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On the cover: Mark Hein's Super Cub. (Photography by Jim Koepnick)

The EMG Glider.

The Future Is Electrifying

The revolution is under way

BY CHARLIE BECKER

I BELIEVE THE FREEDOM we enjoy as homebuilders to adapt to any technology is what is keeping recreational aviation alive. Over the last 60 years, homebuilders have ushered into general aviation so many of the technological advances that improve performance, reduce pilot workload, and enhance safety. Everything from composites to glass panels to ballistic recovery parachutes. The good news is we will continue to play that role in the area of electric aircraft development.

I just finished watching Brian Carpenter's Oshkosh forum (available online) on his new aircraft design, the EMG-6, which he officially introduced at EAA AirVenture Oshkosh 2014. EMG stands for electric motorglider. The forum was extremely insightful on electric aircraft development in general and his design goals in particular. I'm going to share a few of the ideas that caught my attention, but I encourage you to watch his recording and hear directly from Brian.

Thought No. 1: The transition from piston engines to electric motors will be of the magnitude of when airliners transitioned from piston engines to turbine engines. Think about the huge gains in reliability that came with the transition to the jet age. We are on the cusp of that same technological shift. Electric motors typically have just a few moving parts. Bearings should be the only wear item. When you think of the electric motors in your home appliances and how reliable they are, you can imagine how big a leap forward it will be for aviation.

Thought No. 2: Aviation can and should leverage commercial development of battery technology. There is no reason for an aviation company to try to develop batteries; instead, we will piggyback off huge scale industries like cars and cordless drills. Let them fund the research and development (R&D) needed to make the batteries available in mass quantities. I see this as the difference from using a specialty aviation fuel like 100LL versus using mogas.

Thought No. 3: Ultralight aviation will be the first to practically use the electric engine for aviation. The main driver for this is that ultralights are flying purely for the enjoyment of flight. The flight duration is typically short, so landing to recharge your batteries is not a deal breaker. Plus, it will dramatically reduce the noise compared to the two-stroke engines that are the current standard while increasing reliability and decreasing fuel cost.

Thought No. 4: The battery R&D to make all this happen already exists. We are not waiting for a major research breakthrough for this to happen. What we are missing is the commercialization that brings the technology to market in a practical format and drives down the cost. Interestingly, it is the cordless power tool market that is driving much of the commercialization.

If you get a sense that I'm excited about electric aircraft, you would most definitely be correct. I'm excited enough about it that I'm going to start constructing an EMG-6 (when I'm not working on my clone of a Super Cub). I anticipate electric will completely reinvigorate the ultralight and light experimental amateur-built market as existing designs are retrofitted for electric motors and new ones are created. With a foothold in ultralights, the electric revolution will then spread up the line until we have an electric-powered RV! EAA


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EAA AirVenture Oshkosh 2014

WITH THOUSANDS OF dedicated volunteers willing to do whatever it takes to get the job done, it's hard to fail. EAA AirVenture Oshkosh 2014 was an unmitigated success due largely to more than 5,400 volunteers working together for a common cause—to produce the World's Greatest Aviation Celebration, and the 2014 version was certainly that.

Attendance topped 500,000, or 5 to 6 percent higher than in 2013. Saturday and Sunday saw 20 percent more people coming through the gates than a year ago.

"It was a tremendous week on many levels," said EAA Chairman Jack J. Pelton. "We filled Wittman Regional Airport with aircraft for the first time in several years, with both aircraft camping and parking areas completely full at midweek."

The historic first appearance of the U.S. Air Force Thunderbirds at Oshkosh no doubt attracted many people to the event. Exhibitors reported outstanding business throughout the week, with some selling out of product.

Other facts and figures from the 2014 convention:

- KidVenture experienced record attendance in its 16th year.
- More than 10,000 aircraft at Wittman Regional Airport and other facilities in east-central Wisconsin.
- 2,649 showplanes, up 308 from 2013, including almost 1,000 homebuilts, 1,050 vintage airplanes, 303 warbirds, 122 ultralights and LSA, 91 seaplanes, 40 rotorcraft, 38 aerobatic aircraft, and eight hot-air balloons.
- 2,081 registered international visitors from 69 nations, led by Canada (505), Australia (416), and Brazil (194). Many others were here but did not register at the International Visitors Tent.
- 917 media representatives on-site, from five continents.
- EAA's One Week Wonder project totaled more than 2,500 participants and resulted in a finished airplane on closing day, August 3.

