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Celebrating
Breezy
at 50! An Oshkosh icon



EAA and Personal Aviation

BY JACK PELTON

FROM THE START EAA has worked hard to gain the freedom to fly the kind of aircraft we want for our own personal reasons. You can call our flying recreational, private, sport, or whatever you want, but the bottom line is our brand of flying is strictly personal.

EAA has succeeded greatly in helping to create rules that allow individuals to build and fly their own aircraft, whatever that aircraft may be. Builders can use their airplanes with essentially no restrictions except that the flying must be for personal—not commercial or for hire—reasons.

We have also been successful helping to keep warbirds flying under usually reasonable standards. Many of these airplanes were never certified under any category, but by working with the FAA we have helped preserve an important part of our flying history.

But EAA and other pilot groups have had less success in establishing logical and workable regulations of standard category private airplanes flown strictly for personal reasons—until now. Finally, with some pressure from Congress, we are starting to see the FAA consider rule changes that make sense for private aviation.

A first step was creation of the light-sport aircraft category several years ago. LSA can be “certified” under a consensus standard instead of the conventional FARs that regulate standard category airplanes. Pilots flying LSA can also use a driver’s license as evidence of fitness to fly instead of an FAA issued third-class medical certificate.

Both the new aircraft certification standard of LSA and the driver’s license medical have worked. There is no measurable difference in the safety of LSA aircraft in terms of structure and performance, and absolutely no evidence that pilots flying with a driver’s license instead of a medical are any less safe.

This success should surprise absolutely nobody. In fact, LSA and the driver’s license medical procedure bring personal aviation closer in line with the way other activities are regulated.

For example, if you drive a big Class A motor home on your own private trips there is very little regulation. If you drive a bus of similar size and charge people for the ride, the bus, the driver, and the operator all must meet significant standards designed to ensure minimum safety.

On the water, drivers of small launches used to carry boat owners out to their boats must have Coast Guard licenses, the launches must be inspected regularly, and the launch drivers must pass random drug tests. The launch driver is ferrying a skipper to a boat that is often many times the size of the launch, but that large-boat owner is not regulated because he uses the boat only for his own personal and private reasons.

It’s the same in our homes. There are some common sense rules requiring smoke detectors in most locales, and maybe a few other basics like that, but in general our private homes are not regulated. Convert that same building into a bed and breakfast, rent rooms, and serve meals, and you leap into an entirely new, and often intense, regulatory environment because your home is now a commercial operation. And that’s as it should be.

So what we at EAA are asking is for personal flying to be treated the same as other private activities. We are not offering our airplanes for public transportation, the risks of private flying just like private boating or a private residence are our own, and we can deal with them.

The congressionally mandated restructuring of the FAR Part 23 rules that govern certification of airplanes weighing less than 12,500 pounds are headed in the right direction. The new rules will set goals for performance and safety and allow manufacturers to meet those goals in a variety of ways. New technology will be encouraged, not burdened with leaden rules. And there is at least a goal of giving standard airplane owners the ability to do much of their own maintenance and use airworthy but not necessarily certified components.

And now the FAA is formulating new medical standards that we expect will allow many to fly for personal reasons with a driver’s license. At this writing the new proposed rules have not been issued, and details are always important, but Congress is pressuring the FAA to act, and so are EAA, AOPA, and other aviation groups.

It’s way too soon to declare victory, but our combined efforts are starting to pay off. We fly for personal reasons, and we should be treated the same as other private activities always have been. *EAA*

On the cover: Carl Unger prepares to give another passenger for a ride. (Photography courtesy of EAA Archives)

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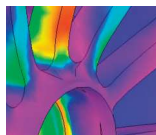
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Volunteer Jim Martin (blue vest) helps members practice covering techniques.

Building Upgrades + Volunteers

= Great workshops at Oshkosh 2014

BY CHARLIE BECKER

NO ONE IS BORN knowing how to build an aircraft. You have to start your learning somewhere. One of the best places to start is our annual EAA convention—EAA AirVenture Oshkosh. Each day, hands-on workshops are held to show how to work with wood, composites, sheet metal, and how to do gas and TIG welding and fabric covering. These workshops are open to anyone wanting to learn, and they are free to anyone on the grounds.

Workshops have been a part of EAA's annual convention since its early days. Some of the first structures built in the convention's move from Rockford to Oshkosh were the workshop buildings. Unfortunately, things wear out, and that is the case for our workshop buildings. If buildings have an expiration date, we are about 10 years past it.

The good news is your organization is making a major financial commitment to upgrade the workshop buildings at AirVenture Oshkosh. We are going to remove the old, worn-out workshop buildings and replace them with new buildings similar in design to our existing forums buildings. This changeover will provide us with one additional venue in which to teach people how to use their hands and mind to build aircraft. We are going to dedicate that building to

providing “live” [Hints for Homebuilders](#), patterned after our successful video series. If you want to meet some of the “stars” of our video series, come on by and attend one of the live sessions.

The new buildings will be an impressive sight and will make the workshop area look great. But at the end of the day, they are just buildings. It is the volunteers who breathe life into the workshop area and create the real value for those wanting to build an aircraft. It is the volunteers who show up early to cut material, set up workbenches, and organize the tools. It is the volunteers who dedicate their time at Oshkosh to teach the classes on composites, wood, sheet metal, fabric covering, gas and TIG welding, and more. It is the volunteers who assist the students as they drive their first rivet, run their first weld bead, or glue their first fabric seam. And it is the volunteers who clean up when it is done.

We have more than 100 volunteers that devote more than 3,500 hours to make the workshops at Oshkosh a destination for thousands of people each year. Many of those people who attend the workshops go home inspired and confident that they can build an aircraft. And that is exactly why the volunteers do it! **EAA**




Return to aviation's **Golden Age** with the EAA "Classic" Sweepstakes



Second Prize: 2013 Can Am Maverick X rs

Built to satisfy the appetite of any high-performance side-by-side enthusiast, the Can Am Maverick 1000R X rs will take trail riding, dune whacking and rock crawling to the next level.

ROTAX  Special thanks to **BRP Rotax** for the generous donation of the Can Am Maverick X rs.

An immediate favorite of outdoorsmen and the Hollywood elite in the '30s, the Fairchild opened up a new realm of recreational possibilities. The 2014 EAA® "Classic" Sweepstakes Fairchild 24H with seating for four, an icon of a bygone era, was meticulously restored in the late 1990s and is powered by a 175 hp Ranger 6-440-C2 engine. And, when you make a donation with your entries, you help EAA build the next generation of aviators.

Visit EAA.org/sweepstakes to enter the 2014 EAA® "Classic" Sweepstakes, complete Official Rules, and prize descriptions.



FAA's Move Toward Rulemaking on Medical Certification 'A Good Initial Step'

THE FAA ANNOUNCED on April 2 that it would begin a rulemaking project that would consider allowing private pilots to substitute the medical requirements of a third-class FAA medical certificate with a valid driver's license.

"EAA's decades-long efforts on this issue, on its own and in association with organizations such as AOPA, are beginning to pay off with steps such as today's FAA announcement and the proposed General Aviation Pilot Protection Act (GAPPA) in both houses of Congress that is gaining significant momentum," said Jack Pelton, EAA chairman of the board. "We are eager to see the details of what they are proposing and evaluate their significance. EAA will support this rulemaking initiative as well as legislative solutions to expand the freedom of flight for our members and all aviators."

Over the past quarter century, EAA has made numerous petitions and requests to FAA to extend medical self-certification to an even greater population of aviators. Most recently, EAA and AOPA joined forces in a March 2012 exemption request to FAA that would expand use of self-certification for recre-

ational flying, based on the outstanding medical incapacitation safety record established over the past decade by pilots flying light-sport aircraft. This petition is still awaiting formal FAA action, despite more than 16,000 comments submitted in overwhelming support of the measure. The FAA's announcement may indicate a willingness to extend the privilege beyond that requested in the EAA/AOPA exemption request, although the agency noted that it is still considering that request.

Over the past four months, Congress has also expressed interest in expanding medical self-certification through the General Aviation Pilot Protection Act. First introduced in the House last December by Rep. Todd Rokita (R-IN) and Rep. Sam Graves (R-MO), the bipartisan measure now has more than 86 co-sponsors. A companion bill was introduced in the Senate last month by Sens. John Boozman (R-AR), Pat Roberts (R-KS), and Jerry Moran (R-KS) and now has eight co-sponsors. More than 35,000 letters supporting the measure have been sent to members of Congress by EAA members through EAA's Rally Congress system.

Enter EAA's Ultralight Flying Video Showcase

ULTRALIGHT PILOTS are encouraged to participate in EAA's Ultralight Flying Video Showcase. Do you have a video that captures the freedom and fun of flying ultralights? If so, EAA wants you to share it with the world! Upload your video to YouTube and [send us the link](#) by midnight, July 1, 2014, to

be entered in EAA's Ultralight Flying Video Showcase.

Once you've uploaded your video to YouTube and shared the link with EAA, your video will be added to a separate playlist on [EAA's YouTube channel](#), where others will have the opportunity to view and "like" your video. The play-

list, which [can be viewed here](#), currently has several uploaded videos available that may give participants some ideas of what they want to submit.

When all entries are submitted, a panel of judges from EAA will choose the top videos to be showcased in the Fun Fly Zone at EAA AirVenture Oshkosh 2014. Videos will be judged based on creativity, overall quality, and the number of "likes" they receive on YouTube.

EAA welcomes the submission of videos that record any form of ultralight flying, including light planes, powered parachutes, weight-shift trikes, homebuilt rotorcraft, hot-air balloons, powered paragliders, and experimental light-sport aircraft. For the showcase, EAA will also accept videos that have already uploaded to YouTube.

If your video is chosen as one of the finalists, EAA will contact you directly to arrange for the submission of a high-quality version of the video (480 pixels or higher). We will also provide the basic legalese at that point to ensure EAA has the rights to publish the video.



Sorting Out Latest on Sleep Apnea Rules



THE FAA HAS REFINED its controversial sleep apnea proposal for pilots and airman medical certification after considerable backlash from the aviation community and Congress. While sleep apnea remains an area of emphasis for the FAA aeromedical leadership, the efforts by EAA and EAA's Aeromedical Advisory Council helped to create a path toward a sensible solution.

The highly contentious plan to require a sleep apnea test and evaluation prior to

approval of a medical certificate, based solely on a body mass index (BMI) of 40 or above, is no longer part of the FAA policy. The agency has developed a new policy that would allow a tiered approach to addressing potential sleep apnea problems while enabling a pilot to maintain a current certificate during any assessment taking place.

"Pilots should not be automatically forced into an expensive sleep apnea

evaluation and out of the cockpit based on a single risk factor," said Sean Elliott, EAA's vice president of Advocacy and Safety. "The pilot community and the aeromedical community have given their input, and we're pleased that FAA used that input to make the necessary changes in its policy. The incoming federal air surgeon has indicated that he has no interest in enacting a sweeping policy that would add financial and regulatory burdens to pilots."

International Learn to Fly Day

EAA ALWAYS ENCOURAGES its members to take others flying, but on Saturday, May 17, there's an even better reason to do so: The fifth annual International Learn to Fly Day is an opportunity to help someone take that first step to discover the fun, freedom, and accomplishment of becoming a pilot. It could be a friend, a relative, a friend of a relative, or a relative

of a friend. For a person age 18 or older, you could take an Eagle Flight. If your passenger is age 15 to 17, you could make it a Young Eagles Flight.

A number of chapters are planning events, which will be added to EAA's [Calendar of Events](#) and tagged as "Learn to Fly Day" so everyone will know it's part of the celebration.

EAA Reviewing Updated Flight-Testing Handbook

EAA IS ACTIVELY REVIEWING the draft of the FAA's amateur-built and ultralight flight-testing handbook, known as Advisory Circular 90-89. The handbook, developed with substantial EAA input, was issued in 1995. This will be its first revision.

Because the handbook has been untouched for nearly two decades,

it's outdated in several major areas. For example, there are no references to light-sport aircraft (which was not yet a legal definition for aircraft in 1995), while there are references to "fat ultralights" (which no longer exist). In addition to content updates and formatting changes to enhance readability, the FAA is working to modern-

ize the language to make the document compliant with the Plain Writing Act.

EAA staff will work with the EAA Homebuilt Advisory Council to review the handbook for clarity, accuracy, and possible areas where information could be expanded or added. After the review, EAA will submit formal comments to the FAA.

New EAA Video Answers Pilots' Questions About Completing FAA MedXPress Form

A NEW EAA video answers the most common questions about the now required MedXPress online form for FAA airman medical certificates, including how to save time when completing the form.

The video, available free of charge through EAA's video player, features Dr. Greg Pinnell, a member of EAA's Aeromedical Advisory Council, which consists of EAA-member physicians who volunteer their time to assist other members and guide EAA policy on aeromedical issues.

"Many longtime pilots are used to filling out the paper form at their own aviation medical examiner's office, but the FAA now

only allows the online form to be used," said Sean Elliott, EAA's vice president of Advocacy and Safety. "The online requirement has led to many questions and occasional confusion and misunderstanding for pilots unfamiliar with the MedXPress system. This new EAA video answers questions, clears confusion, and ensures the first step in obtaining an airman medical certificate is a smooth one."

During the 20-minute video, Pinnell goes step-by-step through the MedXPress registration and completion process. That includes displaying individual online screens and easy-to-follow instructions on completing the pre-examination paperwork.

EAA Hosts Wisconsin Ultralight Safety Seminar; Will Revive Ultralight Day at Pioneer Airport

THE WISCONSIN ULTRALIGHT/Light Aviation Council held its 20th annual Ultralight/Light Aviation Safety Seminar on Saturday, March 15, in the Founder's Wing of the EAA AirVenture Museum. Nearly 200 ultralight and light aviation enthusiasts participated in the day-long event, which qualified attendees for FAA WINGS credit.

During the event, EAA announced that it will bring back its popular Ultralight Day at Pioneer Airport, on Saturday, June 14, which will include the popular pilot proficiency competitions. EAA Ultralight Chapters are invited to participate.

