Vol.4 No.3 / March 2015

EXPERIMENTER

The Spirit of Homebuilt Aviation / www.eaa.org

TEAM Mini-Max «
Yesterday and today

Titan Aircraft Engines «
What's really new

A Corvair-Powered
Tailwind

Women in Aviation: We Need More of Them

BY JACK J. PELTON

THE HISTORY OF WOMEN in aviation is unusual compared to other male-dominated activities because women were involved almost from the beginning.

For example, in 1906, just three years after the Wright brothers' first successful powered flights, E. Lilian Todd designed and built an aircraft. In 1908 Frenchwoman Therese Peltier was the first woman to pilot an airplane. And in 1910 American Blanche Stuart Scott was the first woman to solo an airplane.

The list of female firsts in aviation goes on, and the historic events occurred very early in the history of flight. Women were obviously interested in aviation, and at least some were supported and encouraged to participate.

March is Women's History Month, and we mark the occasion in this month's issue of *Sport Aviation* with an article about female pilots who race at Reno, and another about women who do their flying at the grassroots level. It is important, even vital, to note the success of women who fly.

But somewhere between Blanche's first solo in 1910 and now we lost momentum. Though women have flown everything from ultralights to the space shuttle, their numbers in our ranks remain far too small.

In the United States about 6 percent of all active certificated pilots are female. And that percentage has changed little over the decades. In fact, when the active pilot population peaked in the mid-1980s the share of women was about 6 percent, and it's essentially the same today with a quarter million fewer pilots.

Certainly some of the blame for the small number of female pilots can be placed on outdated attitudes from guys. For too long flying and all things aviation was an all boys club. Even when women weren't actively excluded they too often were not welcomed.

I'm happy to say that the actual barriers to women in aviation have largely been torn down. But we haven't been able to create the critical mass necessary to make girls and women feel welcome. We all want and need to have people around us who we can relate to, who can be examples, and who can inspire us. With too few women in aviation those role models are too often missing.

However, our annual convention at Oshkosh is an example of success in welcoming and including women and girls. When I first started attending the convention decades ago there just weren't many girls and women there. But that has changed. We don't know absolute numbers, but my guess is that at least a third or more of the people at Oshkosh are female. And that's great.

I believe there are two major reasons so many more women come to Oshkosh. One, and perhaps most important, is at the individual level. More of you, the guys, have encouraged your wives, daughters, and girlfriends to come to Oshkosh. That is essential. The other big reason for change is that as a group EAA has created activities and opportunities to include women and girls, to make them part of the overall experience.

Another change has come from the aviation industry, which has actively set goals and succeeded in hiring more women. Now there are women as part of the teams of nearly all exhibitors at the show. They are leading by example.

Welcoming women and expanding the diversity of all who participate in aviation is a major objective for EAA leadership. We simply can't grow, or even survive, as an old white guys club.

That's one of the reasons our Young Eagles program is so successful and vital for the future. Nearly half of the youngsters who participate are girls. EAA's Women Soar program offers an aviation day camp at Oshkosh for girls and includes female-specific activities during the convention.

And EAA will continue to develop programs to involve and include women and girls, and I know they will help. But the most effective outreach must come from each of us guys who fly. When we are attentive to the interest, concerns, and even worries of the girls and women in our lives about all things aviation we make progress. Inclusion must be continuous, not just annual events or even monthly meetings.

It's right to celebrate the history of women in aviation, but it is essential for flying's future to do what it takes to make girls and women an everyday part of the personal aviation world we all love. EAA

Photography by Jason Toney

EAA PUBLICATIONS

Founder: Paul H. Poberezny
Publisher: Jack J. Pelton, EAA Chairman of the Board
Vice President of Communities and Member Programs: Rick Larsen
Editor-in-Chief: J. Mac McClellan
Homebuilding Community Manager: Charlie Becker
Editor: Mary Jones/EditEtc. LLC
Senior Graphic Designer: Chris Livieri
News Editor: Ric Reynolds
Copy Editor: Colleen Walsh
Multimedia Journalist: Brady Lane
Visual Properties Administrator: Jason Toney
Contributing Writers: Charlie Becker, Budd Davisson, Dan Grunloh, Tim Kern, Richard Koehler, Bob Rychel, Grant Smith

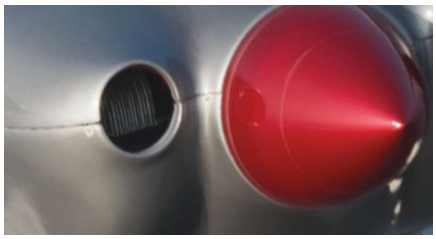
ADVERTISING

Display
Sue Anderson

Mailing Address:
P.O. Box 3086, Oshkosh, WI 54903-3086
Phone: 920-426-4800
Fax: 920-426-4828
E-mail: *experimenter@eaa.org*
Website: *www.EAA.org*

Need to change your address or have other membership questions? Call 800-564-6322 (800-JOIN EAA).

Features



Departments

Columns

On the cover: Bill and Kyoung Clapp's Corvair-powered Tailwind. (Photography by Tyson Rininger)

Give Flight

Learn, build, fly

BY CHARLIE BECKER

LAST YEAR AT EAA AirVenture Oshkosh, more than 2,500 volunteers helped us build the *One Week Wonder*. In just seven days, we took a standard Zenith CH 750 Cruzer kit from its crate to an FAA-certificated aircraft. It was a tough challenge. At times during the week, I seriously doubted that we would complete the aircraft. But the response from everyone who witnessed the project was overwhelmingly positive, and that made all the hard work worthwhile. It put the spotlight squarely on homebuilding right at Show Center, and it introduced the concept of building your own aircraft to thousands of people.

So what can we do to build on last year's success?

How about building five sets of wings that will be given to five different chapters to jumpstart five different building projects that we hope will lead to the formation of five different flying clubs?

This summer at EAA AirVenture Oshkosh 2015, we will be building on the success of the *One Week Wonder* project by constructing five sets of wings for various kit-built aircraft. By kicking this off at Oshkosh we will get to promote two of EAA's core activities—homebuilding and chapters—to tens of thousands of people. Plus we will get to promote the concept that flying clubs are a way to reduce the cost of learning to fly as well as the barriers to participation in aviation. Since Paul Poberezny founded EAA, affordable access to the "vast ocean of air" above us has been a part of EAA's goals.

Volunteers will construct the wings on each of the seven days of the convention, and anyone who walks by may participate by pulling a rivet. The completed wings will then be shipped to five different EAA chapters to help them jumpstart a chapter building project. The chapters will receive the completed wings for free, but they will be responsible for raising the funds to complete the aircraft. EAA is in the process of determining which kit manufacturers want to participate in the project.

Some of you might be thinking, "But I thought chapters are not allowed to operate an aircraft?" That is true, but EAA chapters are allowed to build and restore aircraft. Plus, if a group of EAA members wants to get together and form a flying club, that's not a problem. It just can't be done under the banner of an EAA chapter.

Think of the impact that this whole project will ultimately have on aviation. First, it will inspire a lot of chapters to consider taking on a building project. Second, it will provide countless hands-on learning opportunities for those chapters that end up building the rest of the aircraft. Third, it is an opportunity to highlight chapters all over the country. And, fourth, we hope the finished aircraft will give birth to five flying clubs that will ultimately provide countless flying experiences. Imagine all the Young Eagles flights and pancake breakfasts that these five aircraft will ultimately be a part of.

Plus I'm going to throw out a further challenge to the chapters that ultimately receive these aircraft … why not bring them back to Oshkosh when they're completed to show them off and inspire other chapters to take on a homebuilt project. Imagine all five of the aircraft parked by the Brown Arch on the Oshkosh grounds in a few years!

If your chapter is ready to take on a building project, contact me at cbecker@eaa.org. I'll be putting together the program requirements in the upcoming months. In the meantime, talk it up at your chapter and see what level of interest your chapter has to take on a building project. EAA

Get Hands-on.

The skills you need from the experts you trust.
For workshop dates, locations and costs,
visit **EAA.org/SportAir** or call 1-800-967-5746.

EAA SportAir Workshops

EAA SportAir Workshops are sponsored by Aircraft Spruce & Specialty Co. SINCE 1965 and POLY FIBER Aircraft Coatings www.polyfiber.com

Earplug Alert

A U.S. MARINE CORPS AV-8B Harrier jump jet will perform Level III aerial demonstrations at EAA AirVenture Oshkosh 2015, one of only nine Harrier performances this year. Always a popular item in the afternoon air shows, exact performance dates have yet to be determined, but the specific Harrier flying at Wittman Regional Airport will be from either Marine Corps Air Station Cherry Point or Marine Corps Air Station Yuma.

The demonstration consists of an 8 to 10 minute display of the aircraft's abilities, including a 90-degree climbing turn, a high-speed pass over the runway, and a vertical landing in front of the crowd. According to the Marine Corps, many of the maneuvers demonstrated at the air show represent those executed in Operations Iraqi and Enduring Freedom as well as in operations conducted at sea aboard naval vessels.

With the capability to operate both in day and night, the Harrier is used in combat for engaging surface and air targets, escorting helicopters, and conducting deep air support.

Women Soar *You Soar* Registration Opens

REGISTRATION IS OPEN for EAA's Women Soar *You Soar* day camp program, which will allow 100 high school age girls to discover more about aviation and all its possibilities from aviators, engineers, and leaders during EAA AirVenture Oshkosh 2015. The program will take place July 19-22.

Women Soar *You Soar* welcomes both enrollees as well as female mentors from the aviation and aerospace fields. The program's unique 4-to-1 attendees-to-mentors ratio provides a tremendous opportunity for young women to discover all the possibilities within the world of flight. They can ask questions of women who are already noteworthy and established in the field.

Activities over the four-day session for girls entering grades nine through 12 in fall 2015 include flight simulators, workshops, sessions with aviation personalities, and insider access during the AirVenture air shows.

Cost is $75 per participant and is in a day-camp format, with accommodations not included. More information and registration materials are now available at www.EAA.org/WomenSoar. The program also welcomes additional female mentors from all walks of the aviation and aerospace community who want to give back to the next generation.

Women Soar *You Soar* is supported by Embry-Riddle Aeronautical University, Women in Aviation International, International Society of Transport Aircraft Trading, and Jerry and Lori Fussell.

30,000 Youths Have Enrolled in Sporty's Course With EAA Young Eagles

EAA AND SPORTY'S Pilot Shop are doing their part to build the next generation of aviation, as more than 30,000 young people have enrolled in Sporty's Online Learn to Fly Course as a follow-up to their EAA Young Eagles flight.

The Sporty's course, which was first offered to all Young Eagles without charge in 2009, allows young people to take the FAA sport, recreational, and private pilot ground school courses at no charge. The course is a next step for the more than 70,000 Young Eagles flown each year by EAA member volunteer pilots. Since the Young Eagles program launched in July 1992, more than 1.9 million young people have been flown.