Next year (July 20-26) expect to see Burt Rutan, a new B-29 restoration, 70th anniversary commemorations of World War II's end, and more.

The One Week Wonder team escorts the Zenith Ch 750 Cruzer to the flightline on Sunday afternoon.

First Convention Without Paul

AIRVENTURE 2014 WAS our first convention without the man who created it. But there were reminders throughout the grounds all week of EAA Founder Paul H. Poberezny, who died last year at the age of 91. From the ceremony held at the Memorial Wall Sunday evening before opening day to volunteers raising their glasses in his honor at the annual wind-down party a week later, the 2014 Oshkosh convention was a tribute to the man who made it all possible.

The memorial featured a missing-man formation flight of P-51s led by EAA's B-17 *Aluminum Overcast*. Paul's prized P-64 and P-51 were prominently displayed on Boeing Plaza throughout the week. Members had the chance to learn or revisit Paul's life story at the Welcome Center exhibit, which featured Paul's VW Red One, the replica Waco Primary Glider he built (and flew in June 2003), the *Mechanix Illustrated* Baby Ace that launched EAA into a national organization, videos, and more.

The airplanes that circled the daily air show parachute teams were Paul's planes. The EAA Lifetime Member Dinner had a strong tribute theme, and members shared their Paul stories at Theater in the Woods on Opening Day.

Photography by Jason Toney

EAA Awards Presented at AirVenture

WHILE THOUSANDS OF EAAers annually give of their time to make the Young Eagles program soar, a few are honored each year for their extraordinary efforts. This year's **Young Eagles awards** were presented to Betty Darst, Chapter Coordinator award; Brian Beauvais and family, Ground Support Volunteer award; and Bob Brown on behalf of the Academy of Model Aeronautics (AMA), Horizon Award.

Betty credits her fellow chapter members for her success as Chapter 48 Young Eagles coordinator. "Try to involve as many people in the whole program as possible," she said. "It's a big job so things don't come together without a lot of planning. But you also need to network so you know aviation resources."

Brian and Sabrina Beauvais, of Naples, Florida, and their children were recognized for their efforts at EAA Chapter 1067 flight rallies. The entire family also pitches in for special events and the monthly EAA pancake breakfasts.

EAA and the AMA have a free dual youth membership that has all the benefits, including scholarship eligibility, Brown said. "The cross promotion helps create awareness of AMA and EAA, and as both face various governmental issues, we support those issues as a total entity."

EAA Chairman Jack J. Pelton presented the association's highest honor, the **Freedom of Flight Award**, to Audrey Poberezny, at the beginning of the annual meeting on July 29 in Oshkosh.

Pelton said there is nobody more deserving and who has done more over a lifetime to support EAA and personal aviation than Audrey. She declined to go to the microphone, but whispered to Jack on stage that "she is not the speaker in the family. And I love you all very much."

The **Chairman's Award** for service was presented to Earl Lawrence, former EAA vice president who now heads up the FAA Small Airplane Directorate. Lawrence was instrumental in guiding the sport pilot/light-sport aircraft initiative through the complex federal bureaucracy to its approval in 2004.

EAA Homebuilding Community Manager Charlie Becker (left) presents the August Raspet award to Troy Woodland of Just Aircraft.

Troy Woodland, co-founder of Just Aircraft LLC, received the 2014 **August Raspet Award** from EAA's Charlie Becker recognizing Woodland's SuperSTOL design. The award recognizes a person who has made an outstanding contribution to the advancement of light aircraft design. "My design approach tries to continually make runways unnecessary," he said.

Ann Hamilton, whose passion for people has driven her to volunteer for EAA AirVenture Oshkosh's Operation Thirst for the past 16 years, received the 2014 **Dorothy Hilbert Award**, which is given annually to recognize a woman who exhibits the same passion, dedication, and devotion for volunteerism as did the late Dorothy Hilbert.

AKIA Elects New Officers

THE AIRCRAFT KIT Industry Association (AKIA) elected new officers for the coming year during its meeting at Oshkosh 2014. Jeremy Monnett will serve as president, Dick VanGrunsven as vice president, and John McBean as the new secretary/treasurer.