Speakers for the day included Brett Lawton, talking about maintenance of

Rotax two- and four-stroke engines; Tom Boyer, discussing aviation weather; Jim Ssajkovic, focusing on accident prevention; and Denny Demeter, highlighting the importance of a professional attitude about flying. Drawings for numerous door prizes were held throughout the day.

Experimenter Expands Ultralight Coverage

RESPONDING TO EAA member and reader requests, 10 pages of content will be added to *Experimenter* each month and specifically focused on ultralight-type aircraft and technical insights. In addition, the current in-depth coverage of homebuilt aircraft and building tips will continue.

“As the *Experimenter* digital version continues to grow and evolve, we’ve taken the input of EAA members as to what they

would like to see and find valuable,” said Charlie Becker, EAA communities manager. “The expansion of the digital magazine is possible because of the positive feedback for *Experimenter* and its increasing popularity. Combined with EAA’s current digital, print, and video offerings, grassroots aviation enthusiasts can find what they need in resources specifically created for them.”

The July issue will be the first to include this content.

Tailor-made

Tailor-made stands for quality and durability. Like builders and restorers who tailor-make the intricate details of their aircraft, we take the time to evaluate all your coverage options to tailor a plan that won't fall short of the mark.

Visit EAA.org/insurance or call us toll-free at 866-647-4322 for a quote.



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Sensenich Introduces O-360 Composite Adjustable Prop



SENENICH PROPELLER introduced its long-anticipated adjustable composite propeller for the Lycoming O-360 at the Sun 'n Fun International Fly-In & Expo last month. The prop complies with ASTM standards, and it is ready to ship to owners of Van's RV Models 3, 4, 6, 7, 8, and 9 that are powered by the four-cylinder engine.

The two-blade prop with its aluminum hub and available precut, balanced spinner weighs about 20 pounds, considerably lighter than similar-sized metal props and rivaling the weight of wood. The blades come in any combination of red, white, gray, yellow, or classic black, and it can be indexed without special tools, using the pitch gage system so well accepted on the Sensenich O-320 and three-blade Rotax props.

"This O-360 prop gives the builders of Van's and other high-performance designs, including the Wittman Tailwind, Mustang II, or Thorp designs, a versatile prop for the O-360," said Don Rowell, Sensenich president. "This new prop, along with our O-320 propeller, carries no rpm range restrictions to allow optimum cruising."

The 72-inch-diameter O-360 prop is suited for airplanes that regularly travel in the 150- to 215-mph range, and it has demonstrated speed increases of 5 to 10 mph over the full range of practical throttle settings, along with improved throttle response and acceleration in real-world flying tests against existing-design propellers from other manufacturers.

For more information, visit www.Sensenich.com.

Repairman (LSA) Inspection Course Slated at Oshkosh After AirVenture

IMMEDIATELY FOLLOWING EAA AirVenture Oshkosh 2014, Rainbow Aviation of Corning, California, will conduct a two-day (16-hour) LSA repairman inspection course for EAA members in Oshkosh, Wisconsin.

Successful completion of the course allows an aircraft owner to perform the condition inspection on any experimental light-sport aircraft (E-LSA) he owns. People who successfully complete the course will need to present their certificate of completion to their local flight standards district office to receive their FAA certification.

Some of the reasons to enroll in Rainbow Aviation's Repairman Inspection Course:

- Learn critical information on today's experimental aircraft and engines.
- Find out more than 100 mistakes that cause engine failures.
- Gain valuable information about the maintenance and inspection of your aircraft.
- Learn the common mistakes on amateur-built aircraft that can affect your liability and accountability.

Many participants in previous classes report correcting major problems on their aircraft as a direct result of the

information learned in class.

More than 80 percent of participants learn about problems on their own aircraft of which they were unaware. Left unaddressed, these problems would have led to engine failure.

The certificate earned is valid for any E-LSA currently owned or purchased in the future.

The course fee is \$375 and is for EAA members only. To register, send an e-mail to info@rainbowaviation.com or call Rainbow Aviation at 530-824-0644. For more information, visit www.RainbowAviation.com.

Wittman Model 10 Kits Available



MAX AERO INC. of Hartford, Wisconsin, is now offering kits for builders of the Wittman Model 10.

Max Aero owner Marc Stamsta has been building airplanes and airplanes kits for more than 32 years, including wing kits for the Pitts Model 12 and Tailwind Model 10 as well as wings for the Howard, Fairchild, and Waco antique/classic aircraft.

Working with Tailwind guru Jim Clement to include some of his modifications to the Wittman design, Stamsta has developed wing kits (\$3,500), assembled wings (\$8,500), engine cowling kits (\$830), fuel tank kits (\$800), a tail surfaces kit and a fuselage kit that will be available in limited quantities this spring.

For more information, e-mail maxaero.marc@aol.com.

Cub Crafters Introduces New Flagship Panel

CUB CRAFTERS INTRODUCED a new top-of-the-line panel in cooperation with Garmin, which is simultaneously introducing its 10.6-inch, touch-sensitive G3X Touch flight display system. Cub Crafters' new panel, called the Executive Glass *touch*, replaces the company's previous high-end panel with an integrated suite of Garmin's cutting-edge instruments. Executive Glass *touch* is available immediately in Cub Crafters' Carbon Cub SS, Carbon Cub EX, and Sport Cub S2 aircraft.

The Executive Glass *touch* is centered on Garmin's new G3X Touch flight display system that includes the 10.6-inch, high-resolution GDU 465 touch-screen display. Along with the Garmin GTR 200 Comm and GTX 23 ES Mode S transponder, the system integrates each of Garmin's instruments for a logical, intuitive pilot interface. The G3X Touch

has synthetic vision and video input for cameras or enhanced vision systems. The display layout is completely configurable and includes a front-loading SD card slot for software and database updates.

Cub Crafters also includes Garmin's angle-of-attack sensor and Sirius XM satellite radio weather and audio as standard equipment on the Executive Glass *touch* panel.

The Executive Glass *touch* is available as an option in Cub Crafters' ready-to-fly light-sport aircraft (LSA) for \$24,990. Experimental amateur builders can purchase the panel for \$27,990. Buyers may also upgrade the panel to include Garmin's Dual-Axis Autopilot at \$4,990 and Garmin's GDL 39R ADS-B datalink at \$2,100.

For more information, visit www.CubCrafters.com.



HKS No Longer Producing Aircraft Engines

HKS CO. LTD. of Japan announced it will discontinue production of the 700E and 700T engines and has suspended all U.S. dealerships, according to information received by Green Sky Adventures.

However, the company noted it would continue to sell avail-

able spare parts required for service or repair as well as after-sales service.

HKS further stated it has no intention of selling its product line to other manufacturers.

For more information, contact mail@greenskyaadventures.com.

Glasair Adds Light-Sport Aircraft and Certificated Aircraft to Lineup

GLASAIR AVIATION HAS announced the addition of two new aircraft to its product line—the Merlin light-sport aircraft (LSA) and the Sportsman Diesel. The Merlin is Glasair's first foray into the special



Merlin light-sport aircraft

light-sport aircraft (S-LSA) world and will be the company's first certified aircraft.

The company's second product announcement was about a diesel engine option for its Sportsman, which will provide pilots with a proven engine alternative to current avgas powerplants. The Sportsman Diesel will come equipped with a Centurion 2.0s engine, a Hartzell Bantam three-blade propeller, and VFR glass-panel avionics. With this offering, Glasair is answering the demand for a diesel-powered aircraft, especially as avgas prices continue to rise.

Glasair is now accepting deposits for the new planes, which are expected to



Sportsman Diesel

begin delivery this fall. For pricing and order information, e-mail Glasair at info@glasairaviation.com or call 360-435-8533. More details about Glasair Aviation can be found at www.GlasairAviation.com.

BREEZY AT THE HALF-CENTURY MARK

Breezy at the Half-Century Mark

50 years of pure aviating BY BUDD DAVISSON

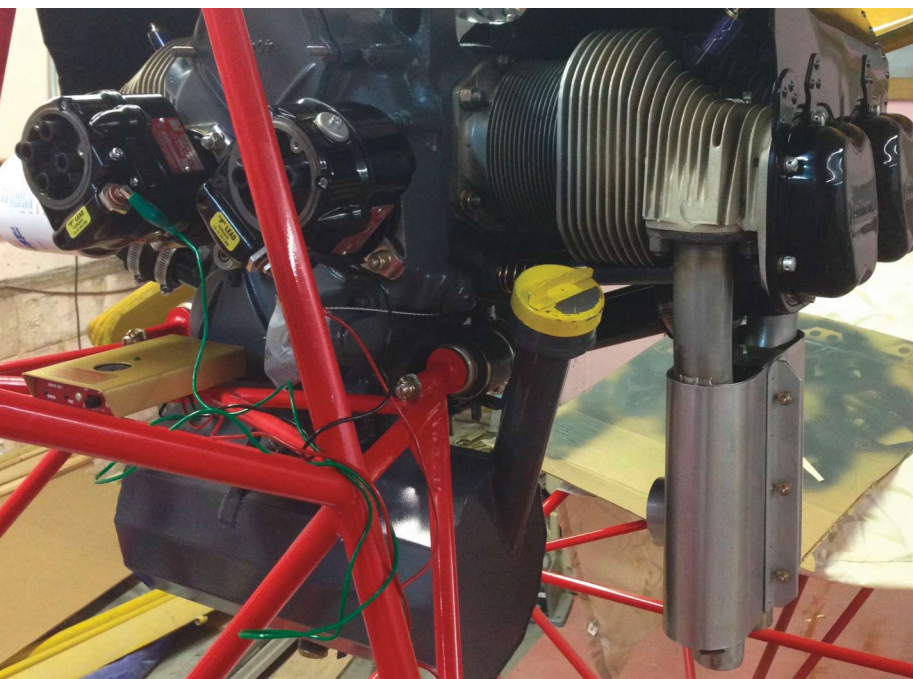




Carl Unger and his trademark vest and invisible dog at an early EAA convention.



Jon and Mike's Breezy fuselage comes together as they fit the seats and install instruments.



Jon and Mike also scratch-built the Continental O-200 engine that will power their Breezy. They started with a first-run crankcase and add a new crankshaft and updated cylinders.

LONG AGO AND NOT so far away, there was a man who walked an invisible dog and flew a nearly invisible airplane. Sadly, Carl Unger is now gone, along with the dog that never was, but his airplane is now more visible than ever and has become the iconic representative of flight in its purest form.

Breezy, as he and his co-designers/builders dubbed the airplane, is enjoying something of a resurgence of interest. More and more EAAers are discovering the minimal costs involved in scratchbuilding, and the joys to be had in flying an airplane that has no rational reason to exist other than pure aerial fun, which is the way Carl Unger, Charley Roloff, and Bob Liposky wanted it. And that is the exact reason Jon Ross and Mike Miller from Long Island, New York, decided to build their own Breezy.

As Jon, EAA Lifetime 135637, put it, "The Breezy represents real flying to me; some of which is lost when flying the jets (he flies corporate jets for a living) or even my RV-8. As such, I wanted to recapture some of those early feelings of flight.

"My partner in the project is Mike Miller, EAA 1014542, an RV-12 builder. We decided early on that this Breezy should be built as closely as possible to the prototype as we could. Meaning it would be simple in the extreme.

"My Breezy actually got its start in 1980 or so, when I got a ride in a Breezy at a local New Jersey airport. After my ride I sought out the Breezy designer Carl Unger at Oshkosh. Carl sat me down in the prototype and told me to place my feet on the rudder pedals. He pointed out that your legs cover the longons from view, so it's like sitting on a chair in open space. With almost childlike enthusiasm, he said, "That's real flying!" Carl's enthusiasm was contagious. I regret that he has passed now and he won't be able to see this Breezy. When I recently told his son, Rob, about this, he said, "He will see it, Jon—don't worry."

Both Jon and Mike own RVs, but those airframes didn't give them the skills to plans-build a Breezy, which is strictly a plans-built "rag-and-tube" machine. In fact, since it does all of its flying uncovered, it's more tube than rag. There is lots and lots of welding in the fuselage, plus woodwork in the wings, skills you don't pick up building an RV.

Jon said, "When I worked as a kid in a machine shop, the Italian owner taught me to gas weld, and I discovered that I had an affinity for it. Later when working at a flight school as an instructor, I had a couple of mentors who were old-time Pan Am flying boat mechanics. They taught me the other skills and encouraged me to get my A&P and IA tickets, which I did. I later bought a Miller Syncrowave TIG welder and thought it was superior to gas welding. I had some welding help/instruction from a friend who made cruise missile parts in his machine shop, and I learned lots about wood and fabric work from my friend and mentor, Don Wolf,

With almost childlike enthusiasm, he said, 'That's real flying!' Carl's enthusiasm was contagious.

designer of the all-wood Boredom Fighter. Don lived in the next town over from me, and we became friends." Jon is also a designated airworthiness representative (DAR).

Jon cautioned, "Even though our Breezy is TIG welded, you still need a torch to make many of the bent fittings. Wittman Buttercup builder Earl Luce and I made a gas welding video with Kent White (TinManTech.com), and it was Kent who reminded me that "...you have to use the appropriate technology." When I inspect vintage airplanes in my DAR work, I see beautiful gas welding. The gas welding on an old Howard DGA is simply beautiful artwork. I am currently practicing on getting my aluminum welding skills to the point where I can build compound aluminum fairing parts for old airplanes."

