew. And that stew is just one course in the flying banquet. So the point to be made is even something as seemingly minor as breakout plus friction can have a profound effect on the airplane's apparent stability and the pilot's opinion of its handling qualities. EAA

Ed Kolano, EAA 336809, is a former Marine who's been flying since 1975 and testing airplanes since 1985. He considers himself extremely fortunate to have performed flight tests in a variety of airplanes ranging from ultralights to 787s.

Curt Shoaf takes a first-time trike passenger aloft in his Apollo Monsoon trike. Trike flying is another unique flight experience.

Let's Go Flying
How to get a ride

By Dan Grunloh

"Let's go flying" are three words that are music to the ears of anyone who loves aviation. The EAA has long known the importance of airplane rides, including a first flight for young kids, thus the establishment of EAA's Young Eagles Program (www.YoungEagles.org). Who doesn't remember their first flight in an airplane? It can change a life. Rides are important not only because they can inspire new pilots, but also they provide an experience with aviation that helps non-pilots have a better appreciation for the merits of personal flight. A chapter's Young Eagles event providing rides to 75 boys and girls also provides 75 to 150 parents with some direct interface with pilots of small airplanes.

Airplane rides are equally important for established pilots. We can't possibly own every aircraft out there (unless we are incredibly rich), so the only way to expand our flying experience is to go for a ride in someone else's airplane. Life is too short and there are too many airplanes not to share a ride. A flight in an open-cockpit, side-by-side Quicksilver type is something no one should miss. As a trike pilot, I understand why passengers coming back from their first flight in a trike always look happy. Powered parachute instruction has re-educated me about what it feels like to fly at 35 mph as we once did in the early ultralight days, and gyroplanes are beckoning me.

Photography by Dan Grunloh

How and Where to Find a Ride

The best places to search for a ride are the Sport Pilot Instructor Database established by the EAA and the FIRM (Flight Instruction, Rental, and Maintenance) List at www.ByDanJohnson.com. Qualified instructors are the only individuals who can charge for their time in an airplane, and they may charge for the aircraft only if it is a special light-sport aircraft (S-LSA) or an experimental aircraft flown under the LODA rules. An instructor is your best option, because as a trained professional, he knows how to safely provide a good flight experience. A hangar tenant you don't know two doors down who wants to impress his friends (or you) with his piloting skills—maybe not so much. You can take a ride in any two-place airplane flown by a properly rated pilot provided you pay no more than your share of the fuel, oil, and any landing fees.

Finding a pilot to fly with can be as easy as hooking up with your nearest EAA chapter. Search the database for one near you. I suggest you check first for an ultralight chapter. There are about 30 of them in the United States, but any chapter president near you may know the owner of a Quicksilver, Kolb, Challenger, or other two-place light plane.

A local chapter fly-in is another great place to connect with pilots of light aircraft. It's considered polite to offer to pay for some of the fuel, even though it is often refused. Most pilots love to take people for a ride and enjoy introducing others to flight. I always try to have some cash in my pocket (or offer to buy lunch) when I go for an unpaid ride. Even though light aircraft are less costly to operate than conventional general aviation, flying is never cheap and someone has to pay for it.

EAA recently launched a new program called Eagle Flights that is intended to help adults get an airplane ride for free from local EAA chapter members. The aircraft used will be conventional general aviation airplanes along with homebuilt and light sport aircraft. Learn more at www.EAA.org/EagleFlights.

Another way to find two-place light planes in your area is to use the FAA database of registered aircraft

Jamie Gull of Girard, Kansas, flew this fully restored 1984 Quicksilver MX II at EAA AirVenture Oshkosh 2013. These open-cockpit aircraft provide a unique flight experience.

at Registry.FAA.gov/aircraftinquiry/. With the make and model search tool, look for "Quicksilver Sport" or "Challenger II" or any other favorite light plane type, and a list will be produced that is sorted by state. If there's an owner in your local area, contact your local EAA Chapter (you can locate one by visiting www.eaa.org/chapters) to see if someone can help you connect with that owner and verify the aircraft is airworthy and that the pilot is trained to offer a ride.