Mark Giron of the FAA addressed the group regarding the FAA's interest in improving transition training by simplifying the letter of deviation authorization (LODA) process, which allows for training in homebuilt aircraft. This would allow builders an opportunity to purchase instruction in an aircraft that is identical or similar to the one they are ready to complete. The FAA is also looking at allowing a second pilot to participate in Phase 1 flight testing of homebuilts to enhance safety. Since most homebuilt aircraft accidents occur within the first 10 hours, as a result of pilot error, the FAA believes a pilot qualified in type could be an invaluable asset in early flight testing.

Charlie Becker, EAA Homebuilt Community Manager, spoke about the organization's future plans for accommodating homebuilts at AirVenture. All of the AKIA members expressed strong support for EAA's hosting of the One Week Wonder project at this year's event.

For more information on AKIA visit www.AKIA.aero. EAA

Photography by Mary Jones

First LSA 'Triphib'

NEWLY FORMED MVP.AERO unveiled a full-scale mock-up and an ambitious plan to create the MVP (Most Versatile Airplane), a "triphibian" light-sport aircraft (LSA) capable of operating on land, water, or snow and ice, while doubling as a platform for boating, camping, and other outdoor activities.

The privately funded, Delaware-based MVP.aero plans to offer the MVP initially as an experimental amateur-built kit, then as an experimental light-sport aircraft (E-LSA), and lastly as a manufactured special light-sport aircraft (S-LSA) on a rough timetable of three, four, and five years, respectively.

A Rotax 912/914 will serve as the launch engine for the MVP. No avionics package has yet been selected. The target useful load is 450 pounds, and the company points to design features that will create numerous weight-saving opportunities and enable the MVP to meet LSA weight limits. The company set a target price of $169,000 for the experimental version and $189,000 for the S-LSA. It hopes to have a prototype flying in 18 to 24 months.

Information at www.mvp.aero.

Sonex Unveils AeroVee Turbo, SubSonex Plans

EXPERIMENTAL AIRCRAFT MANUFACTURER Sonex Aircraft of Oshkosh unveiled its AeroVee turbocharged engine and provided updates on its SubSonex personal jet program during the company's annual EAA AirVenture open house.

The turbo AeroVee ups the power of the kit engine from 80 hp to 100 hp, which, according to Sonex CEO Jeremy Monnett, would outperform engines rated 120 hp, or approaching 130 hp. It increases climb rate by 200 to 300 feet per minute and cruise speed by 25 mph when the engine is operated conservatively.

Priced at $10,995, an upgrade package for normally aspirated AeroVees (500-700 currently in service) costs $3,995. Deliveries are scheduled to begin in the fourth quarter of this year.

Sonex President John Monnett discussed developments in the SubSonex jet program. An updated prototype, the JSX-2, is powered by the PBS TJ 100 turbojet engine and features a larger cockpit. Fuel capacity has been increased to 40 gallons usable, giving the aircraft a range of about 500 miles with reserves. Price for a quick-build SubSonex kit is $130,000, with a $5,000 option for additional assistance for aircraft registered in the experimental exhibition category, which obviates the 51 percent rule for experimental aircraft construction.

More information at www.aeroconversions.com/products/aerovee/ and www.sonexaircraft.com/research/subsonex.html.

New AOA From Safe Flight

SAFE FLIGHT INSTRUMENT CORP. displayed its new SCx angle of attack (AOA) system designed for a range of homebuilt and general aviation airplanes. The system uses Safe Flight's leading edge lift transducer to measure AOA across the operating range of airplane weight, flap position, and airspeed. Most importantly, the SCx accurately measures AOA during uncoordinated flight, which some other AOA systems can't do.

The SCx is a two-box system with no plumbing. The vane is mounted on the leading edge, and a single electric cable runs to the indicator. All cables and hardware are included.

Priced at $1,495, it's available now for installation in experimentals, and Safe Flight hopes to have FAA approval for certificated airplanes as soon as possible.

More info at www.safeflight.com/products/aoa-stall-warning.