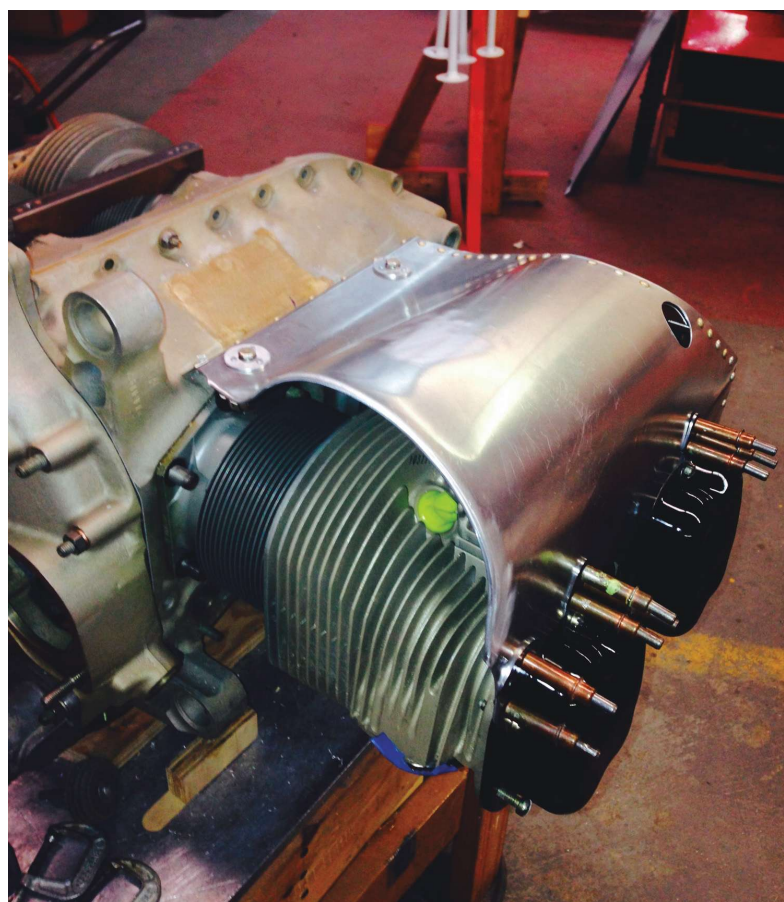
Although Breezy is simple in concept, some parts of it are fairly complex in execution—for example, its fuselage. Where most aircraft fuselages are some form of modified box, the Breezy fuselage almost has to be seen to understand it because it is difficult to describe in words.

Jon explained, "The Breezy has what is essentially a bent, triangular fuselage. This makes it impossible to build two sides and join them later, as is done on most fuselages. A flat table was built and the fuselage top frame was tacked together on the table and then elevated above it. The keel was then bent and installed, held in place with blocks, and the verticals and diagonals were then added.

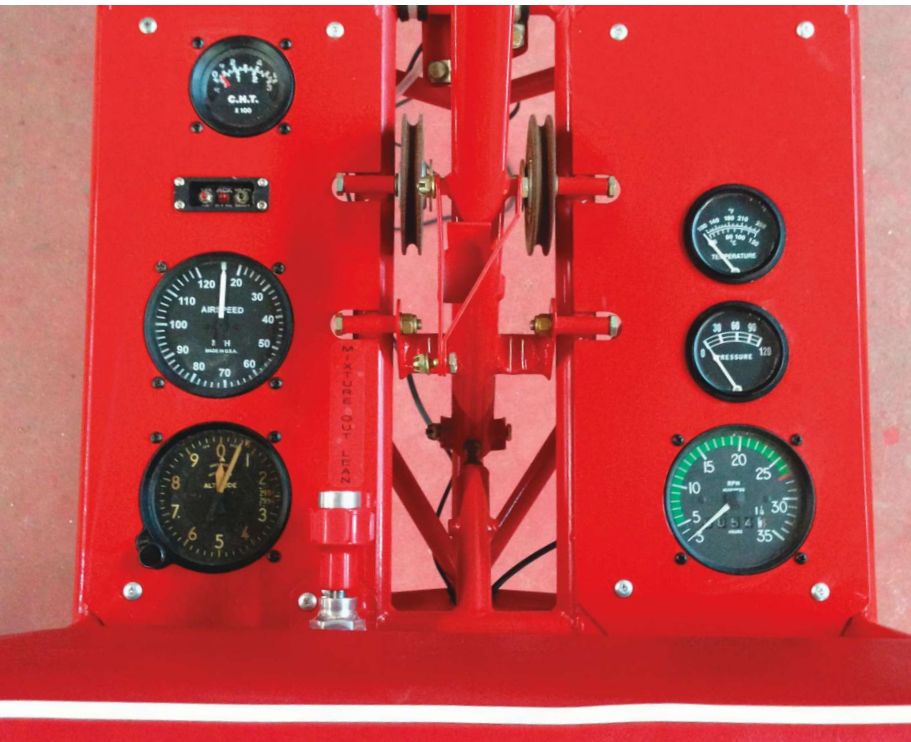
"The longerons were bent cold over various radius dies, one degree at a time. We didn't want to splice them like most people do on Breezys, so we started with tubes nearly 12 feet long. Mike and I would stand there slowly bending them over the die. The length of the area of the bend was marked with masking tape and numbered in inch increments. We would push down over the die and call out the number where we were going to bend. Then we'd place the contact point of the tube on each number (or between) called out on the vertex of the die. After some bending, the tube was then placed in a temporary jig on the table that used blocks screwed to the surface to define the desired bend. We'd bend it, then check it. Then bend it some more. It is an iterative process, allowing you to sneak up on the desired angle of bend. It is kind of like a bunch of small bends, but the result is a beautifully curved longeron with no tubing collapse. We practiced on electrical conduit first to get the technique down pat."



Jon and Mike purchased a wing kit for the Wag Aero J-3 Sport Trainer to build their all-metal wing.



A newly formed cooling eyebrow for one of the engine cylinders.



Looking down at the instruments from the pilot's seat.



The hub caps leave no doubt as to what kind of airplane this is.

Since every single joint in the fuselage is totally visible, Jon and Mike knew they were going to expose themselves to lots of comments if something was less than perfect. This included the many dozens of tubing joints.

Jon said, "To make the joints as tight as possible so each weld bead could be uniform and the right size, we used a joint jigger with a Kool Mist attachment to cut the tubing to the right curvature. The mist attachment greatly extended the life of the hole saws used. I also used slipover templates made of paper to lay out a joint shape and then ground it on a good old-fashioned bench grinder."

Being a bare bones (literally) airframe, Breezy is ready-made for a builder to express his own ideas and change things to his own taste. Jon and Mike, however, resisted the temptation to change something just for the sake of change.

Jon said, "We made as few changes from the plans as possible. For instance, many builders use J-3 landing gear. But we elected to build exactly to the plans because any changes always create delays through a ripple effect. Use a J-3 gear and it forces you to make other changes, which not only adds time but also weight; and weight is the primary enemy of the homebuilder."

Although the backseat of Breezy has been made in any number of varieties, including three fannies wide, Jon and Mike decided to keep their Breezy a two-place machine. That was another move to keep it light, but they elected to farm out the seat covering. I'll confess that I had both seats covered by a friend who does corporate jet interiors," Jon said.

The flight deck/cockpit is like the rest of the airplane: functional in the extreme. Jon added, "Only what is needed is there, including a cable-driven tach with a 90-degree adapter. All instruments are nonelectric, but eventually we'll have a battery-operated intercom. And one concession we have made is a trim tab on the elevator that is driven by a Ray Allen servo with a small battery."

When it came to certificating the airplane, Jon said, "Even though FAA inspectors often do not understand amateur-built or light-sport aircraft (LSA), they were very cooperative in doing the Breezy."

The way they powered the airplane fits right in with their desire to keep the airplane simple and light. The engine, too, was scratchbuilt.

Jon explained, "I have considerable experience building engines, so nothing about building the O-200 Continental was particularly difficult. I bought parts and assembled it using a new crankshaft and new-style cylinders. We found a first-run crankcase and a used carb that I had a repair station go through, and I made the stainless exhaust and

the carb air box myself. Then, to keep it light, we put a Sensenich wood prop on it and didn't install an electrical system. We haven't weighed the airplane yet, but we're hoping for less than 700 pounds, which is about what Carl's first airplane weighed."

For wings, the original airplane used a set from a Piper PA-12, but Breezy has been built using almost every kind of wing that is available on the salvage market. In fact, at least a few have had Cessna 172 wings, complete with flaps, which by the way looks just a little strange. Jon and Mike thought about using PA-12 wings but decided to build their own.

Jon said, "We found that original PA-12 wings were far too expensive. But inasmuch as PA-12 wings are nothing but modified J-3 Cub wings, we used a kit from Wag Aero for their J-3 Sport Trainer, which has aluminum spar wings. The front spar is cut off 12 inches, so the front and rear spar fittings are in alignment.

"We bought a kit for the ailerons from another supplier, but the quality of the parts was so poor I only used the spars. We tooled up and made all of the nose and main ribs as well as all of the hinges. The most difficult part was making and welding the aileron hinges. We also used 2024 .020 for the aileron leading edge. We made a press brake to bend the nose skins. It is the same weight but much more durable than the 1100 aluminum Piper used. The struts are streamlined tubing, all made new, and that tubing is pricey! In fact, I hear people are starting to make their own streamline tubing, rolling round tube through dies. We weren't up for doing that, however.

"The truth is that we both like to build as much as fly, and I love to weld. Mike makes tubes and fits them with speed and accuracy. To us, the journey is just about as satisfying as the destination, and as such, we tend to build everything. This includes the ailerons, wing fuel tanks, engine oil tank, engine cooling eyebrows with wired leading edges, and dozens of other items. This is very satisfying, but it does slow us down a bit.

"Of course, the big question is whether it will be ready for Oshkosh 2014. I hope so, but it will be a race to get it done and fly the restrictions off. I also hope to take the airplane to the Antique Airplane Association fly-in at Blakesburg, Iowa, this year because it is a legacy homebuilt. However, when we do finish it, there will be a vacuum in both of our lives, and I don't doubt that we'll start on another project in a hurry." **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.



The O-200 engine mounted on the steel-tube fuselage, as the project sees daylight for the first time.



The center section of the wing.

The 50th Anniversary of the Birth of Breezy

Editor's note: In 2007 Sparky Barnes Sargent interviewed Carl Unger about the Breezy and how it came about for the December issue of Sport Aviation. Unfortunately, Carl passed away on September 24, 2013. Carl's words follow:

IN THE BEGINNING

BACK IN 1964, fellow Corporate Air Transport captains Charley Roloff, Carl H. Unger, and Bob Liposky were flight-instructing on the weekends at Midway Airport in Illinois. The threesome decided to design and build an airplane that would let them get back into the basics of flying. "We never had any plans; we just had the design in our heads," Carl recalled, explaining, "We made a little wire model out of welding rod just to see what we wanted. I did all the welding and engineering, too. Charley had previously built his own gyrocopter, all by hand, so we knew we wanted to fly out in front of the engine. And I had always wanted to build something like an old Curtiss pusher; so we got together and Breezy is what we came up with."

They scrounged around for parts, and Eleanor Schumacher, who was involved in local aviation, helped out by selling a set of PA-12 wings (from a wreck) to the threesome for \$200. Her interest in the project continued, and one day she stopped by to check on its progress, just as Carl was measuring the size he was going to make the bench seat. "She said, 'Will it hold me?' So we made it to fit her, and that's why we call it a Schumacher seat," Carl said.

All told, it took them about six-and-a-half months to build the airplane from the time they made that welding-rod model to the test flight of the full-scale version. It was Charley who made that first flight on August 7, 1964, at the Chicago-Hammond Airport (now the Lansing Airport). "He had the most instruction time of the three of us, so we gave him the honor," said Carl. "And we all knew we were going to do it the first week in August. Back then, when we were through instructing on the weekends, we'd all go to the Lansing bowling alley and bowl and have a couple of Manhattan drinks," Carl recalled, laughing, "so we had Charley's 'wake' there—a party for Charley just in case something didn't go right! That way, he could be there with us rather than in a box. Then I flew it second, and Bob flew it after me. We knew it would fly, and I loved it!"

The airplane, N59Y, was officially registered as an experimental amateur-built Breezy RLU-1. It had a wingspan of 33 feet, measured 22 feet 6 inches from nose to tail, and had an empty weight of 698 pounds. It carried 10 gallons of fuel and was powered by a 90-hp Continental with a special pusher crank. It cruised 80 mph at 70-percent power, with a maximum speed of 105 mph and docile stalling characteristics at 28 mph.

Throughout more than four decades, numerous sets of Breezy plans have been sold and hundreds have been built in many countries, much to the amazement of Carl, who bought the plans rights from his partners. "We never knew that 43 years later it would be flying like this," he said. "I went to the first EAA air show in Rockford in 1965, and people had never

seen anything like Breezy. We started giving rides that first year. It was Governors' Day, and Governor Knowles from Wisconsin and Governor Kerner from Illinois jumped at the chance for a ride, so I took them both—that made the front page of the Rockford newspaper!"

NUMBER ONE BREEZY PILOT

When he was 10 years old, Carl started building 5-cent stick-and-tissue model airplanes. He went for his first (albeit scary) airplane ride on a windy, bumpy day in a J-5 when he was 12 years old. In one of life's little ironies, 13 years later, after earning his certificate and ratings with the G.I. Bill, he found himself instructing in that very same J-5. As an ATP-rated pilot, his aviation career grew to include flying jets for Corporate Air Transport and later flying King Airls.

Carl flew another Breezy, N79V, for years. It is a Breezy with a bit of history behind it. More than three decades ago, Carl met 12-year-old Jay Vieaux, who "came to every air show, and I'd fly him on my Breezy. He fell in love with the airplane, and one time, he showed up with a control-line model airplane, complete with a little man sitting in the pilot's seat with a red vest! So for his 15th birthday, his father—who was EAA Chapter 260 president then—got a set of plans from me for a Breezy, and I went down in his basement and gave him a few gas welding lessons. That's the airplane I'm flying today, and it is immaculate—he did a great job." (*Editor's note: Carl's son, Rob, is still flying that airplane, and it will be at AirVenture 2014.*)

Carl taught his son, Rob, to fly in 1977 and soloed his two other sons on their 16th birthdays, as well. Today, Rob is a Southwest Airlines pilot who enjoys flying his father's Breezy on the side. "Dad flew people for well over four decades, all for the cost of a handshake, a smile, and the memorable look left on their faces—something that he enjoyed and never forgot," Rob said proudly, "and he never charged for a ride."

Carl's joyful devotion to aviation, his irresistible effervescence, and his personal generosity haven't gone unnoticed; he was enshrined in the Illinois Aviation Hall of Fame in May 2006. At the time, Carl remarked, "I was shocked, and very honored. I never even knew they were considering me—and the reason they did that is I'm taking people for rides, young kids, too, and everything's free. I pay for everything myself; that's my donation to general aviation to get young kids and other people into flying who would never have a chance to fly otherwise. The Hall of Fame people figured that since 1964 I've flown about 8,000 people."