Young Eagles receive information on how to register and begin the Sporty's Online Learn to Fly Course immediately after their flights. The instructions and login information allow young people to start discovering more right away.

Photography by DeKevin Thornton and Melody Wollangk

Pilots Sought to Complete Survey on New Canadian Border Crossing Requirement

AN ADDITIONAL PROCEDURE IS being developed by the Canadian Border Services Agency (CBSA) for pilots crossing the international border with the United States. The Canadian Owners and Pilots Association (COPA) and AOPA have developed a survey to provide statistical feedback to Canadian and U.S. officials to find a solution that both addresses their goals and minimizes duplication. COPA is heavily involved in finding creative solutions to minimize the detrimental consequences that any additional requirements will have on our sector of aviation.

No changes have been made to the existing requirements yet. Any change to the requirements for crossing the border in a GA aircraft will, at the earliest, occur sometime in 2016.

The fundamental issue for COPA is eliminating duplication. Since all pilots must complete the U.S. eAPIS reports for entering and exiting the United States, it seems it would be a relatively simple extension for the U.S. to send information to Canada for its security purposes.

CBSA officials continue to collaborate with our sector, while at the same time respecting the Canadian government's privacy rules and policies, which makes the work more challenging. A Washington meeting succeeded in convincing the CBSA that its U.S. counterpart is willing to cooperate. COPA will continue to participate in the ongoing working group meetings as well as with their counterparts in the U.S. in an effort to develop a program that both meets the government's needs and minimizes the impact on our sector of aviation.

Complete the COPA/AOPA survey on CBSA's Canadian Cross Border NEW requirement.

Gene Kranz to Speak at OSH Lifetime Member Dinner

GENE KRANZ, LEAD FLIGHT director of Apollo 13, will be the featured speaker for the annual First Wing and Lifetime Member Dinner on July 21 during EAA AirVenture Oshkosh 2015. Kranz and several Apollo 13 crew members will attend the convention this summer in honor of the mission's 45th anniversary.

The annual dinner is a special benefit for First Wing and Lifetime members. Attendees will hear exclusive stories from Kranz and have the opportunity to purchase a signed copy of his book, *Failure Is Not an Option*.

To learn more about EAA Lifetime membership, or to register for the dinner, e-mail EAA membership services at membership@EAA.org or call 800-843-3612.

AirVenture to Host World-Record Sky Diving Attempts

A WORLD RECORD SKY dive attempt will be part of EAA AirVenture Oshkosh 2015, with an international team of top sky divers aiming to make history at the World's Greatest Aviation Celebration.

The Skydiving Hall of Fame based in Fredericksburg, Virginia, will organize the 108-person jump team for the record attempts sanctioned by the Fédération Aéronautique Internationale (FAI), which is the official organization that maintains the world's aviation-related records. The teams will practice and prepare with record attempts at Skydive Chicago in Ottawa, Illinois, before the scheduled record attempts on July 22 and 24 at Oshkosh (weather and conditions permitting).

The Skydiving Hall of Fame team, known as the Eagles, will jump from as high as 20,000 feet from its Short SC.7 Skyvan and de Havilland DHC-6 Twin Otters to begin their record attempts. Any record would then be confirmed by FAI and its U.S. representative, the National Aeronautic Association (NAA). EAA

New PS Engineering Audio Panel Designed for Homebuilts

PS ENGINEERING HAS tailored its latest and most capable audio panel to suit the requirements of homebuilt airplanes and other experimental aircraft. The new PDA360EX retains the advanced features of PS Engineering's top-of-the-line audio panel but leaves out capabilities experimental airplanes won't use to save money.

IntelliAudio is a new feature PS Engineering introduced last year. The technology allows pilots to listen to two radios at once but to "position" the sound using stereo headphones so one radio is audibly dominate while the other is still hearable in the background. The technique is essentially the same that we use to listen to a conversation with one person in a crowded room of other conversations.

Listening to ATIS while still being able to hear controllers is a common example of how IntelliAudio is useful. And there are many other situations where you want to "guard" a second frequency while paying close attention to another.

The PDA360EX also has PS Engineering's IntelliVox voice sensing technology on the intercom. IntelliVox uses digital electronics to recognize when you are speaking into the microphone and opens the circuit automatically. The system is smart enough to reject non-vocal noise to keep the intercom quiet when nobody is talking.

The audio panel also has Bluetooth capability so you can wirelessly connect personal electronics to your headset and intercom. A new feature is a USB charger outlet so you can keep the batteries of your personal electronics topped off during flight.

What the PDA360EX leaves out to cut cost is intercom capability for more than four locations, a cockpit speaker amplifier, and marker beacon receiver, which few homebuilt airplane owners would want or need. That allows PS Engineering to price the PDA360EX at $2,095, significantly less than the comparable unit for certified aircraft. Units are available for immediate delivery from authorized PS Engineering dealers. For more information visit the PS Engineering website.

Just Aircraft Offers Spoilers Kit for the SuperSTOL

JUST AIRCRAFT IS NOW providing optional instructions and materials for installing spoilers on its new SuperSTOL kits. The addition of spoilers significantly enhances slow flight control, especially in undesirable wind conditions. The spoilers represent the latest step in advancing the short takeoff and landing capabilities of the SuperSTOL.

Troy Woodland, who designed and flight tested the spoilers, said, "Once a pilot discovers the advantage of spoilers in slow flight and turbulent air, he won't want to fly without them. They go a long way toward taking the rock and roll out of rough air on final, and they open up a lot of new areas for landings."

The kits, which connect the spoilers to the ailerons, take about 40 hours to install. They can be mounted at the factory for an additional charge. Designed to deploy with the ailerons, the spoilers will rise on the right wing when the pilot moves the stick to the right. Since stick movements at cruise speed are minimal, the spoilers have little effect, but in slow speed operations, when the stick movements are greater, the spoilers will reach maximum deployment and effectiveness.

The SuperSTOL wing features slats that extend in slow flight, vortex generators, and Fowler flaps, all of which are designed to allow the aircraft to fly at a very high angle of attack without stalling. That in turn allows a touchdown speed in the low 20s in calm conditions.

Optional spoiler kits, which are available only for the SuperSTOL, are priced at $1,000. With factory installation, the price is $2,500. For more information visit JustAircraft.com.

RV Pedal Plane

JERRY FOLKERTS, EAA 102697, of Troy, Missouri, is selling plans for the first kit pedal plane patterned after the Van's RV series of homebuilts. Over the past year he and a friend, who is a retired machinist, put the finishing touches on The Pedal RV. Recently their website went live, and orders for the $69.95 plan sets ($10 shipping) are being taken.

Folkerts, president of EAA Chapter 1387, will donate $5 to the chapter's Young Eagles program efforts for each set of plans sold.

Folkerts' "secret" project was prompted by a post on the Van's Air Force forum in early 2014 suggesting that someone design a child's pedal airplane made out of aluminum that looked like an RV.

His friend, Charlie Eubanks, provided the expertise and advice as the two devised a design and construction plan and began cutting aluminum. Over the summer Folkerts fashioned the pieces, Clecoed everything up, and Eubanks disassembled and precisely measured before final riveting. In the fall they created an extensive 21-page manual featuring lots of photos along with 2-by-3 foot dimension CAD drawings.

"Maybe in a couple of years we can have a judging contest at Oshkosh for outstanding workmanship!" Folkerts said. He also suggested chapters could build one and auction it off as a fundraiser.

Folkerts flew in the Air Force and has built a Pietenpol. He's about two years away from completing a Murphy Super Rebel.

New Documentation Procedure for Rotax Temporary Revision Pages

ROTAX HAS INTRODUCED a new process to expedite the timely dissemination of important information. Rotax recommends that when a temporary revision (TR) document is released, it should be printed (single-sided) on yellow paper. The cover page should be inserted as the first page of the manual affected. Each of the temporary revision pages (numbered "3A," "7A," etc.) are to be inserted just ahead of their corresponding pages in the manual. Before updating a manual with temporary revision pages, be sure to check that you have the latest revision of the manual.

Rotax recently released two TR documents:

- TR-IM 912-001 (for 912 Installation Manual)
- TR-IM 914-001 (for 914 Installation Manual)

The information provided in these temporary revision pages will be incorporated into the next revision of the manuals (planned for release in the second quarter of 2015). Download the TR pages.

New Soaring Handbook Available From Sporty's

VETERAN GLIDER INSTRUCTOR and designated pilot examiner Dick Eckels shares a lifetime of knowledge in *A Soaring Pilot's Handbook*, a comprehensive new book on mastering glider flying.

A Soaring Pilot's Handbook delves deep into the intricacies of learning to fly a glider while maintaining an easy-to-read style. The book includes nearly 200 pictures and diagrams to help explain the important concepts. Color images abound in the e-book format, while the coil-bound handbook includes crisp black and white images along with a color appendix showing cloud formations important to soaring.

A Soaring Pilot's Handbook is organized by the areas of operation found in the FAA Glider Practical Test Standards. It is an excellent resource for students starting their flying pursuits in a glider as well as for existing pilots with an interest in powerless flight.

A Soaring Pilot's Handbook is also a great resource for glider pilots who would like to brush up on forgotten or missing information. This handbook should also be considered an indispensable teaching tool for glider flight instructors. A solid learning foundation can lead to a more fulfilling and safer flying experience.

A Soaring Pilot's Handbook is available as a coil-bound, printed book [M135A] for $39.95 or a convenient PDF e-book [E630A] for $29.95. Either format may be ordered at Sportys.com. The printed book may also be ordered by calling 1-800-SPORTYS. EAA

Bill

When Bill Clapp needed an airframe on which to do the test flying of his new Spyder Corvair engine conversion, he opted to finish a Tailwind project.

Photography by Tyson V. Rininger

and Kyoung Clapp's Corvair-Tailwind

A Chevrolet six-banger finds a new home

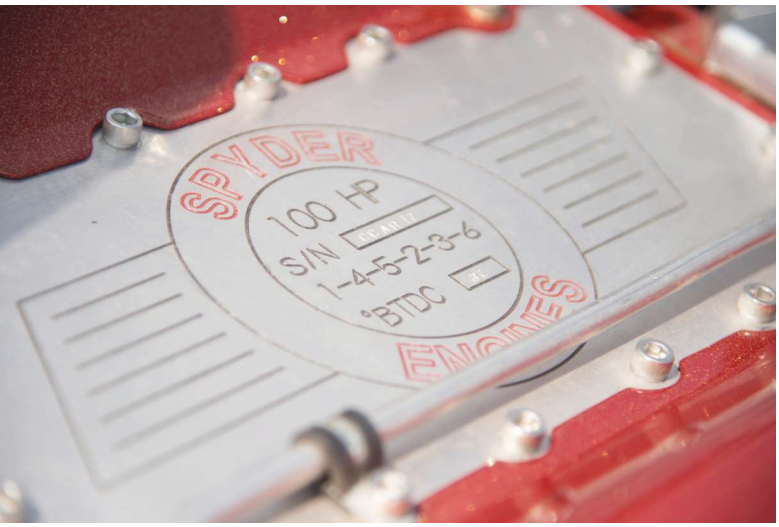
BY BUDD DAVISSON

THERE HAS TO BE A MEMORABLE name for Bill and Kyoung Clapp's Corvair-powered Tailwind. How about Corwind or Tailvair?