Photography by James Wynbrandt

Dynon Shows AFS Quick Panels

DYNON DEMONSTRATED a number of new features in its SkyView flat-glass avionics system for experimental aircraft during EAA AirVenture Oshkosh 2014. SkyView advancements now include a comm radio with the 8.33 MHz frequency spacing required in many parts of Europe and new software adding 60 new display options. The SkyView 11 software adding these and other new capabilities was expected to be available as a free update beginning in August 2014.

Dynon also showed new, complete instrument panels from its Advanced Flight Systems (AFS) division. Its new Quick Panel System for VFR and IFR avionics is professionally wired, configured, tested, and ready to install, potentially saving builders hundreds of hours in construction and SkyView installation.

An all-new Advanced Control Module is at the heart of the Quick Panel System. It integrates electronic circuit protection, EFIS networking, panel switch interfaces, panel dimmer, flap, trim, and wig-wag lighting controllers.

More info at www.dynonavionics.com.

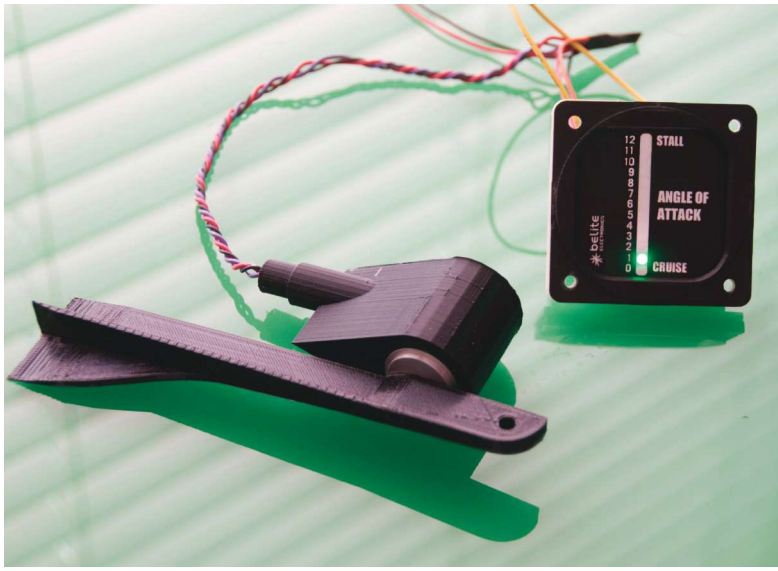
Improved AOA From Belite

BELITE'S IMPROVED ANGLE of attack sensor and display gauge provides immediate feedback as to the angle of attack. Calibrated from 0 to 12 (normal cruise to imminent stall), it features a frictionless mass-balanced weather-vane sensor, combined with a bright LED display, which is readable in direct sunlight.

The complete system includes the weather-vane sensor and housing and cockpit display. It is calibrated in flight by pushing a button: a short touch marks the imminent stall speed, and a long touch marks normal cruise speed setting. That is all that is required for calibration, and the system thereafter provides continuous feedback as to the current angle of attack.

At $499, the AOA system is compatible with most experimental, ultralight, and light-sport aircraft (with manufacturer approval). The gauge is designed for the pilot's choice of heads-up (HUD) reflective display mounting below the windshield or conventional panel mounting. The system is available for shipment now.

More information at www.beliteaircraft.com.



Bearhawk LSA Makes Maiden Flight

BEARHAWK AIRCRAFT MADE the first flight of the first Bearhawk LSA aircraft to be built from a quick-build kit. The completed aircraft, N514AK, was present at EAA AirVenture Oshkosh on display in the Bearhawk Aircraft booth.

The Bearhawk LSA completed the journey from Texas to Oshkosh in 9.7 hours of flight time. Cruise speeds during the flight varied from 98 mph burning 4.5 gph to 118 mph using 6 gph. Empty weight of this aircraft is 818 pounds, allowing for a useful load of 322 pounds with a full 30-gallon tank of fuel.

The Bearhawk LSA sports a 105-hp Continental O-200 engine. It includes a full electrical system. The Bearhawk LSA was also present on the grounds and participated in the Valdez STOL contest. In Monday's event, Bob Barrows, in his Bearhawk LSA, performed a takeoff roll of 94 feet and a landing roll of 140 feet.