Light Plane Rides at AirVenture

It is possible to get a demo flight during AirVenture in the ultralight area. The commercial vendors give demo flights to potential customers and guests, but there is sometimes a long waiting list. Volunteers are occasionally rewarded with a flight when there is an open seat. Getting a demo flight at AirVenture is a fabulous experience that may require a bit of luck. Your scheduled flight can be aborted by high winds, delays caused by congestion on the runway, or a military aircraft flyby on the main runway that halts our flying. Hopefully, persistence will be rewarded (as it has for me) when an acquaintance taps you on the shoulder and says, "Let's go flying." If it's an open cockpit, the pilot will be concerned about any loose items in your pockets or a cell phone that might go through the prop. Cameras should be on a strap, not simply hand held. Be ready to leave any backpacks or other gear with a friend or flight line volunteer.

Watch This

"Watch this" are two words you never want to hear while flying as a passenger. They are usually followed by an abrupt or impulsive maneuver you might not have consented to had you been asked. Such behavior is bad form and a bad reflection on the professionalism of the pilot. It happened to me once quite unexpectedly and so quickly there was no time to speak. We didn't exceed the allowable flight envelope or shed any parts, and it was over in a few seconds; but I was not impressed. The pilot should always brief the passenger on what is going to happen and give him a choice. Make them feel like they have some control. Every airplane ride is a chance to educate. In good piloting we tell our passengers what we are going to do, and then we do it. Don't assume everyone willing to climb into your second seat wants to see how quickly it accelerates to VNE (velocity-never-exceed) or how well it recovers from stalls. Ask before doing.

"Let's go flying" are three words that are music to the ears of anyone who loves aviation.

What If You Get Sick?

Every pilot alive will agree we want our passengers to speak up immediately if they start feeling motion sickness. Don't ignore it and hope it will go away. There is no shame in developing airsickness, as anyone can experience it under the right conditions. A new kind of plane, dehydration, indigestion, a bad piece of fish, or an all-night party can trigger motion sickness even in the most hardy among us. (It's not important how I know about each of those.) Simply ask the pilot to return to the airport immediately because you are not feeling well. Pilots, keep an eye on your passengers and watch for signs of overheating. If your aircraft has a tandem-seat configuration, you have to keep talking and ask periodically how your passenger is feeling. For help with this problem, read the article "Lying Flat on the Grass" in the July 2013 *Experimenter*.

Have Good Equipment

If you are going to give free rides, or charge for time in an S-LSA, you naturally want to have good equipment that will enhance the experience for newcomers. Poor headsets with inadequate noise suppression or an uncomfortable helmet can spoil the flight for your passenger. A good working intercom and radio system that allows the passenger to talk with you and hear the radio calls adds to the fun. Any working instructor should have this equipment. In taking many rides over the years, I have experienced awful helmets with wind noise so extreme it was all I remember from the flight. I have also had someone behind me yelling in my ear while I tried to figure out how to fly the plane. If you want to give rides, get the good gear.

Please send your comments and suggestions about this column to dgrunloh@illicom.net. EAA

Dan Grunloh, EAA 173888, is a retired scientist who began flying ultralights and light planes in 1982. He won the 2002 and 2004 U.S. National Microlight Championships in a trike and flew with the U.S. World Team in two FAI World Microlight Championships.

Dished Out

By Keith Phillips, EAA 5973 Lifetime

Figure 1

Figure 2

If you have spent any time at the local airport or associated with a group of pilots, you probably have heard stories like "Ole Hotshot buzzed the field, pulled up into a roll, and on the back side he dished out and hit the trees!"

Just what does the term *dished out* mean? Basically Ole Hotshot didn't understand the basics of the gravitational pull of the earth and the 2*g* reversal from upright flight to inverted flight. Let's review this basic law of physics and how it affects flight, but before we get airborne we need to understand the static *g* forces. This can best be explained to the fledgling aviator by using an aircraft *g* meter.

In Figure 1 you see a *g* meter in the upright position; notice the needles are pointing at plus 1*g*. The *g* meter has three needles; one moves as the *g* load is applied, and the other two record the maximum positive and negative *g*'s. The needles can be reset to match the movable needle with the push button.