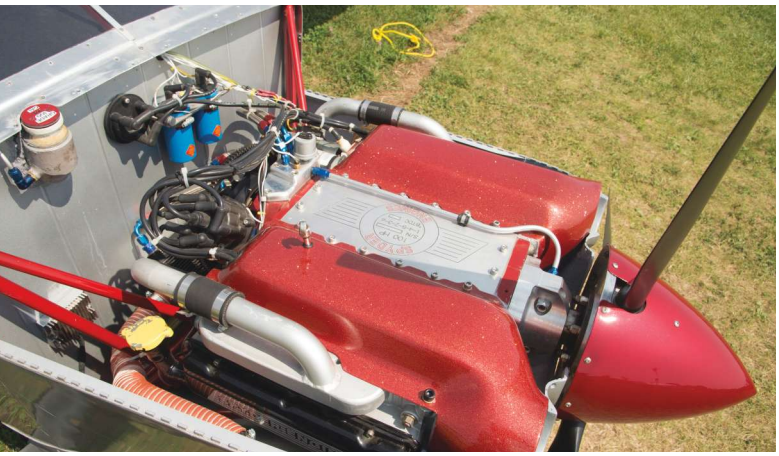
It doesn't make any difference what you call it; the Clapps' Corvair-Tailwind that they brought to EAA AirVenture Oshkosh 2014 was the latest application of an engine that was designed to push its driver but now pulls him around at much higher speeds. Although the movement to use the Corvair automotive engine in aircraft has been slow to gain traction, there are now a number of companies, Bill's Azalea Aviation (www.AzaleaAviation.com) among them, producing information and parts for Corvair engines that are beginning to make big-time inroads in homebuilt aviation. Google "Corvair Aircraft Engine" and several companies will pop up.

FIRST, THE ENGINE

For those who don't remember the Chevy Corvair, it was a semi-sports/compact car for the masses produced from 1959 through 1969 (model years 1960 to 1969) that was powered by an air-cooled, six-cylinder flat engine that looked as if it was specifically designed for use in airplanes. It has an aluminum crankcase, iron cylinders, and aluminum heads and was built in three basic sizes—140 cubic inch displacement (CID 2.3 liters), 145 CID (2.4 liters), and 164 CID (2.7 liters) putting out 80 to 180 hp. Now, however, aftermarket stuff such as crankshafts are pushing displacements up to as high as 183 CID (3 liters). The early production crankshafts were cast iron, but Chevy switched over to forged cranks in 1965.



Clapp leaves no doubt about his engine's firing order or ignition timing.



Close-fitting fiberglass plenums ensure that the Corvair's cylinders get maximum cooling.

In aircraft, these engines are swinging a prop via direct drive (no reduction unit) and putting out 100 to 120 hp. They weigh about 225 pounds in flying condition (a Continental O-200 weighs about 200 pounds dry). Roughly 2 million Corvairs were built, but the later models are more desirable. Bill said they can still be found in scrapyards for relatively low dollars. That's one of many reasons parts are easy to come by and why there is such a strong aftermarket parts support system for it within the automotive enthusiast markets. Bill said he has something like 30 Corvair engines stashed around his workshop. Apparently the accepted proverb says a man can never have too many Corvair engines.

Bill, who bases his business in Valdosta, Georgia, was literally born into aviation. His dad was a pilot for Mission Aviation Fellowship (MAF) for many years. Bill said, "When we returned from the mission field, he got a job as a mechanic and supervisor for Northwest Airlines. When I was a year old, we had moved to Mexico where Dad first started flying for MAF. From then until 1982, we had airplanes literally out our kitchen door. Dad primarily flew C-180s and C-185s. Most of this was in hostile jungle environments in Mexico, Colombia, Ecuador, and Honduras.

"In the early 1970s, my parents visited Ken Rand in California, and my dad had a KR-2 kit shipped to the jungles of Ecuador where he began building one of the first experimental aircraft in South America. I remember spending many hours with my dad gluing blocks and sanding foam.

"The airplane made its maiden flight on Thanksgiving Day, 1981. It was one of the most inspiring things I can remember...seeing a dream turn into hard, honest work and develop into reality."

That concept of building an airplane from nothing had far-reaching effects on Bill, and later, on his wife, Kyoung. They met when she was getting a degree in accounting in Valdosta, and she is very much a part of his entrepreneurial aviation adventures. She said, "I took ground school and have about 10 hours of dual in a C172SP. We thought is was important that I get the feel for flying and understand how airplanes work and why. It helps me in the business to understand the pieces and parts and will make me a better business partner with Bill. Also, since we fly together a lot, I can be useful in navigation and watching for traffic."

Bill's first airplane was his dad's KR-2, but in 2003, when he decided to scratchbuild his own, a KR-2S, he stepped into the world of the Corvair engine.

Photography by Michael Kelly

The hyper clean cowling not only contributes to overall performance but also cools the engine efficiently.

He said, "I gave myself a year to build and fly the plane. I had seen some of the Corvair aviation 'movement' at that time, so I went to the junkyard, bought a worn-out engine, brought it back to my shop, and tore it down. I was impressed with GM's design and strength. My business at that time was auto restoration. I rebuilt a lot of cars, mostly smaller cars such as VWs, Austins, MGs, Triumphs, and also some Corvairs. So, I had a good feeling for engines, and I could see that the Corvair was a good one. After making the decision to build that engine for the KR, it was easy to do. I finished that plane in August 2004 and flew it to Oshkosh in 2005, 2006, and 2008. Being an A&P, I started to help a lot of guys with their Corvair conversions, and I saw that there was great potential to improve the design and increase its simplicity and reliability.

"Because I have a full shop with tooling, a paint booth, and live in an area where I have plenty of room and can make noise, designing and building airplanes is easier. Two years ago we decided to close down the auto restoration business, and my wife and I started Azalea Aviation LLC (Valdosta is the "Azalea City") to concentrate on the Corvair. Initially, we started developing firewall-forward kits for various aircraft like Zeniths, KRs, and Sonex. Then we started developing our 120-hp Spyder conversion on the Corvair and needed a test bed for that engine. That's how the Tailwind came into our lives, and I'm glad it did. It's really an enjoyable airplane and comfortable for my wife and I to fly."

SPECIFICATIONS

Top speed (V_{NE}): 200 mph
Cruise speed: 135 mph at 75 percent
Landing speed: 65 mph (600 to 800 feet landing roll)
Stall: 55 mph clean, 50 mph with full flaps
Takeoff roll: 750 feet
Rate of climb at gross: 750 feet/minute; 1,200-plus minimum single
Range at 65% est.: 3.5 hours (1 hour reserve) for 450 miles
Range at 50% est.: 4 hours (1 hour reserve) for 500 miles
Empty weight: 750 pounds
Gross weight: 1,400 pounds
Useful load: 650 pounds
Fuel capacity: 25 gallons; single front header tank
Wingspan: 24 feet
Wing area: 92 square feet
Length: 19.3 feet
Cabin width: 41 inches
Engine: Spyder Corvair conversion; 100 hp; 120-hp version to come
Propeller: Warp Drive three-blade; soon to test a Sensenich wooden cruise prop

For some years, Bill had known about a Tailwind project that belonged to a friend only a few miles from his shop. He struck a deal for it and brought it home.

He said, "It was a welded frame on its gear with most of the wing structure completed but not closed. It was perfect

as a project. It was far enough along that on the first day I was able to hang the wings, finish the struts to align the wings, cut off the O-200 mount, and build my Spyder Corvair engine bed mount. So we were able to jump right on it. The only serious change was cutting the vertical fin loose and offsetting it the other direction because the Corvair is spinning the other way."

This particular Tailwind was something of a hybrid as it had the more sophisticated W10 wings with the extended trapezoidal tips mounted on an older W8 fuselage that's slightly narrower, with less headroom than the W10. It also has the older squared-off tail. One of the aspects of the Tailwind that worked well as a test bed for Bill's Corvair conversion was the fuel system. "The Tailwind has a simple 25-gallon aluminum header tank right behind the firewall," he said. "All my Spyder conversion engines work best with a simple gravity feed fuel system. Even on low-wing aircraft, I suggest installing a header tank and transferring fuel from the wings to the header. When you're not dependent on engine-driven or electric fuel pumps, you increase your safety margin considerably. The biggest safety concern, if you look at accident records, is fuel management. I choose to increase mechanical reliability by eliminating the mechanical stuff. (If you don't have it, it won't break.)"

The wings came to him in what might be considered "quick-build" condition, with the primary structure in place but needing all control systems installed and the skins applied.

As Bill described it, "The wings are quite simple: basically nothing but wooden ribs, spars, and skins. Because the spars and ribs were already done, all I had to do was inspect everything, install the control system, and skin the wings. They have a 1/16-inch mahogany skin root to tip, top and bottom that laps over a rough-shaped leading edge block. Then once the leading edge is sanded to shape, it's all covered in a layer of 3.5-ounce fiberglass cloth and West epoxy system. Once cured, the wing is lightly sanded, minor filler and epoxy primer applied, and it's ready for paint. It makes for a very stiff wing."

Hundreds of Tailwinds have been built over the years with a wide variety of engines, including V-8s, but to Bill's knowledge, this is the first Corvair installation.

He said, "Part of why I wanted to do it was because of the challenge. It had never been done before, and the Corvair seemed like a natural. However, the challenge of building the Corvair engine into an airplane engine is also one of the things that brought me to it in the first place. To many, the attraction of the Corvair is its lower costs for both initial buy-in and maintenance. It costs me more in some regards, but the gains aren't necessarily seen in dollars.

"However, because it is such an easy engine to build, for many people the attraction is not only building your own plane but your own engine as well. It really is an engine that anyone who can build an airplane can easily build the engine, and we have helped many people do just that. In general, if you build the engine yourself, you'll typically have around $5,000 invested. If you have one built by a known Corvair rebuilding company like Azalea using first-quality parts, including an aftermarket billet crank, you can expect to spend $9,000 to $12,000.

"I am using a 52-inch three-blade Warp Drive with modified tips. It works well as a climb prop and for testing."

THE CORVAIR ENGINE

According to Bill Clapp of Azalea Aviation, "My focus is to develop a marketable, low-cost option that an A&P would not be scared to touch. That requires bringing the engine into an appearance and functionality similar to that of an O-200.