For more information on Bearhawk Aircraft, visit www.bearhawkaircraft.com, or contact Bearhawk at info@bearhawkaircraft.com or 1-877-528-4776. EAA

Rising to the Challenge

Mark Hein and his sorta Super Cub

BY BUDD DAVISSON

Photography by Jim Koepnick

Mark Hein was two years into building his looks-like-a-Super-Cub-but-isn't before starting to take flying lessons. His Cub started out as a kit, but it is a study in small, detailed revisions and corrections.

MARK HEIN, EAA 716635, of Clearwater, Florida, breaks the traditional introduction to a person's airplane project. The vast majority of people in sport aviation have rubber-stamp biographies. Only the dates and locations change. The typical sport aviation biography starts with the builder/pilot saying "aaarhpane" as a baby, building models, hanging out at airports, starting to fly early, getting a certificate, then having to stop flying while career/marriage/family take priority in their lives. Then they finally get back into aviation in middle age. Mark skipped the early years and cut right to the chase when he was 45 years old—a late bloomer, but an incredibly intense, enthusiastic bloomer. "No one in my family was into aviation," he explained.

Mark chose to go with small tires because the airplane was slated to go on floats from the beginning.

"One reason I hadn't paid any attention to airplanes is that I have always been heavy into car racing. We're talking serious IMSA (International Motor Sports Association), Grand Am cars. Our team campaigned for Honda and during the '90's were national class champions for five years. I was doing this at the same time I was holding down a job as a financial advisor."

Having his own race team meant having a number of team employees, and more important to his future aviation ventures, a very complete workshop on his property. It's obvious from the way he talks about his racing (he's not completely out of it) that he values the team spirit and building the cars as much as winning the races. Almost. And in a way, that's what brought him into aviation.

"One of our drivers was a pilot and talked me into going to Sun 'n Fun, which was just down the road for us," Mark said. "We were cruising the flightline and he was constantly on me about building an airplane. He knew I loved building things, anything, and thought it was time I get into airplanes. I didn't disagree. I was intrigued by what I saw.

"Then he said, 'What you need is a Cub.' I, of course, barely knew what a Piper Cub was, but he set it up to go look at a J-3 that was for sale. I liked the looks of the airplane, but the owner didn't like the looks of me. He said, 'If you'll fit in it, I'll sell it to you, but I don't think you'll fit.' And he was right!

The pre-welded kit fuselage, although wildly out of line when Mark received it, is wider than a PA-18 and the left door is standard.

Photography by Jim Koepnick

A "new age" Cub with carbon fiber panel and "glass" instruments. This is the second panel, the first was all steam gauges, but buying and flying a Cirrus convinced Mark that glass was good.

I'm 6-foot-4, and there was simply no way I could fold myself up enough to get my head under the overhead cabin structure or my feet on the rudders and brakes. No way. So, J-3s were definitely out."

No decision about buying an airplane was made that year, but Mark and his driver agreed that Mark would probably fit in a Super Cub much better. So next year they targeted those models.

"When we went [to Sun 'n Fun] the next year, we spotted a Super Cub kit that not only fixed a lot of the shortcomings of the J-3—mainly size—but also went the Super Cub one better in several areas," Mark said. "It had doors on both sides, was three inches wider, and pretty much looked as if it was made for guys my size. So I decided, yeah, I can build an airplane."

The timing was good because Mark's wife, Vicki, who was very much behind him on all his ventures, had been trying to get him to give up racing for something that was a little less time consuming. So he scaled back his racing but got his crew members together and told them, "Hey, guess what! We're going to build an airplane.

"At first, everyone was into it, but little by little, they all dropped out except for Richard Sparks, who stuck with me through the entire ten years it took to get it flying."

It's worth mentioning here that even though Mark was building an airplane in his backyard shop (not your average backyard shop), he still hadn't started taking flying lessons. "I didn't take my first flight instruction until we were at least two years into the airplane," Mark said. "I was having such a good time building that flying just didn't seem important at the time."