It's doubtful that Carl could have imagined that we'd be celebrating a half century of Breezys in his honor, and it's likely there will be a similar celebration at the century mark. Classic airplanes fly forever, and Rob Unger is helping to keep the legend alive by continuing the sales of plans for the Breezy; the cost is \$175 (14 sheets). Contact:

Janet Unger
8751 S. Kilbourn Ave.
Oaklawn, IL 60456

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*The One Week Wonder will be powered by the new Rotax iS
Sport engine introduced by Rotax in April.*



One Week Wonder

**Audience participation to build a Zenith
Cruzer in record time** BY BUDD DAVISSON

ONE WEEK WONDER

THIS YEAR DURING EAA AirVenture Oshkosh 2014, EAA and Zenith Aircraft are combining efforts to demonstrate to the aviation community just how quick (and simple) today's modern light aircraft kits are to build. And what better way to do that than with One Week Wonder, actually building an airplane during the week and doing so with nothing but volunteer labor? If you're in the crowd watching the airplane go together, all you have to do is ask and you can get into the building action yourself. The Zenith CH 750 Cruiser kit will be opened when the show begins and will actually be taxiing when the show ends.



To summarize, those at AirVenture 2014 who want to try their hand at building an airplane can assist the crew of volunteers and actually build a CH 750 Cruiser in seven days. Start to finish. You can stand around and watch, or reach out and find that building an airplane isn't as difficult as you thought it would be.

The goal is to have the airplane inspected and doing taxi tests, ready to fly on day seven. Because of airspace concerns, it won't actually be flown until a few days after AirVenture folds its tent.

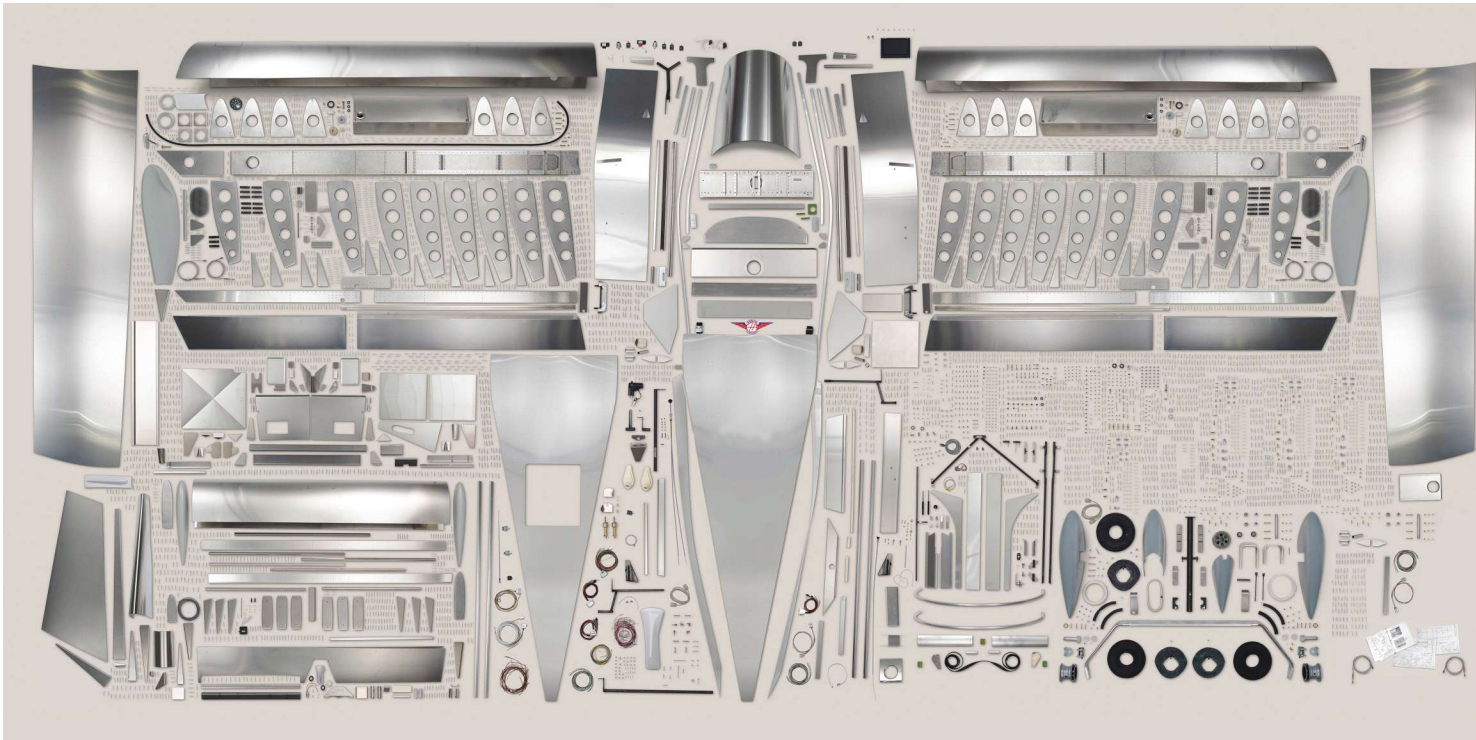
Zenith Aircraft President Sebastien Heintz says, "I've wanted to do this for many years for many reasons. Among other things, I want to demonstrate to the homebuilt community how quickly and easily a modern kit plane, in this case a Zenith, can be built. We want to prove beyond a shadow of a doubt that building an airplane is a viable project for anyone, while at the same time showing how far kits, and the support for those kits, have evolved over the years. Building a kit airplane today is a far different endeavor than it was in the '80s or '90s."

In 1976 Sebastien's dad, Chris Heintz, did a similar project at Oshkosh, but it was with Zenith staffers, not volunteers.

Sebastien continues, "Since this is an EAA project, we are working hand-in-hand with them. We want to showcase the many EAA resources and programs that are available to homebuilders to help them successfully complete their own kit aircraft project through programs and resources such as SportAir Workshops, local EAA chapters, Technical Counselor



Zenair founder and designer Chris Heintz (second from right) watches as Zenith staffers riveted the wing skin on a Zenair CH 200 at Oshkosh in 1976, completing the aircraft in eight days. Here's a [video](#) from that event.



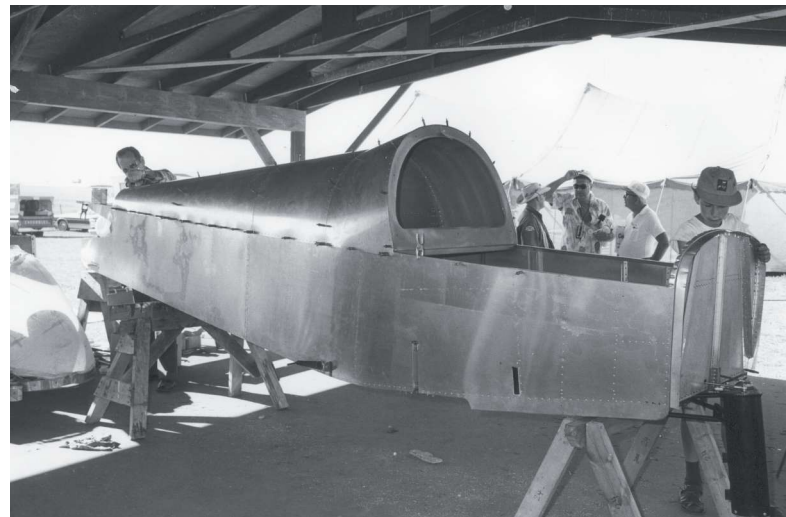
All these pieces will come together as a ready-to-fly Zenith CH 750 during the One Week Wonder project during EAA AirVenture Oshkosh 2014. Your help will be greatly appreciated!

program, etc. These will all be worked into the presentations that surround building the airplane.”

As Sebastien says, “While Zenith Aircraft Company designs the aircraft and manufactures the kit, even though we do supply engine and avionics installation packages, we count on others to supply the engine, avionics, and similar systems for those packages. So, it makes a lot of sense that these other parties also be involved with this AirVenture project, which allows them to showcase their products to the homebuilt community.”

In the CH 750 kit to be used, all of the sheet metal is trimmed, punched, and formed, but when EAA Chairman Jack Pelton starts the countdown timer at 8 a.m. Monday, no components will have been pre-assembled or even unpacked. The components will be coming out of the crates in exactly the same form a purchaser would be receiving them. Every component and item is as-found in the kit, although some, such as the engine, bolted to the engine mount and ready to be hung on the airframe, would be an available option. The only thing missing will be the elbow grease necessary to assemble the components and make them into a living, flying entity. And that’s where the Oshkosh crowd comes into play.

Heintz says, “We’re leaving the vast majority of the work to volunteers. Zenith staffers will be the facilitators and coordinators of the project so that the volunteers can get their part of building an airplane done, but our people will do very little of the actual work. We plan on having as many inexperienced builders involved as possible. They are the reason that we’re doing this project in the first place. Everyone knows that a factory team can



assemble their own product in record time, but that’s not our goal here. We want volunteers, some of which have been recruited ahead of time, along with those interested spectators standing in the crowd to step forward and become part of the project. Building airplanes was never meant to be a spectator sport.”

Obviously, one of the things that makes building an airplane in a week possible is the relative simplicity and completeness of modern kits such as the Zenith CH 750 Cruiser and the way the parts benefit from modern CNC manufacturing processes. Most parts have their holes computer-located

so the holes in mated parts match exactly. They're punched to final size and are ready to be de-burred, put together with Clecos, and riveted.

Sebastien Heintz says, "The real work and challenge for us at the factory is the planning and coordination of the project: making sure that the various different sections are finished, when needed, so that they are ready for the next step. We will divide the volunteers into teams, and we need to coordinate everyone. Some of our volunteers will be experienced kit builders who will spend some time training new, inexperienced volunteers and explaining more about the skills needed to build an airplane."

The work site will be near the EAA Welcome Center at the main crossroads of the AirVenture grounds. There will be interactive displays that highlight the aircraft construction process as well as helping portray the wide variety of aircraft to be found in the homebuilt community. The most interesting part of the display, however, will be the workshop area that will lean heavily on workbenches and tools borrowed from EAA staffers who are building their own CH 750.

Every operation that must be performed while building an all-metal airplane will be involved in this project. So, the volunteers may spend a morning de-burring holes or helping pull rivets. It'll change as the project progresses. Embedded in the building process will be occasional demonstrations by sponsors, when they direct the installation of their own products. For instance, Matco may help with mounting the tires on the wheels, since the tires will come to Oshkosh the same way they would

come to the builder: separate from the Matco wheels and needing mounting. The same type of thing will happen with other specialty items.

The panel itself will also reflect the way in which the home-built community has rapidly moved into the pre-assembled, digital age. No steam gauges will be in evidence, replaced instead by a complete Dynon SkyView glass panel system. Here too Zenith staffers will work with the volunteers on figuring out how the pre-fabbed harness and panel components supplied by SteinAir specifically for the 750 are to be installed. Like we said, building a kit today is much different than only a decade ago.

Ahead of the firewall, the volunteers will be hanging a Rotax 912iS that has been donated by Rotax, for the purpose, and incorporated by Zenith into one of its optional "engine installation kits," as supplied to the customer, when so ordered.

This kind of an undertaking literally begs for it to be made into a video, so EAA will do time-lapse photography from beginning to end. This will result in a short video that, like a new flower opening in high speed, will compress seven days of nonstop building into three or four minutes. Viewers can see an array of random aluminum pieces grow into an airplane right before their amazed eyes.

The conclusion of that video will be on day seven. After a designated airworthiness representative has inspected the airframe and the appropriate paperwork is filled out, the aircraft will leave its nest for the first time and be towed to the taxiway. There, after fueling and doing preliminary engine runs, a brand new Zenith CH 750 Cruiser missing only paint will make its first taxi tests.

As the aircraft rolls under its own power, what the crowd will witness is the mechanical equivalent of the proverb "It takes a village to raise a child." The very concept of an individual actually hand-building an airplane sounds absurd to those not familiar with EAA. But the concept of amateur-built aircraft, as represented by this particular Cruiser, has been the result of long-term nurturing that has, over the years, been provided by the community we call sport aviation. And a critical ingredient in that nurturing is a passion for what many see as a machine, but which we know actually represents a portal into the magical kingdom of personal flight. To many within our own village, the concept of building that magical machine seems beyond their grasp. Hopefully, through the One Week Wonder project, would-be builders will be convinced that the concept is neither as complex nor as unobtainable as it would seem, and they'll take that critical first step into experimental amateur-built.

EAA will be announcing additional ways for visitors to get involved both before the convention and on the grounds. Check the EAA website for updates and details on this as AirVenture grows closer. *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.Airburn.com.

AVIATION COMMUNITY UNITES BEHIND ONE WEEK WONDER

More than a dozen companies are pitching in to support our unique One Week Wonder airplane-building project planned for EAA AirVenture Oshkosh 2014.

Zenith Aircraft has donated a CH 750 aircraft kit. The Zenith CH 750 is an economical all-metal light aircraft available as a Cruiser (for cross-country operations) or STOL (short takeoff and landing) model.

Rotax has contributed its new 912iS engine. The engine features the latest technology with a single-lever control, fuel injection, and extremely efficient fuel burn. In 2013, Rotax received EAA's August Raspet Award for innovation such as the 912iS engine that advanced sport aviation technology.

Skytek Aircraft Services Ltd., which designed the Rotax 912iS firewall-forward installation for the CH 750, is providing a Rotax Engine Installation Package (REIP) kit. In addition, Dynon Avionics has donated a complete glass cockpit, featuring the new SkyView with comm radio, intercom, transponder, ADS-B weather and traffic, and new control panels.

Aircraft Spruce & Specialty, one of the world's leading aviation and pilot supply companies, is also backing EAA's unique building project with extensive promotional support before and during AirVenture 2014. Other companies already committing to One Week Wonder include Poly-Fiber, Sensenich, Sennheiser, Scheme Designers, SteinAir, Matco, and Flightline Interiors.



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Bob's airplane, True Love, wears the colors and markings of a P-51. He was hoping to replicate a polished aluminum look with the silver paint.