"We first tear down the core motor. We have collected many cores (we keep about 30 on hand at any time) so typically will tear down five at a time. We will normally only keep the case, crankshaft, heads, distributor, cylinders, rear housing, and assorted small parts. The rest gets shipped out for core value to Corvair car shops or is recycled. As we process and clean the parts, we will inspect them for suitability in an aircraft engine or car. (I still drive Corvairs and build car engines when needed.) We inspect/clean the cases and have our integral front bearing (IFB) housing installed. The crankshafts (if they are good standard cranks) have the gear/flange removed and our IFB prop hub installed. It is then sent off for magnafluxing, grinding, nitriding, and polishing. We also have the option of new crankshafts. The heads are rebuilt with some modifications done to the intakes. All new springs and valves are installed. New forged pistons, remanufactured or new cylinders, camshaft, new connecting rods, and bearings, and it starts to go together. Also available is the integral rear alternator/starter (IRAS). It is a 32-amp alternator driven off the crankshaft (no extra moving parts or brackets/belts/brushes) and a simple starter (off the shelf from NAPA).

"We include a heavy-duty oil pan with an extra quart of oil capacity. The distributor is rebuilt (now with ball bearing option) and recurved with a dual ignition (points and electronic) setup. It has proven to be reliable and simple to set up. We do keep a single plug in the heads because we have shown that failure of a plug does not induce too much vibration and still have partial power (75 percent); this is an obvious advantage of a six-cylinder motor. I've never had a plug failure, but I did fly a pattern (takeoff to landing) on five cylinders (plug removed) to test its capability.

"We have a dedicated section of our shop for engine assembly (clean room). Once the engines are assembled, we run them on a dynamometer that I designed where we can check for performance and condition. Once we have about three hours of run time on them and are confident in the engine, it is packaged and shipped out.

"We do have customers who build their own engines, and we help provide parts, expertise, and information that they may require. Many choose to assemble their engines here at our shop under our supervision and run them on the dyno before going home. We take each customer where they are at and take their goals into consideration before accepting or advising them on a path to take. From what I've seen, I believe that the full potential of what this engine could mean to experimental aviation is just starting to be seen."

FINISHING THE AIRPLANE

When it came time to finish the airplane, Bill used the tried and true Poly-Fiber/Aerothane combination on the fuselage and fabric but used normal automotive acrylic enamel for the trim. The finish, however, is one of a number of areas in homebuilding that he has some opinions about.

"When we got serious about building, we decided to keep ours simple to keep it light," he said. "Every extra pound costs in performance. We came in fairly light at 735 pounds empty. With little add-ons to come, I think it will probably finish out at about 750 pounds empty. That's about a hundred pounds lighter than many Tailwinds out there. Our gross weight is 1,400 pounds, so the useful load is 650, which might sound a little low but isn't. That means it can carry my wife and me (300 pounds total), a full header tank (150 pounds), and about 50 pounds in the baggage. We don't have a lot of room in the baggage area, but we can still carry one backpack each plus tools.

"The main focus on any build I do is to keep it simple. It can be hard work to preplan simplicity, but it pays for itself in less time and cost to both build and maintain the aircraft. Getting complicated costs time and money and can slow down a build tremendously.

"The biggest difficulty I have seen on any build project is making the decision to go in a particular direction. Once the decision is made, I find reaching the goal to be relatively easy. If you want a showplane, be ready to spend countless hours on noncritical items. If you want to just fly, you can get there easier and much faster, if you're not concerned about a perfect finish, which always eats up time and money and adds weight. That's a very personal decision, but it helps tremendously if the level of perfection is part of the planning that goes into the project right from the beginning. I, however, live by the mantra 'Perfection is the enemy of completion.'

"We probably spent about 500 hours to finish this Tailwind, but we used the opportunity to teach a couple of people a bit about building a fabric airplane. That time was spread out over

In keeping with the Tailwind's simplified approach to aviating, Bill designed his panel to the same philosophy.

Bill Clapp has been building aircraft for years and his wife, Kyoung, an important part of his business, is taking flying lessons.

Photography by Michael Kelly

about 24 months. We picked up the airframe in April 2012, and I did a lot of work on it right away. However, at the same time I was closing out the automotive shop, so the work was done in a hit-or-miss fashion. We started work on it in earnest during the winter of 2013 to get it to Oshkosh in 2014. Kyoung was heavily involved in the build and a great supporter."

FIRST FLIGHT THRILLS

N196BC's first flight was May 5, 2014. Bill said, "I have a particular way I do my first flights. I never do them the day of the FAA signoff. There's too much stress then to be mentally safe. I do a complete inspection the day before the flight. The day of the flight I will normally run up to the fire station on the field and let them know I will be doing a test flight. I will also be sure that the tower knows what I will be doing. They are always gracious and give leeway to me for the flights. Typically, I will do a couple flights around the pattern in another aircraft on the days before the test flight to be current on emergencies and have my critical off-field landing spots in mind. Luckily, at KVLD (Valdosta Regional Airport) we have an 8,500-foot main runway and two other crossing runways that give me ample room for any emergency.

"I usually do all my initial test flights during early evening hours, in calm and stable air. I take off and set up a stable climb. At 300 feet above the ground, I am committed to continue the climb. I only glance at the gauges a couple times. (You can hear most any information you need.) If all is well, I normally fly two patterns at pattern altitude and then return for a full-stop landing, put the airplane away, and relax. Once the first flight is in, I can concentrate on any rigging changes, inspections, and documentation I need to do.

"The first flight can be stressful, so it is best to keep it short and simple. I normally keep the first 10 hours within gliding distance of the airport. Once I start the cross-country phase, I will climb high and go to the next airport, descend, and land. And then on to the next. I try to stay at altitudes where I am always within gliding distance of an airport. This system works well for me, and the Tailwind was an absolute no-sweat airplane to test.

HOW DOES IT FLY?

According to Bill, "The takeoff is pretty simple: Apply power smoothly, stick full forward, left rudder slightly and increasing, as the tail comes off the ground at 30 mph. Keep the plane level, as the stick comes back and lifts off at about 65 mph (10 mph over stall); as I pass through 80, I increase pitch and maintain 80 mph on climb-out. I normally climb at 1,200 feet–plus per minute in light load conditions (sea level). At gross I see about 700 feet per minute. Once through safe return altitude (typically 500 feet AGL), I transition to a cruise climb of 100 mph. Once through 1,500 feet AGL, I will throttle back to 25 inches MAP and maintain that (into full throttle) to cruise altitude. I set up cruise at 21 to 22 feet and 130 mph indicated for a low power cruise at 5 gallons per hour.

"Landing is just as simple as the takeoff. I fly downwind at 110 mph and 18 inches MAP. Throttle back to 15 inches abeam the numbers. At 100 mph, the first notch of flaps (10 degrees) goes out, throttle to 13 inches mixture rich. The carb/engine design means no carb heat is necessary. I turn base and the second notch of flaps goes out to 20 degrees at 90 mph indicated. Turn final, check brakes, mixture full rich check, establish 75 to 80 mph (pitch) glide, and adjust descent rate with throttle.

"Keep eyes out…checklist complete. Do a slight flare, bleed speed off, and let the mains touch. A little forward stick nails it on, the throttle goes to idle, and I keep it straight and tail up until out of forward elevator. The tail comes down, and I pin it to the ground with full back stick. That's it. It's a nice flying plane and is especially easy on grass. My biggest complaint is that there is a little wheel shimmy at certain speeds due to the gear design."

In ending his comments, Bill said, "And before I forget, I want to thank the guys and gals on the Tailwind Forum for the input and encouragement we've received from them over the last couple of years. Visiting them at Baraboo, Wisconsin, for the Tailwind Gathering before AirVenture 2014 was a wonderful experience."

It's pretty obvious that Chevrolet never imagined its lowly compact engine gaining a reputation as a viable airplane engine. But it wouldn't have surprised Steve Wittman. And for obvious reasons, certainly not Bernie Pietenpol. He saw the potential before almost anyone. Good call, Bernie! EAA

THE PILOT IS PART OF THE EQUATION

Bill Clapp said, "As a certificated flight instructor (CFI), I fly with a lot of different pilots in their experimentals, and frankly, I have more concerns with their ability to fly than I do with their ability to build. I fear that a lot of nice planes are built but have very inexperienced pilots at the controls. One reason I got my CFI was to help people with transition training and testing. In that role, I've seen many pilots say that there is something wrong with their plane, but when I fly with them, I find that their pilotage skills are the problem and require a lot of work. A well-trained pilot can deal with an emergency or the flying of a new airplane and will make good decisions. I've heard the "I'm safe now because I have a bulletproof engine" line before from pilots who can't fly a straight line or hold altitude/airspeed. I'd rather see them become a skilled pilot. I am glad for the updated Additional Pilot Advisory Circular that allows a second pilot in the test phase. I did this for years as 'a necessary crewmember' to help the new plane/pilot combination get in the air safely."

Budd Davisson is an aeronautical engineer, has flown more than 300 different types, and has 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 on www.AirBum.com.

Pre-order Your AirVenture 2015 Collector Mug & Save.

Visit **EAA.org/Shop** or call toll-free 800-564-6322 to order.

$19.95

Pre-order your mug **before April 30** for the special price of $19.95.*

EAA
THE SPIRIT OF AVIATION

EAA.org/Shop | *Pre-ordered mugs will be shipped in May 2015.

Team Mini-Max

Yesterday and today

BY GRANT SMITH

A TEAM Mini-Max painted in U.S. Navy trainer colors comes in for a landing at EAA AirVenture 2003.

Photography by Dennis Biela

Wayne Ison shows off the PDQ-1 at an early 1980's EAA Oshkosh Fly-In.

The shoulder-wing PDQ was Ison's attempt at a low-cost, easy-to-fly machine. It pre-dated the establishment of the Part 103 ultralight rules.

Skip Little frequently demonstrated the capabilities of the TEAM Mini-Max at fly-ins around the country.

TEAM MINI-MAX LLC is a relatively new company with old roots. Since August 2012, the director of operations for the United States has been David Cooper of Niles, Michigan. The company's current business plan is centered on offering homebuilders no less than nine airplane models. Team Mini-Max is also a full-service aircraft supply house offering products ranging from downloadable aircraft plans to traditional pilot supplies. Team Mini-Max can supply most products typically ordered from suppliers, such as Aircraft Spruce & Specialty Co., Sporty's Pilot Shop, or Wicks Aircraft Supply, at a savings, as well as raw materials such as aircraft quality wood and fabric covering materials. Mini-Max aircraft kits can be purchased as precut material packages or the AeroMax CNC laser-etched rapid-build kit.

Think Minimum cost and Maximum enjoyment, and you have the concept of the Team Mini-Max line of small, simple, easy-to-construct homebuilt airplanes. If you read various Internet blogs, you may get the impression that true light flight is unobtainable for the average or limited-income person, and that ultralight flight is dead in the United States. But a dedicated international group of individuals, working together as a team, have been doing a fine job of keeping the dream and the reality of personal flight at a reasonable cost alive and well.