Now look at Figure 2 where the *g* meter is inverted and note that the movable needle is now pointing at minus 1*g*. If you do the math, the total change is 2*g*.

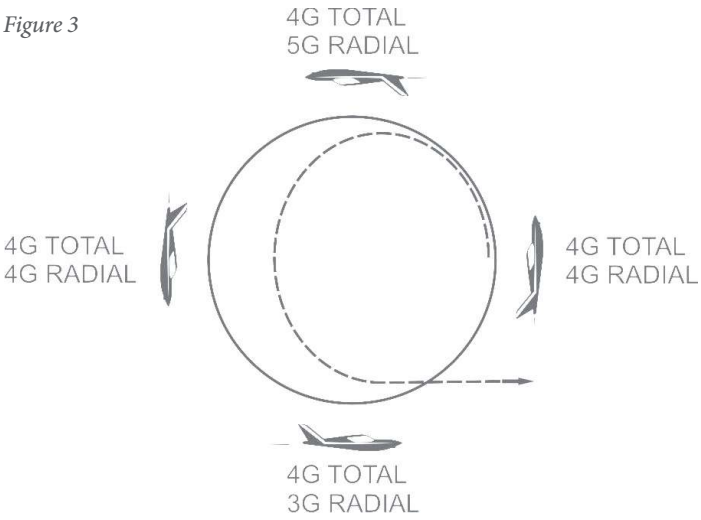
Note: The *g* meter is a self-contained instrument and a worthwhile addition to your instrument panel if you don't have one. Most general aviation aircraft and many homebuilts do not. A *g* meter not only records the maximum *g*'s you have pulled during flight, but also it will show 2*g* when you are turning level in a 60-degree bank turn…just like you were taught during flight training.

So what has this got to do with Ole Hotshot dishing out and subsequently crashing? Let's now transition to the dynamics of flight and see what happened. Rather than analyzing the varying *g* loads in Ole Hotshot's three-dimensional roll, let's review the *g* loads on a two-dimensional loop, and to help simplify things, we will take some academic freedom and assume our souped-up Westland Wapiti or SX-300 will perform this loop at 4*g* and a constant 200 knots true airspeed.

But first let's introduce the term *radial g* or *centripetal force*. This is the force or load factor that causes an aircraft to turn. Basically *all* aircraft turn as a function of radial *g* and TAS. With this in mind, let's review the academic loop. Looking at the loop in Figure 3, notice at the beginning of the loop that we pull back on the stick/yoke to establish a constant 4*g* on the *g* meter. The aircraft now has a ***4g*** total load factor but is accelerating in a 3*g* radial vertical turn. (Remember, we have to overcome the 1*g* gravitational pull per Figure 1.) As the aircraft reaches the vertical position, the *g* factors are equal at 4*g*. However, as

the aircraft continues the loop to the inverted position, we are still reading 4*g* on the *g* meter but our **radial *g*** (centripetal force) is now **5*g***. Thus we have a 2*g* (radial) reversal from the bottom of the loop to the top of the loop while maintaining a 4*g* load factor.

Figure 3



So in the real world when Ole Hotshot pulled up and started his roll, it was like being on the bottom of the loop. He has to overcome the constant **1*g*** gravitational pull, but when he becomes inverted, Mother Earth is now helping. Additionally he probably lost airspeed as he increased the *g* load; and this subsequently increased the aircraft pitch rate, so his turning radius was decreased. Now the aircraft was inverted, so the summation of *g* reversal, decreasing airspeed, and increasing pitch rate caused the aircraft nose to rapidly point to Mother Earth and reach a point from which aerodynamic recovery was impossible.

Aerobatic pilots and fighter pilots are well versed in this law of physics, but all too many GA pilots are not, and when they venture into the occasional aerobatic maneuver, even something as basic as Ole Hotshot's roll, they are in danger of inflicting damage to themselves as well as the aircraft. EAA

Keith Phillips is a member of the EAA Homebuilt Aircraft Council. He regularly flies his SX-300 from the Spruce Creek Air Park.

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