Life Kept Getting in the Way

Bringing an RV-8 to completion

BY MARY JONES

LIFE KEPT GETTING in the way of Bob Juneau, EAA 812345, in completing his RV-8, N623RJ, or so he says. After more than seven years of construction, the airplane took flight on September 17, 2013. Bob said, “I used to say it was a fun airplane to build; now I say it’s a fun airplane to fly.”

Bob’s RV-8, named *True Love*, is powered by an Aero Sport IO-360 engine and is equipped with a Hartzell constant-speed, two-bladed blended tip prop, a Dynon SkyView with dual 7-inch screens (no room for the 10-inch screens), dual ADAHRS, dual backup batteries, EMS, an ARINC 429 converter, and a transponder. He added a Garmin radio stack including a GTN 650 to be legal for filing IFR.

Bob explained the name of his airplane. “*True Love* was given that name for several reasons:

1. Love is what’s important in life; God’s love for us, and the love for each other that we should strive to show.
2. The N-number is my wife Angie’s and my wedding anniversary.
3. RJ (my initials, phonetically) are Romeo Juliet, the ultimate love story.
4. And, of course, the love of airplanes one must have to take on such a project.”

The project took seven years and nine months to complete, with Bob working on it mostly at home. “All but the last three

months were done at home in the third stall of my garage,” he said. “I wanted to have as little as possible to do after I went to the hangar.

“When I was actively working on the project, I averaged around 15 to 20 hours a week with some weeks as high as 40 to 50 hours. But unfortunately I also had gaps of months and even one of almost two years when absolutely nothing was being accomplished. It was a feast or famine approach; when I had the time to work on it, I had a lot of time. When I didn’t, I had none.

“I went through two separate layoffs from my day job as an airline pilot (read: no money). During one layoff, I got another type rating (read: no time) and worked and commuted to Montreal (from Prior Lake, Minnesota) for a year (read: no life). I accomplished nothing during that time.

“I was in Montreal when the prop arrived. My intuitive wife Angie called me before the FedEx guy drove off to tell me that there was a big forklift gash in the box. I told her to stick her hand in there and see what it felt like. It was clear that there was a big gash in one of the blades, so she refused the shipment. We had to wait for the whole thing to be sorted out between Hartzell and FedEx, and several weeks later, we had another prop delivered to us.

“I had two separate surgeries during the project, too, one on each foot. Having a landing gear inoperative for three months

each time resulted in nothing getting done during my recuperations. The lack of funds precipitated by layoffs and medical bills made it difficult to keep the project financed. I tried to fund this project as I could afford it, but I had to dip into my retirement to pay for the engine and prop, and again to pay for the panel.

“Angie and I also decided in the middle of this daunting project to remodel our bathroom. I am a DIY’er, so of course, time spent cutting tile is time not cutting aluminum. The following spring, we decided to make another house addition; a three-season porch that we have always wanted. That led to landscaping around the new porch, which led to landscaping the front of the house.

“I also endured the sudden loss of my brother just two years short of the airplane’s completion. I was really looking forward to giving him one of the first rides...that was very de-motivating.”

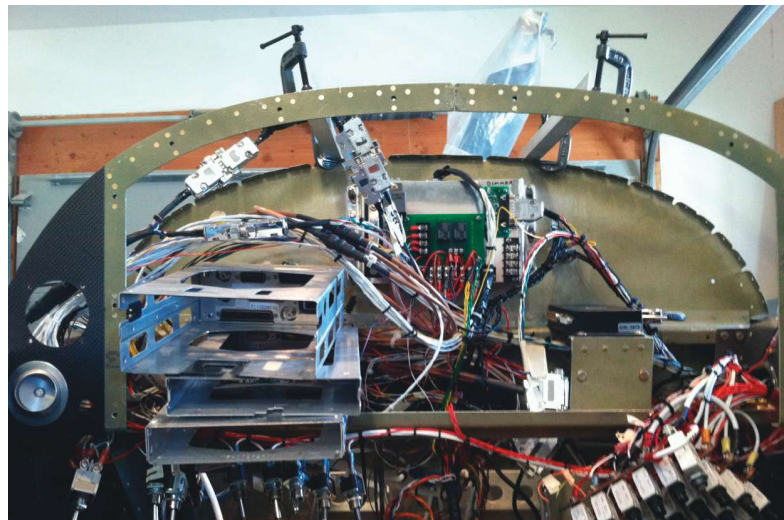
While this was a slow-build version of Van’s kit, Bob’s kit was one of the first that was built completely using “matched-hole tooling,” including the fuselage. Bob said, “This made it a ‘faster’ build in that it ‘clecos’ together right out of the box. Almost eight years of building is certainly not a record for the longest build, but still it was double the time I had originally expected it to take. Funny how everything seems to double; the financial contribution to this project was exactly double of my original projection as well.

“My explanation of why it took me this long to build has been—life kept getting in the way. That’s my story and I’m stickin’ to it. The clock keeps ticking away as we take on projects and struggle to complete them; that’s just the way life works.”

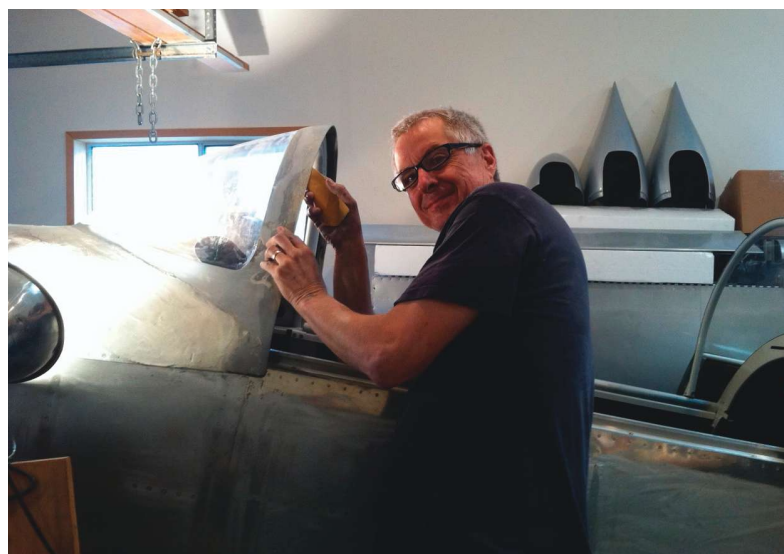
True Love was painted using Sherwin-Williams automotive silver right out of the can, and the red color is Dodge Viper red. Bob explained the color scheme: “I wanted a P-51 look about it, but I intentionally did not want to duplicate or model it after an actual aircraft. I wanted a civilian look to come through as well. I wanted the silver to look as close to polished aluminum as possible, with the rivets still visible. From even a slight distance, you would swear you were looking at polished, bare aluminum. A friend that I went to high school with owns an auto body shop in my town. We had lost touch over the years but were recently reacquainted. I started asking him about his comfort level with aluminum, and he said that he had done several aluminum cars. I did as much of the grunt work as I could but deferred to his and his brother’s expertise in final prep and shooting the paint. I brought it to him in pieces at a stop between my garage and the hangar.”

Being a true Minnesotan, Bob isn’t slowed down by winter. He said, “RVs are loud and cold without any insulation, and I like flying in the winter; so I chose to put in an interior despite the weight penalty. I had Classic Aero Designs build my leather seats with seat heat.”

Otherwise, Bob didn’t stray from the plans. “I didn’t want anymore unknowns than are already inherent in an experimental amateur-built aircraft,” said Bob. “That’s one of the reasons why I picked an RV; you can’t miss with this highly proven kit.



The maze of wiring behind the firewall was a challenge for Bob.



Bob works at fitting the sliding canopy.



Success! Bob’s digital instruments light up and function like they are supposed to.

WHAT OUR MEMBERS ARE BUILDING

“One feature that I do get compliments on is the carbon-fiber instrument panel and subpanels. I didn’t want to spend a ton of money on this, so I went with a product called Dragon Plate (still not cheap). It’s a thin (0.032) sheet that I just glued to the already cut panel, and then just cut out the holes to match. I had to sand their finish off in order to ‘bury’ my switch decals under an eggshell clear coat of my own.”

Bob’s advice to other builders is: “In the words of Commander Taggart played by Tim Allen from the movie *Galaxy Quest*, ‘Never give up...never surrender.’ As with anything in life, if it’s worth starting, it’s worth finishing; you must keep pressing forward. I know that’s a bit cliché, but it’s true. I found that when I was away from the project, that bothered me. I wasn’t very motivated. When I was working on it, I couldn’t get enough—I had to work on it every day.

“Reading articles and seeing completed projects in the ‘What Our Members Are Building’ section of *Sport Aviation* is very motivating. Watching YouTube videos and hanging out with other builders is also fun and inspiring. Van’s website links to builders and the Van’s Air Force forum help answer questions and motivates you, as you can see the mini-victories others have had.

“Being an A&P, I had many ideas and techniques that I bounced off other builders. Just like an extra set of eyeballs in the cockpit is always desirable, getting as many looks as you can at each stage of the project is important. That’s Airplane Building 101.”

When it came to fly N623RJ, Bob chose to get some dual before beginning flight testing. “I highly recommend getting some dual (insurance requires it anyway) from one of the professionals,” he said. “The RV is a different animal and deserves a great amount of respect as to its flying characteristics. I received dual

from Alex DeDominicis in the Dallas/Fort Worth (Texas) area, and I highly recommend him. My first flight would have been extremely stressful or worse had I not received that training.”

What advice does he have for a person sitting on the fence who may want to build an airplane? “I’d say to him or her, be certain that you can separate building an airplane from owning and flying an airplane,” Bob said. “The fact that the first and most common question asked by visitors to the shop is, ‘When will it fly?’ is telling. Of course we understand why they ask this question; nevertheless, they don’t get it. I always answered with Tuesday. The day I flew, don’t you know, it was a Tuesday.

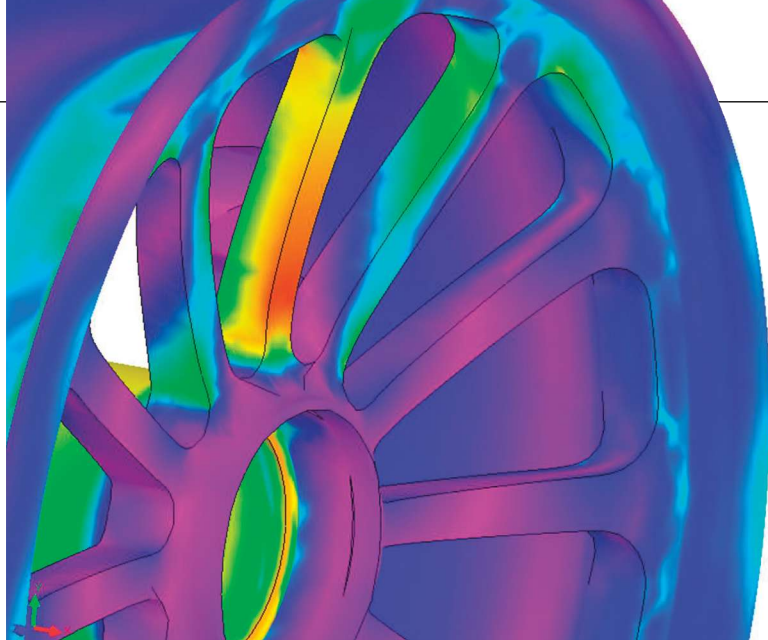
“You will never stay the course if your longing lies only in the desire to have a cool airplane at the end of the project; that is just the bonus when you do finally get there.

“Having understanding and cooperative family members behind you is imperative. Even if they will be offering little to no building assistance, they are key in your ability to stay on task. If the family is frustrated by you being in the shop all of the time, your project will become a burden instead of the fun and rewarding venture it was meant to be. My wife was incredibly supportive of this project throughout, but I still found that a big part of all that that needs managing was time spent with her.

“A project of this magnitude must be premeditated with the same concern as entering into marriage. Pick the right project that is a good fit for you. Like a marriage, the road will be fraught with bumps, curves, and financial challenges. No one goes to his or her wedding thinking about the end result of the marriage but rather about the life you will spend together. When you get to the place where you ‘can’t live without her,’ it’s time to place the order for the kit or the plans. The friend that turned me on to RVs aptly gave me this adage to hold on to: ‘It’s about the journey, stupid.’” *EAA*



Bob’s RV-8 midway through the project. Have you recently completed your project? We’d love to hear your story. E-mail Experimenter@eaa.org and share your photos and building experience.



Stress concentration is shown on this Beringer wheel. Knowing where the stresses are allows engineers to optimize strength versus weight.

Choosing Wheels and Brakes

Comparing the options

BY TIM KERN

WHEELS AND BRAKES ARE useless in flight—mere dead weight and often drag. Reno Air Race pilot Kevin Eldredge said that extending the gear on his NXT, *Relentless*, doubles the drag. But, once we're on the ground, wheels and brakes are our best friends.

The basics matter when choosing the right wheels and brakes for your aircraft. What is the airplane's gross weight, landing weight, and speed? Is it being flown off a hard-surface runway, gravel, or grass? These determine what tires are necessary. Everything else follows from accommodating the required tire.

Buyers of experimental light-sport aircraft (E-LSA) and amateur-built kits have options. While kit manufacturers obviously have selected systems based on their own engineering, operational, and cost criteria, many kit manufacturers will test and approve a customer's rational requests. Kit providers can opt to sell their airframes without wheels, etc. Many kits are sold in stages. In response, wheel and brake manufacturers often develop complete systems for LSA and amateur-built kits.

Design solutions are as varied as the manufacturers—magnesium or aluminum alloy or sand-cast, die-cast, spin-cast, and full-machined wheels, with open ball and tapered roller or sealed ball bearing wheels. Fixed-disc, floating-caliper or floating-disc, fixed-caliper brakes; single- and multi-caliper, carbon, iron, or stainless-steel discs; and single- or multi-piston calipers—are fed by flexible or monolithic tubing. Hundreds of master cylinders are on the market. And complicating all this are two incompatible fluids.

Disclaimer: This discussion is brief and necessarily generalized to fit in the space of one article.

WHEELS AND TIRES

Aircraft wheels are cast or machined. Forged wheels are not available in our aviation market, and stamped wheels are found in specialized applications only.