You are able to join in those activities, thanks to the dedication and efforts of individuals such as the late EAA Ultralight Hall of Famer Wayne Ison, who in the early 1980s had the concept of building a simple, inexpensive airplane that was quick and easy to build. Many people believe that Ison's designs are more fun to fly than the bigger, faster, more complicated, and expensive aircraft of traditional aircraft manufacturers. The adoption of the light-sport aircraft (LSA) regulations in place of the ultralight training exemptions has made this trend more predominant. But, many new LSA cost more than $100,000 U.S. and are beyond the reach of typical wage earners. Not so for builders of the Team Mini-Max designs. In exchange for 300 to 500 hours of building time and reduced performance expectations, one can easily take one of the zeros off the otherwise typical aircraft price tag. A little scrounging, more do-it-yourself ingenuity, and eliminating frills can scrape even more dollars from the final cost.

In the early 1980s, prior to the adoption of FAR 103 ultralight regulations, Ison built the PDQ and later the PDQ2, both very minimal and basic single-seat aircraft with fabric covering over a wood wing and aluminum frame, and an over-the-wing, strut-mounted pusher engine. Ison went on to design airplanes and sell plans by founding Ison Aircraft in Bradyville, Tennessee. He worked with Fisher Aircraft to develop the FAR 103-compliant FP-103 and other high-wing, tractor engine configurations using similar light-weight, easy-to-build, all-wood construction. When Ison and his associates began selling plans and kits, they formed TEAM Incorporated, an acronym for Tennessee Engineering And Manufacturing.

Photography by EAA and Dick Stouffer

TEAM Inc.'s designs included the Mini-Max 103 ultralight, a mid-wing airplane with the lift struts connected to the landing gear. This aircraft became the prototype for the 1100R sold today. The high-wing version evolved into the 1700R Hi-Max and eventually the AeroMax. The AeroMax is an all-wood replacement for the Airbike.

Let's review a little more of the company history. In 1986 a new design adapted the simple, wooden wing construction of the Mini-Max to a high-wing configuration incorporating a narrow, sit-astride, open steel-tube fuselage framework. This unique aircraft, known as the Airbike, was popular and well liked by builders and pilots alike.

One Airbike was involved in a fatal accident that resulted in several lawsuits by one individual. That individual lost the court battles as TEAM Inc. succeeded in defending the company. However, the cost of litigation forced a reorganization of the company and removed the Airbike from the TEAM product line. TEAM Incorporated became JDT Mini-Max of Nappanee, Indiana, and eventually Team Mini-Max LLC of today.

As a result of the lawsuit, John Graber, David Trump, and Thinus Debeer bought the TEAM Inc. company assets in 2003 and started JDT Mini-Max; JDT being the first initial of each person's name and indicating the down-to-earth first-name friendliness of the organization.

Thinus Debeer went on to other business interests while John Graber, the Nappanee, Indiana, connection, retired nine years later, leaving David Trump of Tasmania, Australia, as the sole remaining partner.

David Trump retained his ownership interest in the company and, along with fellow Australian David Kyle, continued to provide international product support, including research and development. David Trump has expanded and streamlined the company and has renamed the organization Team Mini-Max LLC in honor of the original TEAM Inc. workers.

The expanded team includes David Cooper of Niles, Michigan, who represents the restructured company in the United States and is in charge of material receiving, cutting, and shipping. He is supported by Phil Knox and Lowell Farrand in Indiana, who provide metal cutting, fabrication, and CNC laser services, while longtime test pilot Larry Israel of Ohio continues to provide builder support. On the international scene, David Trump's brother, Frank Trump, operates a sales office in New Zealand while Kerry-Lee in South Africa assists with marketing. In China, Team Mini-Max LLC is represented by David's relative, Byron Trump, and local James Yan.

WHAT ABOUT TEAM'S CUSTOMERS?

Team customers must accept three basic premises: First, wood and fabric, the traditional aircraft building materials, are a superior method of aircraft construction. Second, the balance wheel, aka tail wheel,* belongs on the back of the airplane. Third, pilots of experimental aircraft have more fun than "Spam can" pilots, and owners of experimental amateur-built planes should have some time invested in knowing the airplane.

The Hi-Max was TEAM's first effort at providing a high-wing aircraft for its customers.

The all-wood TEAM product line offered builders the opportunity to work with a material with which many were familiar and comfortable.

A later model TEAM Eros with tundra tires skims along a beach.

Photography courtesy of EAA and Team Mini-Max

If you want a sleek glass ship or all-metal, sit-out-in-the-weather airplane, look elsewhere than Team. If you are too timid or unwilling to learn to fly a taildragger, look elsewhere. If you are in a hurry to get someplace and want air-conditioned comfort while relaxing or engaging in nonpilot activities, purchase an airline ticket or hire a charter company. However, if you can accept the delayed gratification of building a working airplane and can enjoy wandering around the countryside with an extraordinary view and the unmatched freedom of flight, you need to read on.

TEAM'S OFFERINGS

The Team Mini-Max LLC product line is built around the concept of the easy-to-build, box frame, wood construction of the Mini-Max. As the product line developed, refinements were added to improve the appearance and performance of the product. The 1100R Mini-Max with a Rotax 447 engine was adapted to accept the Hirth F-33 engine and became the 1100F Mini-Max.

The 1030R Mini incorporated the Rotax 277 to meet FAR 103 weight requirements. When that engine went out of production, the design became the 1030F with the Hirth F-33 engine.

The AeroMax with a 14-inch-wide wood fuselage and the Hirth F-23 engine was developed and put into production by JDT Mini-Max as a replacement for the Team Airbike. The AeroMax remains a current production kit and has the laser cut and labeled rapid-build parts kit. The 1700R High Max and AeroMax are both over FAR 103 weight limits. They need to be registered as experimental amateur-built (E-AB) aircraft in the United States and also meet the LSA regulations.

Some Mini-Max designs are no longer in production. The 1990s saw the introduction of the Zenoah G-50 two-cylinder opposed, air-cooled, two-cycle engine into the 1200Z Z-Max (open cockpit) and the 1300Z Z-Max with an enclosed cockpit. These designs have been replaced with the 1500R Sport (open cockpit) and the 1600R Sport (enclosed cockpit), both powered by the 40-hp Rotax 447.

The open-cockpit 1550V V-Max was developed to accommodate the four-cylinder, four-cycle, 50-hp VW engine. The fuselage was widened from 21 to 24 inches and the wingspan increased from 25 feet to 26.5 feet to account for the increased engine weight and wider flat-four engine layout. Some builders have used the two-cylinder, one-half VW engine in this airframe. The V-Max increased-span variant was further modified by Team Mini-Max test pilot Larry Israel using a Rotax 503 engine and adding an attractive canopy and turtledeck. Equipped with wheelpants, fiberglass wingtips, and other quality details, it became the very popular 1650R EROS.

Keep in mind that Team's aircraft are basic, minimum-cost, wood-and-fabric machines. Many are open cockpit with either a mid wing or high wing and a tractor engine configuration of generally moderate power. Both the wing and empennage are strut-braced, and the landing gear in mid-wing models supports the wing strut. This configuration has a between-the-wheels cross brace and solid (no shock absorbing) landing gear where the spring suspension consists of the low pressure tires only. This can be a good configuration, but it has limitations and is not as forgiving in some respects as more complex equipment. See the company's website for specific model performance estimates, design specifications, and recommended limitation.

Simple and low cost are powerful key words. But is there any word more powerful than "free"? Don't even consider adding the common scam of "You pay only for shipping and handling." Team Mini-Max LLC provides free downloadable plans for many of its basic models. Add this to its discounted prices on common building materials and pilot supplies, and you will do yourself a service by visiting the Team Mini-Max LLC website, www.teammini-max.com, on a regular basis. This company will support you and asks for your support by purchasing your supplies from it.

Team Mini-Max does what it can to tailor its designs to the demands of the customer. One of those requests was to provide a two-place Mini-Max so builders could share the fun and convince their partners that this project is not for just one person alone. The two-seat, side-by-side, high-wing Epic is being developed to fill that need. The trend to evolve into bigger, faster, more expensive aircraft apparently applies to Team Mini-Max LLC, too. However, by starting at the near bottom of the scale, its products are still very basic and economical.

The prototype Epic is scheduled to fly this summer. Team Mini-Max LLC hopes to have one at EAA AirVenture Oshkosh 2015. High-quality kits will be available, and one lucky purchaser in the first 40 sets of plans will win a free Epic kit. Watch the website for special offers and the latest developments.

In summary, Team Mini-Max can provide: ultralight or light-sport aircraft kits; mid-wing or high-wing models; two-cycle or four-cycle engines; plans-only, partial, and complete kits; CNC laser-cut and labeled quick-build kits; and complete pilot shop and builder accessories. If your area of interest intersects those boundaries, you will find much more of interest on the company website.

A few pilots think the training wheel, aka nose wheel, should be mounted on the front of the aircraft. Team Mini-Max LLC has given in to the demands of those misguided pilots and offers a nose-wheel kit that may be installed on some of the aircraft models.

Team Mini-Max LLC
2030 Lake St.
Niles, MI 49120
269-262-0866
www.TeamMini-Max.com
theecoop@comcast.net
info@TeamMini-Max.com EAA

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

Relax... You're covered.

Accidents happen. And when they do, you'll have the confidence of knowing that EAA Aircraft Insurance is there to protect you and your aircraft when you need it most. We know aviation, and we know what you need as a pilot. Trust us to evaluate all the options to get you the right coverage at the best price.

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

EAA Insurance Solutions

Administered by Falcon Insurance, Inc.

EAA.org/Insurance
866-647-4322

Bob Rychel with the two airplanes he completed in three years—the CH 650 Lil Bit *on the left and the CH 750* Lil Bit Too *on the right.*

Two Planes in Three Years

When my sweetheart travels, I build

BY CLYDE "BOB" RYCHEL

HOW TO BEGIN? Well, let's just say that many years ago I wanted to be a pilot, but eyesight held me back. So I became an aircraft mechanic in the U.S. Air Force. Fast-forward...in 2011 my sweetheart's brother, Gene, who has built two Zenith aircraft—a CH 2000 and a CH 601—encouraged me to build something, so I got the itch. Not having a pilot's certificate, I began the process of getting my sport pilot certificate, and I had narrowed down the field of aircraft that I was interested in building.

In March 2011, my sweetheart told me she was going to Texas in June for three months for the birth of a grandchild. Quick, call Zenith! When can I get a CH 650 kit? April? I'll be there!

Having carpentry experience, I built a 4-foot-by-2-foot workbench prior to leaving. Excitedly I hooked up my 4-foot-by-12-foot enclosed trailer and headed for Mexico, Missouri, built the rudder for my CH 650, and three days later I arrived home. It was slow going at first. Then in June, I was working 12-hour days on the project. Great fun! In June 2012, assembly/painting was completed and my aircraft passed its FAA inspection.

Little Bit was ready, but I had not soloed yet. I needed five hours to qualify for insurance. I called Buzzy of Buzz Air in

Photography by Larry Gilbert

AIRPLANE NO. 2

It was April 2013, and my sweetheart just said she may be gone for two months to help her daughter move to Florida. Gasp! What will I do? Quick! Call Zenith to see if I can get a CH 750 kit. Zenith said I could have a slot if I came to its next workshop and built the rudder. Let's see—I can be there in two weeks, I thought.

In May, I loaded up the trailer and drove to Missouri again, built the rudder, and was back home in four days. Then the building frenzy began! Larry's wife was going to be gone for a week. Rather than fly Larry's Citabria, he agreed to be my cleco man, making the process quicker. My sweetheart returned sooner than expected, but no problem. I had completed some parts, began the painting, and took the parts to the hangar. In the meantime, I had flown in a Viking-powered 750 and decided I had to have a Viking engine! Then when the Jabiru engine on Aircraft No. 1 failed to start for the umpteenth time, I made a quick call to Jan Eggenfellner at Viking Aircraft Engines and changed my order to two engines!

By now, it was January 2014. I begin removing No. 1's engine while finishing Aircraft No. 2, loving every minute. Finally, in March 2014, *Little Bit Too* passed its FAA inspection, insurance was acquired, and flight testing began.

Meanwhile, I was also completing installation of the Viking engine on Airplane No. 1. Once the engine was installed, I completed the paperwork for the engine change, did the five hours of additional flight testing, and notified the FAA.

By August 2014, both airplanes were complete and both were a lot of fun to build!

After flying to the Zenith factory in Missouri, to Sebring, Florida, for the recent U.S. Sport Aviation Expo, and other places here in Florida, my sweetheart and I are planning a

Lawrenceburg, Tennessee. He checked my log and completed my flight checks, then endorsed me for solo so I could fly off the five hours in type to qualify for insurance. I was back home in four days. Next, I needed to be checked out at my home field and finish my flight training. My good friend and certificated flight instructor (CFI), Larry Gilbert, completed it. Then I called EAA, which assisted me in acquiring insurance. With this done, I began my 40-hour Phase 1 flight testing.

Finally on October 16, 2012, I called the designated pilot examiner to schedule my FAA checkride in my aircraft. But first, she wanted to learn about the aircraft and its handling characteristics. The next day she called and said, "Okay!" On October 18, with all of my nerves shot, she reached over and said, "Congratulations!" I became a certificated pilot and thrilled beyond words.

My CH 650 *Little Bit* was a joy to build and is a joy to fly.

Bob's CH 650 Lil Bit.

cross-country flight. We plan to go to Prescott, Arizona, then to Winnemucca, Nevada, to visit our brothers. We feel it will be a great adventure, taking one to two months.

In closing, the N-numbers for my aircraft—N5970C and N5970H—have some significance. I graduated from high school in 1959, was 70 years old when Airplane No. 1 was completed, and "C" is my initial; 59 was my sweetheart's age when I started Airplane No. 2, 1970 was when she graduated from high school, and "H" is her initial.

I need to express lots of thanks for help during these projects: for the patience of my sweetheart during all of this airplane building; to Zenith Aircraft Company for answering all of my questions during the builds; to EAA for its help with an issue with FAA during the inspections; and to my flight instructor and a host of others who helped to get all of this done. EAA

Clyde "Bob" Rychel, EAA 1051181, lives in Mims, Florida.

Photography by Larry Gilbert

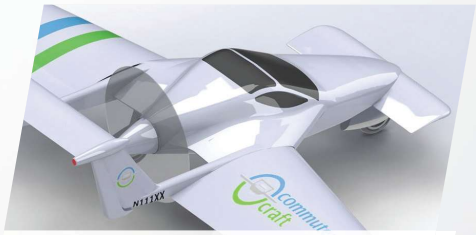
DESTINATION OSHKOSH

Makers, craftsmen, pilots, DIYers, and dreamers. Like our founders who built their own aircraft, these people come together each year to celebrate their passion at EAA AirVenture Oshkosh.

BUY YOUR TICKETS TODAY!
Visit EAA.org/tickets

Get hands-on with 1,000 workshops & forums

Jaw-dropping daily and night air shows
Presented by Rockwell Collins



Discover new technologies and innovations

EAA AIRVENTURE OSHKOSH 2015

WORLD'S GREATEST AVIATION CELEBRATION®

July 20-26

Don't Do This!

Unintentional damage

BY RICHARD KOEHLER

I WAS DOING AN ANNUAL last month when the checklist called for testing the stall warning system. Most certificated aircraft have a stall warning horn, and most homebuilts do not. On certificated aircraft, there are two basic types for general aviation aircraft.

The Safe Flight version has a mechanical tab that extends from the lower front edge of the leading edge. It is located at the airflow separation spot on the leading edge where the airflow reverses direction just prior to stall. The reversing airflow pushes the tab upward, and the tab actuates a microswitch, setting off a warning horn and/or light in the cockpit.

The other common type of warning system is on many Cessnas. It is fully pneumatic in operation. Again, the "sensor" is on the lower leading edge, but in this case it is just a slot in the leading edge skin. When the airflow reverses direction, the air pressure reverses from pressure to suction. The "sensor" port is connected to a reed horn in the cockpit with a section of hose. The horn will buzz when air is sucked through it, providing the pilot with an aural indication that a stall is about to happen.

On the first electromechanical type of stall warning system, testing involves turning on the master switch so that the system is energized, and then gently flipping the sensor tab upward with your fingers and listening for the cockpit buzzer, or seeing the light. This test checks the functionality of the system, not the accuracy, but it is the best one can do during the annual.

On the second Cessna system, the best way to test the system is to stand on a stool, put your mouth over the port, and suck gently. If all is well, you will hear the buzzer. This can be a rather disgusting exercise if there are dead bugs and whatever on the leading edge. As an alternative to using your mouth, Aircraft Spruce & Specialty sells a suction bottle for only $10 that is designed to provide sufficient suction to set off the horn.

Anyway, back to the annual. It was a Cessna, and I did not have the $10 suction bottle; I did not particularly want to suck on the leading edge, so I used a blower nozzle on a hose connected to the compressor. With the compressor set to about 100 psi, the blower nozzle put out a mighty blast of air. The trick then was to angle the blast of air up and over the leading edge, like the airflow would be following, as the aircraft approached a stall. I was doing this, but due to the noise of the rushing air, I could not hear if the horn was activating. I asked the owner to operate the air nozzle while I went into the cockpit to listen for the horn.

HINTS FOR HOMEBUILDERS VIDEOS

HERE ARE SOME OF THE LATEST HINTS FOR HOMEBUILDERS ADDED TO THE MORE THAN 450 HINTS CURRENTLY AVAILABLE HERE:

Removing & Replacing Avionics
Dick Koehler shows how to remove and then replace avionics from the instrument panel. Dick is a Technical Counselor for EAA Chapter 186, A&P aircraft mechanic with Inspection Authorization (IA), and SportAir Workshop instructor.

Cutting Holes With a Fly Cutter
Sebastian Heintz and Roger Dubbert from Zenith Aircraft demonstrate how to use a fly cutter to cut a large hole in an aluminum fuel tank used to mount the fuel sending unit.

Cutting Dacron Sailcloth
Brian Carpenter from Rainbow Aviation Services shows how to cut Dacron sailcloth by modifying a soldering iron into a hot knife.

Joining Foam Cores
EAA Technical Counselor Mike Busch shows how to join foam core pieces together to make larger foam sections.

Photography by Richard Koehler

As I tucked my head into the cockpit, I asked the owner to blast away, and there was no horn. But out of the corner of my eye I saw the airspeed indicator spin around. Yes, you guessed it; the owner misunderstood my vague request and hit the pitot tube instead of the stall warning slot with the air blast. They are within a couple of feet of each other.

When I looked back at the airspeed indicator, it looked like the attached photo, with the needle stuck at about 75 knots. We fruitlessly tried sucking on the pitot tube and tapping on the airspeed gauge, to no avail. I removed the instrument from the panel, and the next day we packaged it up and shipped off to Century Instrument in Wichita, Kansas.

Century is probably the largest instrument repair company in the United States. I am told it does hundreds of instruments per week. If anyone could fix the airspeed indicator, it was Century. It didn't take long after Century got the instrument that we received a call saying the internal diaphragm was ruptured, and the unit was not economically repairable. The amount of $425 got us a replacement instrument. It was an expensive mistake.

Airspeed indicators are extremely sensitive. To give you a feel for it, a rough calculation of dynamic pressure can be done with the equation $P_d=1/2\ \sigma v2$ where P_d is the dynamic pressure, σ is the density of air, which is 0.0765 $pounds_m/feet3$ at normal sea level day temperatures and pressures, and v is the velocity in feet per second. For example, 75 knots gives 0.15 psi, and 200 knots results in just over 1 psi.

It is no wonder that the airspeed indicator went berserk when we hit it with 100 psi! This is why you never want to even blow on a pitot tube with your mouth. Also be careful when washing the plane. A blast from a water hose, or even worse, from a pressure washer can result in a damaged airspeed indicator. Ditto for altimeters and vertical speed indicators, but they are not as sensitive as the airspeed indicator.

By the way, the stall warning system did work when we sucked on it, but I still have the flavor of dead bugs on my tongue.

All homebuilders should think about a stall warning or angle of attack (AOA) for their birds. The National Transportation Safety Board estimates that a stall is involved in more than half of our fatal accidents. Noncertificated systems are available for less than $200.

I hope this little discussion helps you with building and maintaining your aircraft. EAA

Richard "Dick" Koehler, EAA 161427, is an active pilot, A&P mechanic with inspection authorization (IA), an instructor for the EAA SportAir Workshops, and EAA technical counselor for EAA Chapter 186.

The AX50 GA 133 engine. The large intake plenum and oil sump are clearly visible in this view from below.

The differences in the original 360 crank and the AX50 crankshaft are obvious in this photo. Note that the ACE crankshaft is counterbalanced.

The ACE valve and its seat, keeper, and single valve spring unite to save weight, reduce stress, and transfer heat.

When New Really Means New

ACE parts

BY TIM KERN

EVERY YEAR AT EAA AirVenture Oshkosh, the buzz in the Press Tent is about what's new. Unfortunately, so much of what's new is either just old ideas that still aren't useful (e.g. nutating crankshafts) or new applications of unsuitable technology (such as race car engines geared 6-to-1).

But sometimes there's effective new technology—in metallurgy, manufacturing techniques, or design—and we get something that's not only new but right. It's rare, but an example may be parts designed and developed by Andrew Higgs (EAA Lifetime 884422), an Englishman living in Japan and the design engineer at Advanced Component Engineering (ACE), which is the performance house of Titan Aircraft Engines (formerly known as ECi). Titan is the distributor of completed R Series experimental-market engines that incorporate Higgs' upgrades: R360, R409, and R540.

Higgs is also president/CEO of AC Aeronautical Ltd, a Japanese engineering company that designs and develops engines for auto racing, especially development of Formula One technologies; AC also has experience designing and upgrading components in other pro racing formulas.