Cast aluminum (several different methods of casting are used) has moderate weight and moderate strength, takes paint well, and is low cost. Cast magnesium corrodes fast, has very low weight and relatively high cost, and is comparatively brittle. Cast wheels can be porous, so they usually require tubes or special sealant coatings.

Machined ("billet") aluminum wheels, properly engineered, are strong, shiny, and relatively expensive. They can be much lighter than cast, rivaling magnesium in weight. Machined aluminum can be anodized for protection and beauty. Aluminum is also much less brittle and less corrosion-prone than magnesium, and paints adhere better to aluminum; so "alloy" wheels can look better longer.

Nick Kaccludis, engineering manager at Cleveland Wheels & Brakes, said, "Don't be seduced by exotic materials and their promise of a few ounces [of weight] savings. Look at the operating environment and match your equipment to it. Magnesium is lighter than aluminum but is more susceptible to corrosion. Fix nicks in the paint right away. [Cleveland's online manual details how to do it.] There is a touch-up for corrosion: polish, clean, prime, paint." But he added, "If you



When well-protected and where flexibility is not critical, clear brake lines can save ounces.



For fast-landing or heavy airplanes, or an aircraft with tundra tires, one caliper may not be enough.

are a novice, don't just paint it yourself; modern two- and three-part systems may require professional intervention."

Comparing apples to apples, Rémi Beringer, chief engineer at Beringer Wheels & Brakes, noted that, in aluminum, "the breaking load of a cast wheel could be 25 kpsi; 61 kpsi for machined. Machining has a higher cost than casting but can be worth it."

Matco mfg, which provides parts to a myriad of original equipment manufacturer (OEM) kit builders and a large portion of LSA manufacturers, said that its products speak for themselves. With a wide range of master cylinders, wheels, and brakes in many sizes and capacities, the Matco line, backed up by its information-rich website, continues to dominate its segments.

Robbie Grove of Grove Aircraft Landing Gear Systems Inc. makes both tubeless and tube-type wheels and said, "Tubeless tires can lose a pound of pressure a day; corrosion is always a problem."

On lightweight airplanes, slightly low pressure in tires usually results only in sloppy handling, but that's not good when everything else is against you. But on heavier airplanes, where the tire's rating is closer to the actual load, even extended taxiing can fail an underinflated tire.

Typical modular designs add options for sizing; precision machining and nonporous material encourage tubeless applications, saving weight. Goodyear notes that both tubeless and tube-type tires can lose a pound a day from normal inflation and remain within spec. But that does not mean that your air pressure is in spec; check it every day.

Cheaper tubes, especially non-aircraft tubes, can lose a lot of pressure quickly. Though they may be lighter and are almost always less expensive, resist the temptation. Use the right components.

BEARINGS

Robbie Grove said, "The nose wheel has about twice the [side stress] requirement as the mains; we use tapered roller bearings in nose wheels." Rémi Beringer countered, "Due to its conical configuration, the tapered roller bearing pre-stresses the wheel and the axle; the ball bearing does not create an axial load when we apply a vertical load on it." And George Happ, president of Matco mfg, noted that the axle tension required when using tapered rollers contributes only a miniscule amount to rolling resistance.

There is less disagreement about sealed versus open-pace bearings: The big advantage of sealed bearings is that sealed ball bearings don't need periodic repacking, as do open ball or roller bearings, and their seals are more resistant to the entry of water. Though sealed bearings, in fact, cannot be repacked, that has not been a problem for most users. Beringer (which uses sealed bearings exclusively) noted that it has never sold a replacement bearing. That does not mean that Beringer never will, but it speaks well of the sealed design, popular across wheel manufacturers.

The basics matter when choosing the right wheels and brakes for your aircraft. What is the airplane's gross weight, landing weight, and speed?

BRAKES: FIXED OR FLOATING DISC, CALIPER

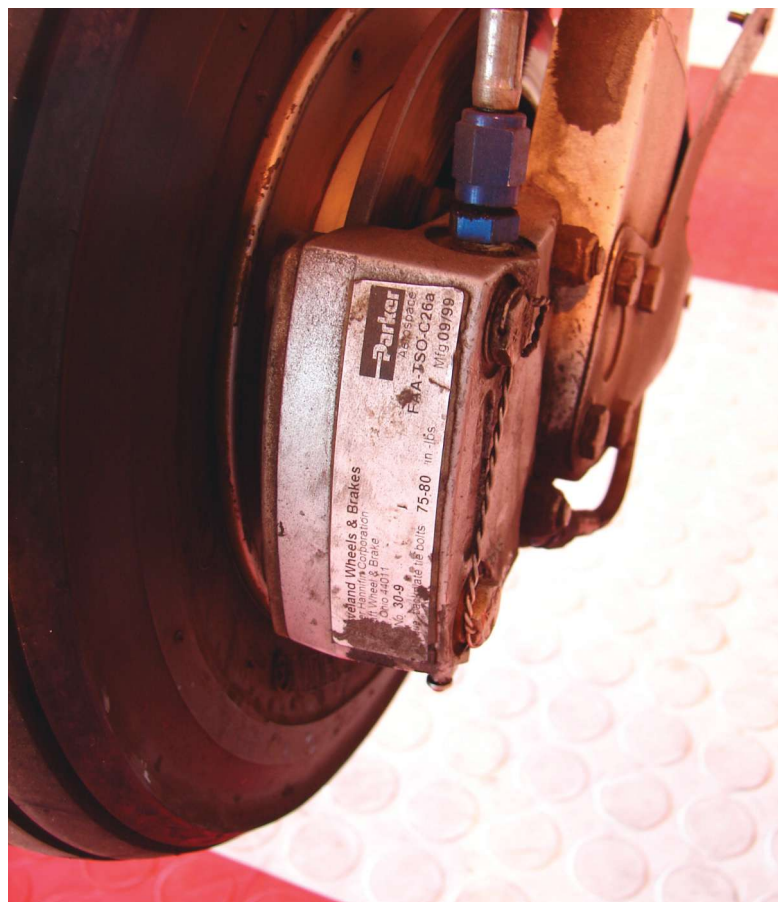
Either the disc or the caliper needs to “float” to make up for wear, disc warp, and inevitable tiny misalignments. Most automobiles use a fixed disc/floating caliper design, where the rotor is mounted directly and rigidly to the wheel, and the caliper is on a pivot. Costs are low; the necessary offset disc and caliper placement pose no great space penalty in a car; and maintenance requires a bit more disassembly than with a floating disc.

The floating-disc design, where the caliper is mounted rigidly to the airframe, tolerates greater misalignment, and the disc is less likely to get stuck while parked for months than in a floating caliper system. The fixed caliper system is often considerably less bulky and lighter than the automotive approach, important in retractable or low-drag designs. But a floating disc is generally more expensive and has a higher parts count, as the relatively soft wheel must be protected from the hard disc, usually by replaceable steel shields. Also, a floating disc's diameter is limited by wheel size. Though in practice it is rarely seen, a fixed disc mounted alongside the wheel can be of larger diameter.

Disc material: The disc absorbs and then radiates the heat generated in braking. Though some have tried stainless-steel and carbon discs, the most common material is still iron. Iron can absorb a lot of heat, so it's almost universal, even though it does rust overnight. That light surface rust disappears quickly with brake application and does not affect operation.

Brake pads: There are two families of pad materials: organic and metallic. Organic pads grip well when cold, offering good braking immediately and good control when taxiing, but they wear relatively fast and fade as they get hot. Metallics have the inverse characteristics. Consider when you first touch down, your airplane is light and can't use a lot of braking power, but as it settles onto its wheels, more braking is desirable. A brake material that grips better when hot best exploits available traction during landing. However, metallic pads require considerably higher pedal pressure when taxiing and are not effective when cold.

Calipers: The caliper works like a C-clamp on the rotating disc. There is a brake pad on each side of the disc. In one side of the caliper is one or more pistons, driven from the master cylinders by the pilot's feet. That pressure moves the pistons, which push the pads against one side of the disc, tightening the “clamp” against the disc on both sides. More pistons (typically two) allow more even pressure to



The Cleveland setup on F1 racer Endeavor.



Very light, very small aircraft don't need a lot of braking power. This Infinity powered parachute carries only one tiny, cable-operated brake on the front wheel.



Master cylinders come in a myriad of sizes and configurations. Match them to the rest of the system.



No matter what brakes you have, bleed them frequently and properly, as this RANS employee demonstrated at Sebring.

be applied over a larger brake pad, in turn allowing a larger pad and lighter backing plate. A multiple-piston design also allows a smaller caliper that more closely follows the arc of the disc profile. The downside is that multiple-piston calipers are more complicated (with, say, two moving parts instead of one) and are more expensive.

Sometimes, when loads increase and space for available brake components does not, multiple-caliper designs are necessary, as in high-energy or high-leverage (e.g., tundra tire) applications. Here two calipers are mounted opposite each other, and brake application then energizes multiples of pistons. Note that master cylinders need to be matched to the system; you often can't change or add calipers and expect the original master cylinders to handle the job.

Master cylinders: Master cylinders contribute to brake efficiency at least as much as the brake itself. They are often neglected; some wear, then leak or get blocked. Remi Beringer said, "Many 'brake problems' come from master cylinders that are worn or mismatched, resulting in a spongy or 'too hard' feel, even if your caliper is the best in the world."

The job of the master cylinder is to move brake fluid to the pistons in the calipers. The amount of fluid that must be moved and the pressure at which it needs to be moved are critical for proper brake operation. For any given amount of toe movement from the pilot, a small-diameter master cylinder will exert more pressure on the fluid, but less fluid will move. If the calipers have large or multiple pistons, there may not be enough travel in the master cylinder actuation to move enough fluid. If the diameter of the master cylinder increases, it can move more fluid, but it requires more pedal pressure for the same result. The entire system—from pedal and actuation geometry, to the stroke of the master cylinder and its diameter, to the size and number of pistons in the calipers—must be balanced. Master cylinder diameter and stroke must complement brake caliper requirements; a mismatch can result in oversensitive brakes or require excessive pressure from the pilot's toes. Either scenario detracts from control.

Brake lines: Small-diameter tubing translates the pilot's signals from feet and master cylinders to the caliper's pistons, containing the high-pressure brake fluid. Non-flexible metal tubing is inexpensive, excellent for transferring pressure without loss, light...and non-flexible. On lightly loaded systems, flexible "clear" polymer line is used throughout; stronger and more reliable steel-braided Teflon hoses are both tough and flexible. Many systems alternate lines according to where the flex is needed. This may or may not save weight, depending on how many fittings are incorporated; and more fittings mean more opportunities for leakage or line failure. Where long lines are necessary, consider using flexible lines only where flexibility is needed, and plan well to minimize the number of fittings.

Fluids: Typical in aviation is the familiar red mil-spec fluid. It has the advantage of not destroying paint when it's spilled or when it leaks. If leakage isn't a problem (and it

shouldn't be!) some now opt for DOT 4 fluid, which is automotive. It has a higher temperature tolerance and is available worldwide. The downside to DOT is that it's a serious paint remover. It is also hygroscopic—it absorbs water from the air. Note: Mil-spec and DOT fluids are not compatible, and each requires a different seal material in the master cylinders and the calipers. Pick one, buy the right components, and don't mix.

THE BIG PICTURE

So, it's best to choose a complete brake system (kit) where parts will work properly all together and are properly sized for your aircraft; consider the total system anytime you think about changing any component.

Just when you thought it would get easier, you'll realize that many specialty parts are available. In addition to the custom parts that Robbie Grove mentioned and the non-catalog parts that most manufacturers will provide, Beringer has a pressure-limiting system (called anti-lock in-line regulator, ALIR) that weighs about a pound and limits braking to a user-defined limit. The company said it allows maximum braking effectiveness, even if high but unequal pressure is applied to the pedals.

The amount of fluid that must be moved and the pressure at which it needs to be moved are critical for proper brake operation.

To aid understanding and help form the questions you'll want to ask the manufacturers, Matco mfg's George Happ points out that there is a huge amount of information on his new website (www.Matcomfg.com), discussing not only the items Matco sells but also the theories behind design, maintenance, and matching wheels and brakes to the applications. This information is not designed to sell a particular brand; it's there to help enlighten the reader, and it does a good job of it.

Reading all the manufacturers' information is highly recommended. It is all important and can give insights that this short feature cannot.

TIPS AND WISDOM

Nick Kaccludis said, "Match the tire and rim standards. And don't buy 'more axle than you need'; check with the airframer." To that end, all the "big four" offer complete systems—masters, brakes, and wheels—for OEM applications; all will also develop a parts list of what's needed for any known airframe; and all will offer advice on what to do with an all-new application.

Know what you're buying and why. Robbie Grove said, "Your basic 5-by-5 [tire] can go on a lot of wheels, and the



Don't neglect space for the fluid reservoir and lines. Plan ahead for every component, as in this Air Cam.



This Grove tubeless wheel sports a solidly mounted disc and floating caliper.

wheels may look the same. Check part numbers. We make both tube-type and tubeless wheels, and these too can look alike.”

Questions? Ask! Robbie said, “We have more than 500 master cylinders and field approvals are fairly easy. We have a lot of things that are not in the catalog, but we can make them or have already made them. Customs, too...clevises, shafts, spacers...they’re not all in the catalog, but maybe we have it.”

Vern Rodgers, who runs tech support at Cleveland, summed things up: “Follow directions. Don’t treat organic pads like metallic, though the other way isn’t as bad. Brakes wear prematurely more from neglect than abuse. Still, you can’t ride [aircraft] brakes; they don’t like doing 15 consecutive turns—these are not like car brakes.”

Whether you have metallic or standard organic pads, inspect them frequently. And look at both pads on each wheel. Sometimes the calipers hang up or dirt changes the equation, and one pad gets considerably more wear than the other. Wheelpants are not an excuse to avoid looking or for having low tire pressure.

Brake fluid is incompressible. Its volume will not change as pressure changes. That is not true with gases—air or water

vapor. No matter what your brake system’s componentry, it won’t work if there is anything but brake fluid in it. Learn to properly bleed your system, and do it at least annually as you flush out the old fluid. Bleeding removes air; flushing removes contaminants.