Higgs said, "The balance is among performance, reliability, and regulations in materials and design versus actual engine manufacturing." In aviation, this balance necessarily tilts toward reliability and maintenance, and Higgs starts with his mechanical engineering and race experience and applies his tools: 3D CATIA modeling; SolidWorks; ProE; thermal and mechanical finite element analysis; computational fluid dynamics and fatigue post-processing software; and his proprietary valve train software, which also employs advanced materials and coatings.

The goals: weight reduction, improved power/weight ratio, cleaner component packaging, increased reliability, and fuel efficiency.

Photography courtesy of ACE

Recently, Higgs and businessman Kevin Eldredge (builder/owner/pilot of the Reno Super Sport racer *Relentless*) formed ACE to improve Lycoming 360 and 540 engines. What is left of the originals are the engine crankcase and accessory cases, plus a few wear parts—bearings, gears, washers, gaskets, etc.

Major new-design parts include cylinders, cylinder head covers, valves and springs, pistons and pins, connecting rods, crankshaft, camshaft, sump, plenum, and induction tubes.

The valves are solid, with small stems to reduce mass, lowering stresses on cam lobes, reducing wear, and allowing a lower spring rate in the single valve spring. Guides are aluminum-copper. Higgs said, "Heat absorbed by the valve during operation is approximately 70 percent via conduction through the valve head, so we use a seat material that releases this heat more effectively."

The monolithic cylinder, with its removable hard-coated inner aluminum sleeve, eliminates the problem of cracked head/cylinder joints. Its heavy fins (with more surface area than the standard part) have a wavy shape and are spaced for maximum heat transfer. They're made of a 354 alloy (rather than traditional 242) for increased thermal margin, and they are attached to the case with spherical washers, reducing stress in the flange area—an expensive and effective practice usually reserved for radial engines.

The completely new design of the combustion chamber allows the use of very low octane nonaviation fuels. (100LL is rare in many parts of the world.) The ACE design is compatible with all ethanol and methanol fuel types—E10, E15, E85, etc.

Note to legacy engine owners: the ACE cylinder is a drop-in replacement for most 360/540/720 engines; a bonus is its bosses for knock sensors and direct injection. (AC cylinders will become individually available as production of new engines allows and will require AX pistons and rods. And the AX50 pistons require oil squirt jets.)

This photo of a piston from a test engine clearly shows the large amount of swirl in the ACE combustion chamber.

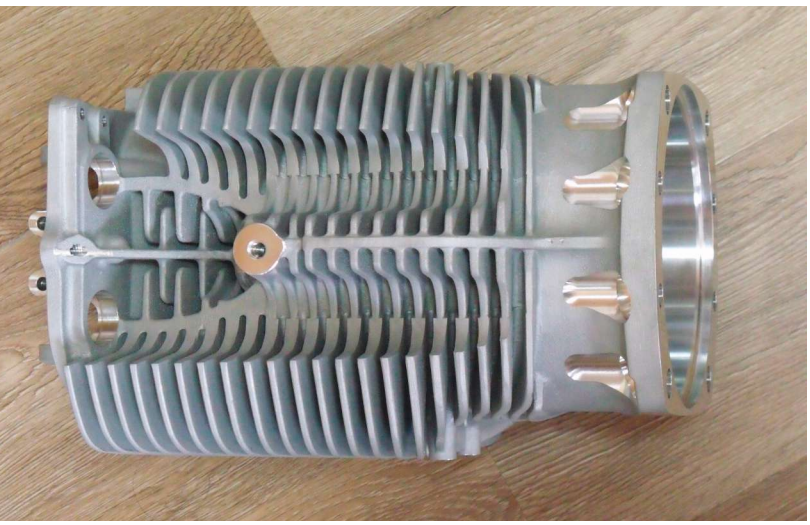
The 409's 4-bolt big-end connecting rod shows how little clearance is available between the crankshaft and the camshaft on the big stroker engine.

HOW DIFFERENT ARE THE MAJOR COMPONENTS?

The slipper-skirt pistons differ from legacy parts to keep inertia low; the 5.125-inch part weighs just 823 grams (versus 1,360 grams for the Lycoming part). As an engine runs, each piston stops twice per revolution, facing thousands of *g*'s and transmitting incredible loads to the small end of the rod. Lighter pistons help bearing and moving parts a lot. For reference, the standard 360 piston has an inertial force of about 1,358 pounds versus 821 pounds for the AX50 piston. At top dead center (TDC), the piston reverses; the standard part's inertia is 1,798 pounds versus 1,072 pounds.

Heat helps pistons fail. Ironically, so does a thick piston crown, as it absorbs and holds heat, even as it tries to

The specialized rod bolts demonstrate the attention paid to designing each component for its task.



The intricate finning on the monolithic cylinder adds to cooling.

The piston employs modern design and materials to yield a strong and light component.

rip itself to pieces, starting and stopping its own considerable mass. If the crown and piston are lighter, stresses are reduced and heat transfer is enhanced. But less material alone also makes the piston weaker. The ACE solution significantly reduces mass in modern, heat-tolerant extruded billet A2618 alloy and also—another technology from car racing—cools the piston crown by squirting oil on the underside of the piston crown. This oil's duty is to absorb heat and transfer it through the oil cooler to the air. The thinner piston crown gives up its heat quicker than a heavy one.

Modern lubrication allows improved piston skirt design, keeping the piston from welding itself to the cylinder bore. A smaller skirt is lighter, but it also has less surface. That's where modern oils help; offset piston pins help a lot; and the skirt's surface finish itself keeps oil between the piston and the cylinder wall. Just the right type and amount of roughness is necessary.

Beyond materials and lubrication are fundamental design considerations. The top land is noticeably narrow; this reduces "crevice volume," reducing the onset of detonation. ACE also employs "scuff bands" for a conformal fit; they are designed to roll over and deform, matching the shape of the bore.

Higgs explained, "If there were no scuff bands, the side of the piston would simply wear. With a big top land clearance, wear is not an issue, but we optimize the piston and reduce clearances. Big clearances used to be the only way to make things fit and work; we have better materials and technology today."

Further reducing top-end reciprocating weight, the piston pins are shorter, have a smaller diameter, and are held in place with simple clips. They are made of C350 steel and are diamondlike carbon (DLC) coated to operate in regimes of low lubricity.

Rings are thinner, reducing inertia and its ugly cousin, flutter. ACE uses a three-piece oil ring to better "hug" the cylinder wall.

ACE also has two "flavors" of connecting rods. The stroker 409 rod uses a reverse four-bolt design that allows clearance to the camshaft and allows more even clamping of the bearing. Rods for the standard crank are aerospace 4340 steel with a bronze small end bushing that incorporates an "oil eye" to capture oil. The bottom end sports two bolts that thread directly into the cap, reducing weight.

The counterweighted, "round" 409 crankshaft is the largest crank that can fit inside the standard engine case. Higgs said, "We sketched the design and did a fatigue analysis. We have a longer stroke, a smaller crankpin—and *less stress* than a standard 360 crank! The heavy weights gave us mass to help absorb some of the nastiest propeller-induced vibrations. We also kept rotating inertia close to the crank centerline, reducing stress." The round

Photography courtesy of ACE

design? “It’s my design choice. Some people will like it; some will not.” Four thousand man-hours went into the crank design and analysis.

All that weight saving, improved cooling, and modern design and materials mean little, however, if power doesn’t go up, and power comes from the amount of air the engine can efficiently process.

The high-performance camshaft’s new profile design results in higher lift; the cam also has adjustable timing gears to allow setting the optimum timing.

The aluminum “pressure recovery plenum” with integral tapered intake tubes and electronic injection fuel rail aids this mission while reducing weight. The inlet is in the standard position for ease in retrofitting and can be either vertical or forward facing. As the plenum has two options for servo location, the unused location mounts a pop-off valve to save the intake in the case of a backfire. It fits closely under the engine, designed to complement the new sump.

Port, combustion chamber, and cam profile are an integrated system and cannot be designed in isolation. Higgs noted, “When I designed the components for the AX50 series engines, these were all considered as one, not as separate issues.”

High inlet charge density increases inlet charge volume, increasing performance. Higgs explained, “With an increase in airflow tumble in the combustion chamber, we can improve the mixture stability. This improves the engine’s knock resistance.” Then power can be increased even more.

Airflow depends primarily on two complementary features; port design and cam profile mated to ACE’s computational fluid dynamics capability rendered a design with high flow and low port losses, increasing valve flow area to complement high flow ports.

The extent to which the intake system packs large volumes of high-density air into the combustion chamber determines what engine guys call “volumetric efficiency,” or VE. Higgs added perspective: “For comparison, a standard engine has about 85 percent VE; our racing engines produce over 114 percent VE.”

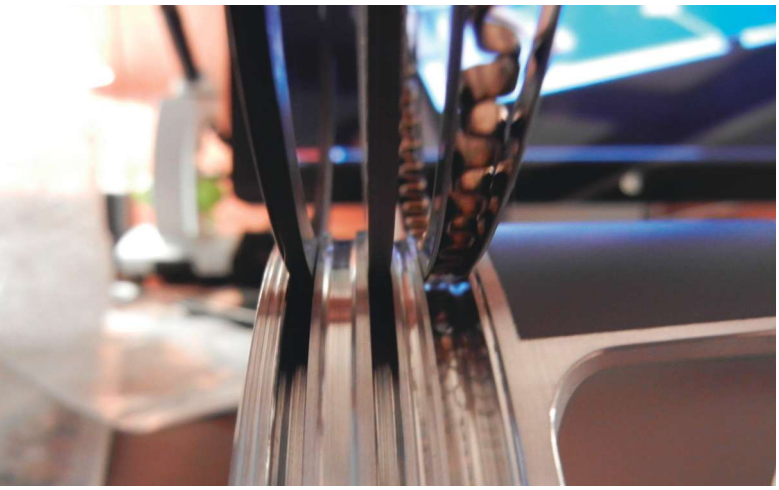
The new sump has two iterations by design, one being a simple replacement with fitting locations to allow connection of a Christen Eagle oil kit to the system. The second iteration is a full dry sump conversion with scavenge pumps to reduce “windage” losses and allow continuous inverted flight.

New mechanical technology is enhanced by parallel new material technology. The ACE engines prefer unleaded fuel, but they can use 100LL avgas. Higgs cautioned, “If you use leaded aviation fuel, you are stuck with using traditional aviation oils and their limited service life. If you use unleaded fuel, you have several fully synthetic oil options.”

Detail of cylinder base, with lands for spherical hold-down fasteners.

The 409’s crank size is apparent when it’s in the case.

Micro-polishing on this piston pin makes the best use of modern lubricants.



Radical (for aviation) ring placement and piston design are apparent when rings are superposed over their grooves.

Full synthetics may be the way to go, as these engines don't use roller tappets. Higgs said, "These are more trouble than they are worth, and at the low speeds that these engines operate, the flat tappet approach is effective. However, design, materials, and finish are critical to make those components work."

BOTTOM LINE—WHAT'S THE PRODUCTION SCHEDULE?