Always inspect the purged fluid; it often warns of rust, corrosion, or deterioration. And Robbie has a reminder, “Parts don’t last forever. Don’t stretch it.”

Lastly, weight is important, and every ounce counts. But the easiest way to save a couple pounds is to *have lunch after you land*. **EAA**

Tim Kern, EAA 852075, is a private pilot and certified aviation manager as well as an aviation writer and consultant based near Indianapolis, Indiana. In addition to having written for more than 50 aviation magazines, he handles marketing for Beringer Wheels & Brakes. He has made every effort to be objective in this article.

LINKS

- Grove: www.GroveAircraft.com
- Beringer: www.Beringer-Aero.com
- Matco: www.MatcoMfg.com
- Cleveland: www.Parker.com



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Longitudinal Static Stability, Part II

Friction

BY ED KOLANO

SO FAR IN OUR discussion of longitudinal static stability, we explained why this characteristic is important and how it can affect your perception of your airplane's handling qualities. We described how to test your airplane to determine its trim-speed band—that range of airspeeds the plane will maintain without any force on the control stick.

Last month we described a very basic flight test for getting a general feel for your plane's static stability. This time we'll finish the topic with the detailed flight test technique for assessing the friction in your plane's longitudinal control

system. Still no equations, and the only math is simple arithmetic—and it's optional.

From the basic approach explained last month, we produced the plot in Figure 1 and suggested it provides a general idea of the plane's static stability but is overly simplistic. It does not show the trim-speed band or the control system friction, but we're going to fix that now.

Performing the basic assessment will be tougher if there's a lot of friction in your longitudinal control system. The friction raises the force you must apply to the stick to

make the elevator move. And it lowers the stick force required to hold the deflected elevator in its new position because the friction is helping to prevent the elevator from returning to its pre-deflected position.

It's a good idea to spot-check for friction while performing your first test. Using our example from last time, your first data point target airspeed is 110 knots. To arrive at a stabilized 110-knot condition, you initially apply back-stick to begin the deceleration from your 120-knot trim point. As the airspeed approaches 110 knots, you'll probably vary your stick pull, searching for the pitch attitude that results in a stabilized 110 knots.

At this point, you're holding some back-stick. Let's say it's 5 pounds of pull. To check for friction, after you've stabilized at 110 knots, you slowly decrease your pull force (just like you

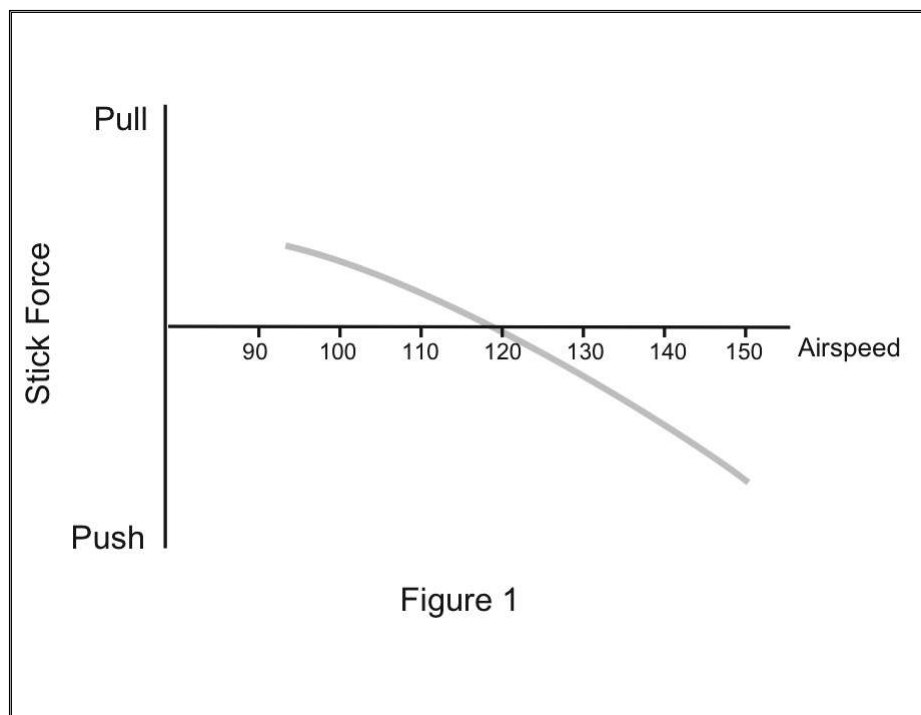


Figure 1

did during the trim-speed band test) until you notice the plane's nose begin to lower. You'll have to watch carefully because the nose drop will be subtle. Any head movement that changes the relationship between your eyes, the plane's nose, and the horizon can appear to be a pitch attitude change, so make sure you hold your head steady for this check.

As soon as you notice the nose drop, note how much pull force you're exerting and reapply a little more back-stick to prevent the airplane from accelerating. The pull force you apply here should not be more than the original 5 pounds you were holding when you first stabilized at 110 knots, because the idea is to stay within the friction band and maintain the 110 knots. If the airspeed increases when the nose drops, simply re-establish the 110-knot condition without retrimming or adjusting engine or propeller controls.

Let's say your pull on the stick is 2 pounds when you notice the nose drop. So far, you've established the low end of the control system friction band. Now repeat the process in the opposite direction. Slowly increase your pull force on the stick until you notice the nose start to rise. Note the force you're exerting on the stick, then relax your pull back to the original 5 pounds. Let's say the pull force is 6 pounds when you notice the nose rise. The total friction in your longitudinal control system for this flight condition is 4 pounds ($6 - 2 = 4$).

You must perform the test in both directions because you don't know where your original 5-pound pull was within the friction band when you first stabilized at 110 knots. In this example, our airplane will maintain 110 knots with any stick pull between 2 pounds and 6 pounds. Only by subtracting the low force from the high force can you determine the friction.

Although spot-checking the friction is a good idea, determining the friction band for the entire range of tested airspeeds is not a test you would likely perform unless you were looking for answers to flying task problems. For example, maybe you have a difficult time maintaining your final approach airspeed within 5 knots. Sometimes you nail it, and sometimes you think you have it nailed only to discover you're 5 knots off a few seconds later. Control system friction could be the cause, but you won't know for sure until you perform this test.

Figure 2 shows a static stability curve that includes friction. This level of static stability documentation is probably unnecessary for your flight test program, but the curve illustrates the effect of control system friction. The green curve represents the high end of the friction band, and the blue curve represents the low end. We've also included the original 5-pound pull force as a single data point to show where it lies within the friction band. In our example airplane, you could exert any pull force on the stick between 2 and 6 pounds, and not change your airspeed once established at 110 knots. This is because the friction prevents the elevator from moving until

you either decrease your pull to less than 2 pounds or increase it to more than 6 pounds.

For this example, we've presented the 4-pound friction band as constant, depicted by the green and blue lines parallel to each other. That is, the friction remains the same 4 pounds at all tested airspeeds between 97 knots and 142 knots. There is no rule that says the friction must be constant, but it usually is.

Notice the curve does not extend into the region between 114 knots and 124 knots. This 10-knot spread represents our example airplane's trim-speed band that we determined two articles ago. Remember, the definition of the trim-speed band is a range of airspeeds the airplane can maintain hands-free. No stick pull or push force is needed within the band to maintain airspeed there, but you could exert a variety of stick forces (up to the breakout force) within the band with no resultant airspeed change. This month we are interested in the airplane's static stability outside its trim-speed band, so stick forces are not shown within the trim-speed band.

BY THE NUMBERS

1. Trim for hands-free, level flight at the desired flight condition.
2. Using only back-stick, decelerate and establish a stabilized condition a few knots slower than the slow-speed end of the trim-speed band. Do not retrim or adjust engine or propeller controls.
3. Check for friction.
 - a. Carefully watch your airplane's nose and the horizon as you slowly relax your pull force on the stick.
 - b. When the plane's nose begins to lower, note your pull force and reapply some back-stick to prevent the airplane from accelerating.
 - c. Slowly increase your pull force on the stick.
 - d. When the plane's nose begins to rise, note your pull force and slightly relax your back-stick pull to prevent the airplane from decelerating.
 - e. Determine the friction band by subtracting the stick force in Step 3b from the force in Step 3d.
4. Using only forward-stick, accelerate and establish a stabilized condition a few knots faster than the fast-speed end of the trim-speed band. Do not retrim or adjust engine or propeller controls.
5. Check for friction.
 - a. Carefully watch your airplane's nose and the horizon as you slowly increase your push force on the stick.
 - b. When the plane's nose begins to lower, note your push force and slightly relax some forward-stick to prevent the airplane from accelerating.
 - c. Slowly relax your push force on the stick.
 - d. When the plane's nose begins to rise, note your push force and reapply your forward-stick push to prevent the airplane from decelerating.
 - e. Determine the friction band by subtracting the stick force in Step 5d from the force in Step 5b.

- Repeat Steps 2 through 5, targeting a test airspeed a few knots slower and faster respectively than your previous test airspeed until you've mapped the entire airspeed range of interest.

Note: This alternating slow/fast method helps to keep your airplane at approximately the same altitude for all test points. If you are only interested in how the stick force increases as you fly further and further from the trimmed airspeed, it would be more illustrative to fly progressively slower or faster test airspeeds in order—for example, 110, 105, 100, 95, 90, 130, 135, 140, 145.

Whether you opt to measure the control system friction for every test airspeed is up to you, but here's a guideline. If the nose moves with just the slightest stick relaxation and with the slightest increase in stick force, the difference between these two forces is small, and the friction is probably insignificant. In this case, you might opt to limit your testing to the basic approach described last month. If you find you have to relax and increase your stick force substantially, there's probably a significant friction band. At this point, you could measure the friction, but this qualitative assessment is probably all you need to answer your airspeed control difficulty question. We've overlaid the basic approach curve from Figure 1 on Figure 2 to show that this is only one of many possible curves you might have come up with had you not checked for friction. Another note: Although we showed the blue and green curves as straight lines to better illustrate the friction band, this is not usually the case.

Center of gravity (CG) can drastically affect the shape of your airplane's static stability curve. The farther aft the CG, the flatter the static stability curve, meaning it takes less stick force to fly "off-trim" airspeeds. As the CG moves progressively aft, eventually it will reach a location called the neutral point. When the CG is located at the neutral point, the airplane will maintain any airspeed hands-free, that is, neutral static stability. With enough friction in an airplane's longitudinal control system, the plane can appear to have neutral static stability even with the CG well forward of the neutral point.

Because you're looking for tiny pitch attitude changes during this test, calm air is essential. If it's bumpy, save the test for another day. Early morning is usually the best time to find calm air.

Those same tiny pitch changes can only be accurately detected with an outside reference. The artificial horizon, altimeter, and vertical speed indicator are too coarse. The real horizon is the best reference. You can try using a distant cloud; but clouds move, and the closer

Performing the basic assessment will be tougher if there's a lot of friction in your longitudinal control system.

you are to your external reference, the greater the likelihood of a parallax error.

When mapping the airspeed range for this test, it is not necessary to stabilize on an exact target airspeed. Your goal is to feel how the stick force increases as you fly further and further away from your trimmed airspeed, so it's the stick-force trend that's important. For our example, we targeted 110 knots for our first data point. If the pilot stabilized at 112 knots or 108 knots when aiming for 110 knots, it would have been okay. If we were being rigorous about this test, we'd be fairing a curve through all the data points, anyway. When collecting data to create a curve, high-quality test data with a consistent airspeed spread between test points is more important than testing at the exact target airspeed. The same logic applies to our test. We're essentially constructing that curve in our heads as we feel how the stick-force requirement changes at the different airspeeds.

This wraps up our four-part series on longitudinal static stability. Next time we'll take a break from the technical stuff and start exploring the fussier world of pilot decision-making. *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.

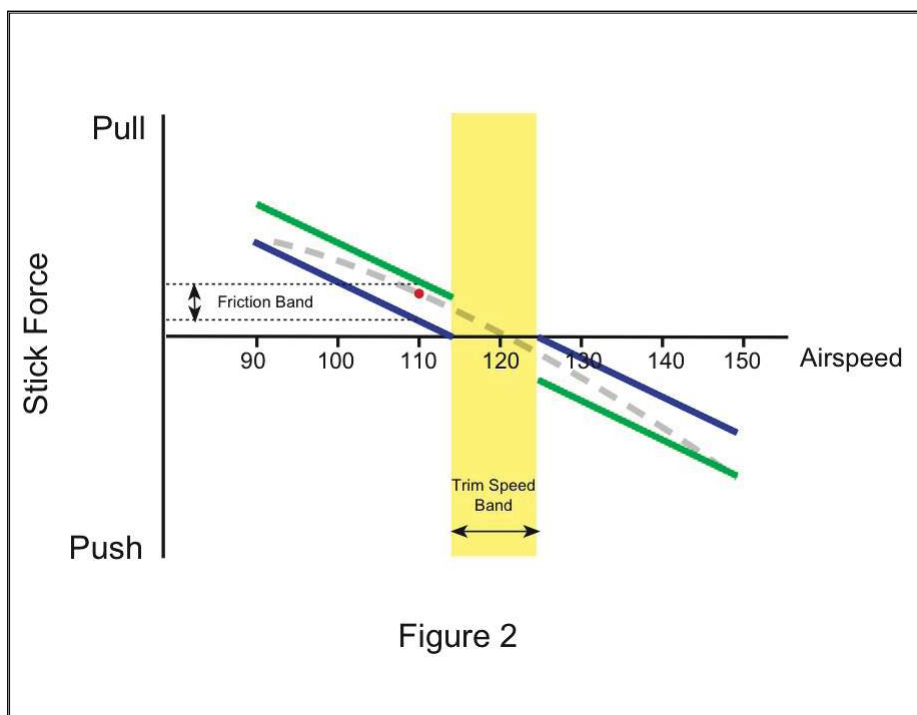


Figure 2

Flying With Your Smartphone

Top aviation GPS apps for Android phones

BY DAN GRUNLOH

NO TECHNOLOGY IN HUMAN history has achieved a faster adoption rate than the mobile phone. There are 4.5 billion individual subscribers on the planet (mobiThinking.com), and we have as many mobile devices as humans. Smartphones account for 80 percent of all mobile phone sales in the United States. About 40 percent of U.S. smartphones run on the Apple iOS system while Android phones dominate worldwide due largely to the lower cost. With GPS receivers becoming commonplace in smartphones, more pilots are using them as a backup navigation device.