Right now, cylinder production is ramping up; the first cylinders are destined for new-build engines before any will be available for field upgrades. ACE is currently gearing up to upgrade legacy Lycomings to the ACE specs. Pricing for the various configurations and models is on the website, www.ACE-Performance.com, and ACE answers the phone at 805-996-0800.

The 320-hp engine will be available in the summer of 2015. The current configurations are:

- R360—approximate weight 250 pounds; 208 hp at 2750 rpm, 222 hp at 3050 rpm. For reference, a 190-hp 360 with magnetos weighs about 280 pounds.
- R409—285 pounds; 230 hp at 2750 rpm.
- R540—370 pounds; power is still being tested. Expect 315 to 330 hp at 2750 rpm. (A developmental turbocharged version targets 700 hp.) For reference, a high-performance 540-hp engine of similar power weighs about 450 pounds. EAA

Tim Kern, EAA 852075, is a private pilot and Certified Aviation Manager as well as an aviation writer and consultant based near Indianapolis. You can find him online at www.TimKern.com.

Photography courtesy of ACE

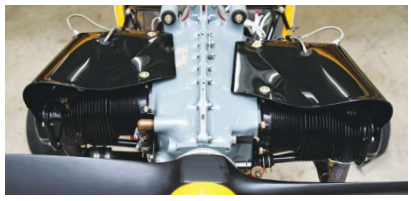
EAA
THE SPIRIT OF AVIATION

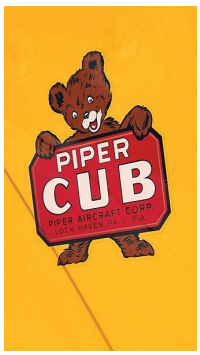
Grand Prize: Piper J-3 Cub

BACK BY POPULAR DEMAND for the

2015 EAA® SWEEPSTAKES

Nobody wears yellow better than the Piper J-3 Cub. This stunning, fully restored 1946 powerhouse is not just fun to fly, but it's a classic piece of aviation history. That's exactly why it's the 2015 EAA® Sweepstakes aircraft. With less than 100 hours of flight time since its restoration, this aircraft is ready for you to enjoy. Plus, when you make a donation with your sweepstakes entry, you're supporting EAA's programs working to build the next generation of aviators.





Second Prize: EAA AirVenture® Oshkosh™ 2016 VIP Package*

- Two weekly AirVenture® wristbands
- Two Bell Helicopter flight passes
- Two B-17 flight passes
- EAA Lifetime Membership
- Lunch for two at the Aviator's Club for one day (day determined by EAA)
- One weekly AirVenture® camping pass
- Two Ford Tri-Motor flight passes
- Two Flightline Pavilion passes
- $500 EAA merchandise voucher
- VIP tour for two of AirVenture® grounds

**Valid only for EAA AirVenture Oshkosh™ 2016*

Enter the 2015 EAA® Sweepstakes by sending in your enclosed coupons or visiting **EAA.org/sweepstakes**.

Complete Official Rules and prize descriptions available at EAA.org/sweepstakes.

NO PURCHASE OR DONATION NECESSARY. A PURCHASE OR DONATION WILL NOT IMPROVE YOUR CHANCES OF WINNING.

Deadstick Landing Secrets

It's not a gliding contest

BY DAN GRUNLOH

IMAGINE THIS SCENARIO. You are cruising peacefully in a headwind in level flight at 1,000 feet when the engine quits suddenly, and the best place to land is a 10-meter (32.8-foot) long spot directly under the airplane. That describes the first two scoring boxes at recognized FAI-style engine-off landing contests for microlights (which covers what we call ultralights and light-sport aircraft). The nonpilot might think, how could you miss? Unfortunately all of our sport aircraft glide well enough with the engine stopped for a pilot unfamiliar with the test to mess it up.

Dan Grunloh at Long Marston Airfield, Warwickshire, United Kingdom, in 2003.

U.S. Microlight World Team members gather around Steve Bensinger's CGS Hawk while watching the final deadstick round at the 2003 World Microlight Championships in England. Left to right: Russ Hauser, Tom Gunnarson, Jon Jacobs, Steve Bensinger, and Dave Hempy.

All pilots get some training for power-off landings. And certificated pilots are tested in periodic flight reviews, but we do it mostly at idle power with the engine still running for obvious safety reasons. Pilots naturally avoid actually turning off the one device on the airplane that enables most of what we do. That's where I was in 2002 when, through a series of very lucky events, I began a period of competition flying that led me to several national and world microlight championships. There were navigation tasks, along with fuel economy and speed tasks, but the classic deadstick landing with the engine stopped was sprinkled liberally through the contests.

Competition flying was one of my greatest experiences because most of the top pilots were very helpful to newcomers and gave advice freely. They want newcomers to succeed, stay in the sport, and improve the level of competition. If I did well, I might also take some points away from their closest rivals. A week or two flying alongside the best pilots in the world provided a cram course in flying technique. How can you not learn something from watching 75 different pilots flying trikes and fixed-wing aircraft complete a deadstick landing in a little more than a two-hour period? They don't stop for wind, turbulence, or light rain, either. Don't pass up an opportunity to attend a world microlight championship as a spectator, volunteer, team assistant, or if you are really lucky, a competing pilot.

I learned that deadstick landings aren't nearly so difficult once you know your aircraft and have a few simple tricks for hitting the target. It made me a safer pilot, gave me more confidence, and has provided a source of fun. Knowing with certainty where you can land safely in an emergency widens your flying options. Every pilot who operates a powered aircraft also has a glider. There is no additional cost or extra hangar space needed. You only have to flip a switch to convert your aircraft to a glider. It really is fun and can be as safe as you want, if you're smart and control the conditions.

DON'T CREATE AN EMERGENCY

You don't have to stop the engine to practice deadstick landings. All of the important skills can be rehearsed much more safely at idle power settings. Eventually you must test for the difference between idle power and engine stopped, but that should be done very carefully in a safe environment. The difference cannot be predicted because there are too many variables. Flying speed, idle rpm, prop diameter and pitch, and presence of a clutch all have an influence. For what I flew with two-cycle Rotax engines, the glide was considerably shorter with the engine off. There was still some thrust when the idle rpm was set as recommended by Rotax. If idle rpm is set

Photography courtesy of Dan Grunloh

deliberately low, the opposite can happen when the prop acts like an air brake.

Avoid practicing deadstick landings at public airports that have traffic. Even if you can hit the spot every time, it's disruptive for other pilots when you fly steep close approaches. Never do deliberate engine-off landings to a runway only wide enough for one airplane. Even if you are self-announcing on the radio, another aircraft may appear low on final approach. Worse yet, I have had an aircraft taxi out and begin a downwind takeoff after I announced on the radio and stopped the engine. Fortunately I can do an in-air restart most of the time, and the runway had plenty of room for me to land in the grass alongside.

Begin each practice session with an idle power approach even if the conditions are safe for engine-off landings. It provides a chance to check out the actual wind conditions, aircraft performance, instruments, and the nut holding the stick (the pilot). I learned it the hard way.

I had completed a series of engine-off landings the previous day and was anxious to resume some testing. The wind sock was hanging straight down that morning, so I blasted off the same direction as yesterday, climbed quickly to 1,000 feet, and confidently shut down the engine.

Something looked wrong immediately. I suspected trim speed or airspeed error and worried I wouldn't make it back to the runway. I was crawling along on downwind and losing altitude fast. The base leg drift revealed the wind had changed from yesterday and everything above 200 feet was blowing the other way! I made a downwind deadstick landing, went very long, and barely got it stopped at the far end with inches to spare.

IT'S NOT A GLIDING CONTEST

In a real emergency when the engine quits in flight, slow down to best glide speed and pick a spot you can reach easily, but don't think of it as a gliding contest. Never try for anything at the margins, because landing short is unacceptable. As soon as the target is selected, increase the speed to slightly faster than best glide. When flying at best glide and coming up short, anything you can do makes it worse. If you are a little faster, you might be able to stretch the glide by slowing down. The faster flying speed also reduces the displacements caused by turbulence and thermals. I prefer to fly the entire approach at a constant airspeed so I have consistent glide performance and a good platform for observing ground drift. Success depends entirely on where you make the turns. It's not a gliding contest.

My essential tools for practicing engine-off landings are an altimeter set to the surface, a clock, and established sight lines. Practicing from a standard altitude establishes the ideal height at every point in the approach. A stopwatch on the descent gives additional information. The average glide time from 1,000 feet in a contest is about 90 to 100 seconds. We start directly overhead, but you can begin anywhere. The halfway point even with the target on downwind is my first important benchmark where I should still have 600 feet. Established sighting points on the airframe help to set the desired angle downward to the runway at midpoint and on the turn from downwind to base leg. Once on base leg, you adjust or play the turn to final to hit the target. Don't be bashful about extending base leg beyond the runway centerline if you are too high. If you never have to extend the base leg, you are either very good or perhaps cutting it too close.

With practice, engine-off landings are easy if the wind is calm. Wind gradients, sinking air over cool marshes or green fields, and gusts that halt your ground speed help to make it a mental challenge. In a real emergency (or a contest), an engine-off landing may be required in strong crosswinds, or strong headwinds, and in either direction. Pilots of side-by-side aircraft should consider how well they can perform engine-off with a right-hand landing pattern. I thought practicing in winds up to 15 mph was enough until I had to do one in France in an honest 18- to 20-mph straight-on headwind, with gusting. It was humiliating to be 200 feet short, but I had some company. All gliding practice in strong conditions should be at idle power for safety, and keep the engine ready to go.

TOO HIGH ON FINAL

You should always be too high after turning on final approach. Regardless of pilot skill, bad things happen on a deadstick final that can't be fixed. The final glide should be a short, getting-rid-of-altitude contest. It needs to be long enough to identify the likely landing point, dump any excess altitude, and then complete the touchdown. Any major FAI microlight engine-off competition will provide an amazing display of slips, use of flaps, spoilers, S-turns, parachute turns, and trike bar pumping. Almost everyone starts high and then skillfully sheds altitude. A few may arrive very high and do multiple S-turns off the end of the runway until it looks right, though contest rules tend to discourage the practice. They do this because in contests and in real life, coming up short is unacceptable. To pen a phrase, "The ditch in front of the runway is a mortal threat, but the ditch at the far end will only scratch the paint."

Contests are commonly scored based on the actual landing spot (after any bouncing), though occasionally stopping distance is rewarded. A wheel-type landing with extra speed works best. When the target is made for certain at about 50 to 75 feet of altitude, drop the nose and descend smartly into ground effect. Skim along 1 or 2 feet off the ground with good control, plant it when the chalk line arrives, and enjoy your gold medal. Gliding down slowly and hoping for the best is less predictable. Dropping low and skimming can also help to gain a little distance in strong headwinds when raising the nose will make things worse. I hope you enjoy some careful gliding experiments. May your emergency landings be in your favorite direction, and may you always be high on final. Please send your comments to dangrunloh2@gmail.com. EAA

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