Apple iPhone users have a head start in GPS flying apps, and they report the highest level of customer satisfaction. ForeFlight

is currently number one and popular with busy, working pilots. There is no Android version. Next in subscribers is WingX Pro7, popular for light-sport aircraft pilots building flat-panel avionics around the iPad. An incomplete Android version was offered, but it is not supported. In third place and catching up fast is Garmin Pilot, available for both iOS and Android devices.

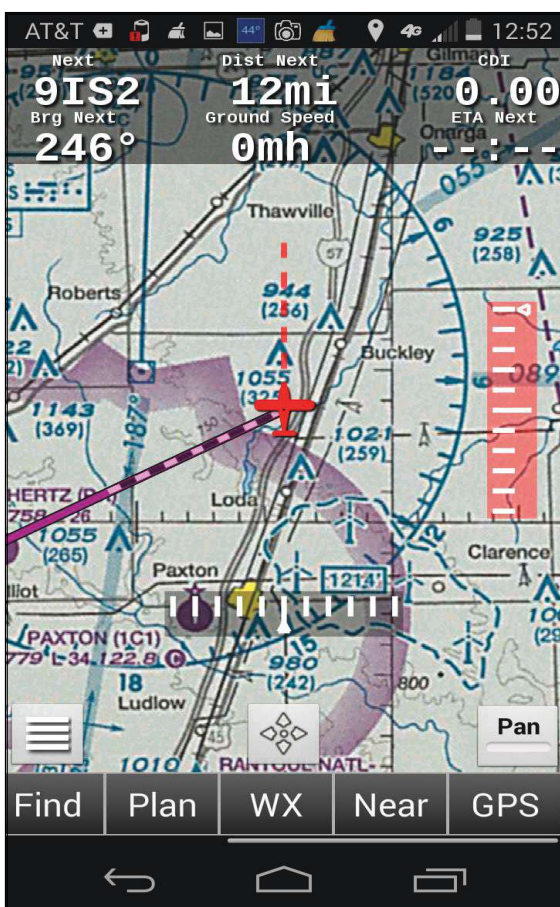
It would be foolish to fly into unfamiliar terrain with a smartphone as the only navigation aid. Smartphone apps update frequently, and what worked yesterday might quit working today. The phone technology and the features of the apps evolve rapidly. The only way to know which features will work for you is to take a 30-day free trial. All four of the reviewed Android apps offer some form of ADS-B (automatic dependent surveillance–broadcast) service that provides in-flight weather, TFRs (temporary flight restrictions), and traffic advisories through the addition of a receiver that costs around \$500 and up.

AVARE – FREE ANDROID APP

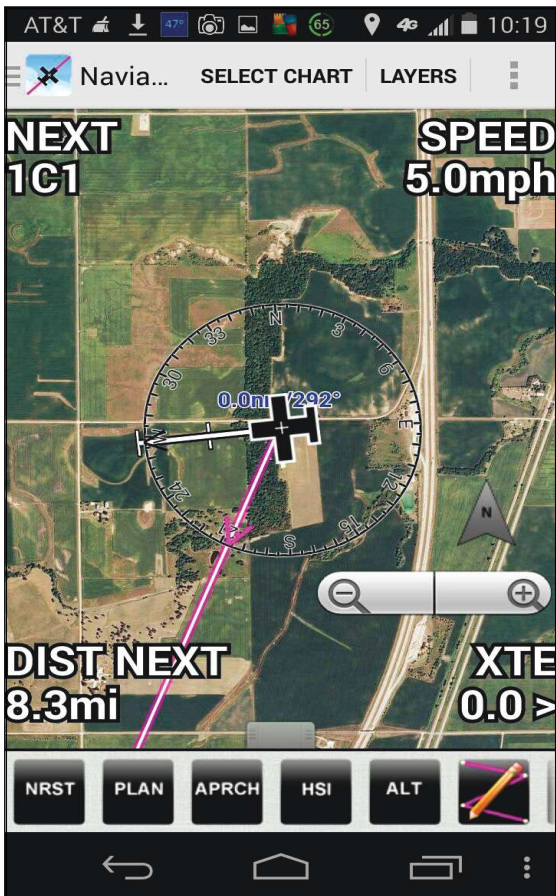
Avare is a totally free moving-map GPS app with FAA charts and airport directory and approach plates with more than 50,000 installs on the Google Play store. FAA NEXRAD graphics, MET-ARs, TAFs (terminal area forecasts), and TFRs are available. It was introduced in 2012 as a free open-source app with no subscription fees and no ads. A group of volunteers continues to add features such as ADS-B capability and connectivity to an external GPS source. The ADS-B function works through an XGPS170 receiver (\$495). Questions from users are answered on the [Avare forum](#).

The moving map screen includes six customizable navigation data blocks at the top in large white lettering. A double tap on any of the data blocks opens the options screen. You can draw or write on the chart to record notes. There is no separate NAV data screen. A course deviation guide bar can be displayed on the map main screen, and course deviation data is available in the top data block.

A long press anywhere on the chart opens a window with distance and bearing from the current location and the option to set it as the destination. To use the amazing “Fly There” function, open Google Maps with an Internet connection while Avare is running and search for any location or any point where you drop a red marker. Activate the share option and choose the Avare icon among the list of apps. The location will be instantly set as the active destination, saved under the “Find” menu, and Avare opens ready to navigate. The app does not brief or file



Avare map screen with track line, course line, and NAV data.



Navia... on aerial map with track line, course line, and NAV data.

your flight plan with DUATS, and the route planning features are rudimentary. And did I mention it is free?

NAVIATOR

Navia... from 123west Software Inc. has charts and data for U.S. and Canadian airports with more than 50,000 installs on the Google Play Store. Navia... has been upgraded with many new features, but it retains a somewhat traditional appearance to the screens. This is a great asset when running on a phone because the symbols, icons, buttons, and NAV data displays are large and boxy. You can see them on a small display and in bright light. The simple, all-black, boxy airplane icon on the moving map is terrific.

The full-screen HSI (horizontal situation indicator) is very visible in full sun, and that is a major selling point for me. The new aerial imagery map layer (satellite view) includes a very high zoom level. It would be great fun for low-and-slow flying. When viewing U.S. sectionals, the app does not “roll over” to the adjoining sectional when you fly off the chart. You must manually choose the appropriate chart with the “Select Chart” button.

Use a long press on any of the four NAV data fields on the corners of the map to customize the display. A single tap on an airport identifier provides access to airport information, including plates and the airport diagram if available. Or choose the “Direct To” function and make it the current destination.

Routes can be modified by dragging the course line with a “rubber band” tool. The annual subscription is \$34.99, making it the least expensive of the paid apps. Navia... provides ADS-B traffic and weather information with the dual-band SkyGuardTWX receiver, which is \$675. See your location on geo-referenced approach plates and airport diagrams with a subscription from Seattle Avionics Software at \$75 per year.

GARMIN PILOT APP

Garmin Pilot for Android has more than 10,000 installs on Google Play and is the only major developer committed to offering a pilot GPS in both iOS and Android version. The latest release brings its feature set to par with any other offerings. Garmin brings name recognition, long experience with GPS products, and emphasis on in-flight use and delivers a smartphone app with a familiar friendly appearance.

The app itself is large and slow to load initially; but the display screens are impressive and the charts are very sharp. A long press anywhere on the chart brings up a radial menu tool that provides context-sensitive quick access to weather, airport information, direct routing, and flight planning. The graphical route editing tool allows “rubber band” route modifications and creation of user waypoints with astonishing ease. The weather



Navia... full-screen HSI can be easily viewed in full sun conditions.

text section under the home screen button beautifully displays translated METARs, TAFs, and forecasted winds aloft.

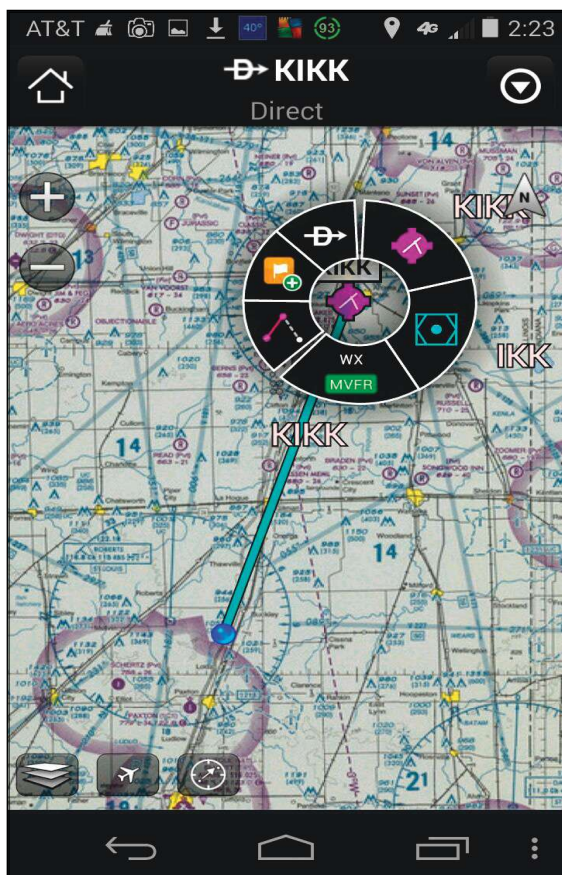
On the negative side, the moving map window does not include a graphic track line indicator, and the NAV data bar described in the manual is not included in the smartphone version that I am previewing at this time. The moving map features only an airplane icon and a course line. Garmin Pilot has very nice NAV screens, but the smartphone version does not enable split screens. The NAV units can only be set to knots and nautical miles. The annual subscription is \$74.95. Garmin offers an external GPS Bluetooth receiver for \$129 and a combination GPS and ADS-B receiver with advanced weather and traffic displays for \$599.

AVILUTION – FOREFLIGHT FOR ANDROID?

Avilution AviationMaps is a fast, full-featured GPS flying app with more than 10,000 installs on Google Play and has been compared to ForeFlight for iOS. The manual is sparse, but the developer gets top marks for product support. The display of airport information and weather is simply superb, but flight planning was not as easy for me. This is the only app of the four tested that enables a split-screen function on a smartphone. If you are careless, it's possible to get a confusing mixture of overlapping screens all at the same time. There is no separate



The Garmin NAV screen looks like the real thing.



Garmin map screen with multipurpose radial ring tool centered on airport.

HSI or NAV screen and no graphical track indicator on the map screen as included in Avare and Naviator.

On-screen NAV data is displayed in a large font, but it needs to run in landscape mode on my phone. In portrait mode, the NAV data at the bottom of the map screen displays in vertical columns, using up too much screen space. The button controls seem a little small on my 4.7-inch screen. The app is probably better suited to a tablet where it apparently excels. The standard subscription is \$54.95 per year or \$114.95 per year with geo-referenced approach plates. A single subscription is good for one user on multiple devices. Avilution uses the SkyRader DX (\$849) or the Dual XGPS170 (\$495) for ADS-B weather and traffic advisory functions.

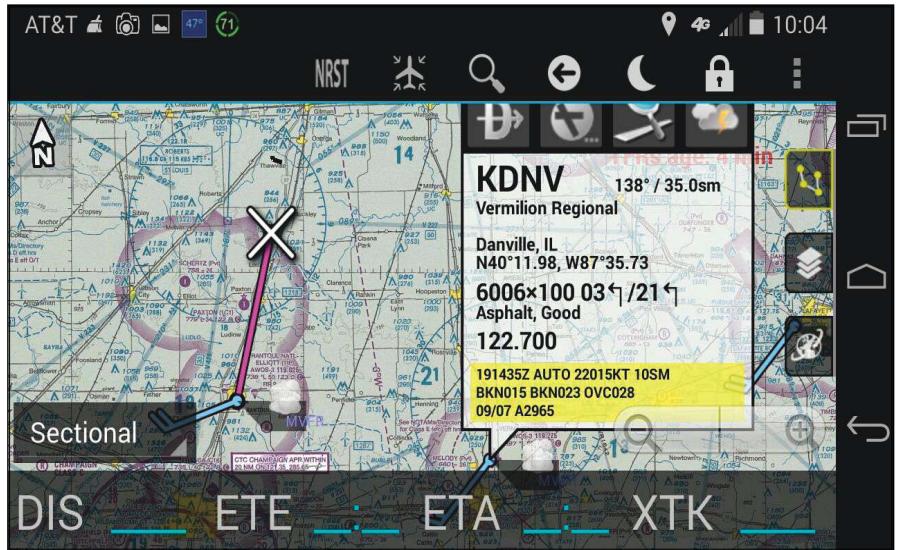
REAL FLIGHT TESTS AND CONCLUSIONS

Working these apps on the ground for flight planning is only half the picture. Will they be functional enough in flight to serve as an effective backup? To find out, I started all four apps running on a Motorola Moto X phone and set them for the same destination. I then took off in my trike (open cockpit) on a sunny day while wearing gloves. Removing a glove in an open cockpit to operate avionics is a good way to lose it. A solution is to cut a small slit on the inside of the glove's pinky finger so you can slip your finger out to work the touch screen. The phone stayed firmly attached to my kneeboard

with its belt clip, and I could quickly toggle between the running apps.

The real surprise was how well they all worked in flight. I deliberately flew off course and then tried to get back on course using a single screen. The graphic track line projections in Avare and Naviator were helpful in bright sun. The HSI screen in Naviator and the NAV screens in Garmin Pilot were tops. Battery drain will be huge if the screen is on full time at full brightness. The all-black NAV screens will save much power. I tend to use GPS for backup and intermittent use. All the apps except Avare will remember the last active route and return to it automatically even if the phone has been shut off. A full installation of all charts and plates for the United States could require up to 8 gigabytes of storage. The data for a two- to three-state area is barely one gigabyte. Conclusion: A single flight is no indication of reliability, but I think I may soon retire my antique, 7-year-old handheld aviation GPS. It has become a dinosaur.

Please send your comments and suggestions to dgrunloh@illicom.net. *EAA*



Aviation map screen with airport information and tools window.

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.

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