Looking back at the project, he said, "We really built the airplane at least twice, maybe three times. For one thing, as we got deeper into the project and started networking with other

HEIN CUB SPECIFICATIONS

Top speed: 110 mph
Cruise speed (180 hp): 95 to 100 mph
Landing speed: 50 to 60 approach, 15 to 20 mph landing speed
Rate of climb at gross: 1,600 to 1,800 fpm
Range at 65% est.: 4 hours (400 miles)
Range at 50% est.: 4.5 to 5 hours
Empty weight: 1,300 pounds
Gross weight: 2,200 pounds
Useful load: 900 pounds
Fuel capacity: 48 gallons
Wingspan: 35.5 feet
Wing area: 172.25 square feet
Length: 23 feet
Cabin width: 27 inches
Cabin length: 72 inches
Engine: IO-360, 180 hp
Prop: McCauley 82-by-42 inches

The side, aft cargo door is a common modification to Cubs and involves moving some of the internal structure, but the increased utility makes it worth the effort.

Mark Hein.

Cub builders, we found that this particular kit had a reputation for not being as precise as it should be. To most guys, that made little difference because they could rig-out any flying difficulties. But I just couldn't handle that. For decades I had been obsessed with the precision that's involved in building championship race cars, where precision is everything. So I wouldn't be able to sleep at night knowing some critical dimensions were off.

"We went after the airplane with a tape measure and level and found that what we had been hearing was right. Some of the dimensions were off far enough that we were going to have to do some surgery and welding. The rear of the longerons, for instance, were close to an inch out of place, so the horizontal stabilizer was, too. It would have made the airplane almost impossible to land with any load in the airplane because I couldn't get enough up elevator. So we cut the longerons loose and squared everything away. Then we checked the main spar fittings and found they put the wings on the fuselage at a different angle of indices. They were nearly 3 degrees different. Yeah, you can asymmetrically droop flaps or ailerons to make it fly straight, but that just wasn't right; so more surgery was in order."

Every time Mark turned around he found things that wouldn't work for him or which the original Super Cub also didn't have exactly right.

He said, "On a Super Cub, the engine sits slightly out of line with the airframe centerline, which causes undue drag. So we got ahold of Mark Englerth of ThrustLine Products of Alaska who makes a modification for the mount that lines everything up. But we're so used to seeing Super Cubs with droopy noses that mine looks as if the nose bowl is a little high.

"That change was just one of many that became like dropping a rock in the pond...the ripples...demand that other things be changed. And this was to be a continuing theme for the entire project. It would be four steps ahead and three back because of the secondary and tertiary changes that would follow behind seemingly minor modifications.

Photography by Jim Koepnick

"The motor mount change meant that none of the kit sheet metal would work. I would probably have changed it anyway because I didn't like the quality, but this forced us into it. We bought a slip roller, taught ourselves how to use it, and made an entire new cowling and boot cowl.

"By the time we were done with the airframe, we had gotten rid of everything but the basic wings and the fuselage. However, we spent a lot of time on the wings because they had so many stripped screws. We repainted the entire fuselage because we had welded on it so much."

One of the seemingly minor changes to the fuselage started a long chain reaction that could be traced back to Mark's height. He said, "When you looked at the seat and the cockpit, it looked as if I'd fit fine. But as soon as we had the seat in it and I climbed aboard, it was obvious we still had problems: My head hit the cross-member. Fortunately, there's a lot of room under the seat to lower it, so I got ahold of Jay DeRosier of Javron Inc. They do their own Cub kit, so I had him make us a new seat frame.

"When we got the new seat, it was plain that we were in for another series of linked changes. In fact we had to re-engineer the flap handle and find another place for the float pump tank... as our goal this year is to put it on Clamar floats."

The Super Cub is flown from the front seat, and this gave Mark problems with the brakes because of the length of his legs. He said, "I couldn't reliably get at the brakes, so we had to design and build toe brakes. That's a change I'm really glad we did because it makes flying the airplane much more comfortable."

He added that sometimes the changes and their effects were almost comical. "We bought an off-the-shelf throttle quadrant and it looked as if it would work fine," Mark said. "But we had to change the arm a little, then this or that wouldn't fit. In the end, all that remained was the knob and the Phillips screw that held it on."

By the time he was well into the airplane and taking flying lessons, he truly had been bitten by the flying bug. As he

Mark's super-long legs forced him to modify the rudder and brake pedals.

The movable Mackey slats from Back Country Super Cub make the airplane almost impossible to stall and they allow 18-mph touchdowns.

worked on his private pilot certificate, the required cross-countries got him thinking about getting a four-place airplane for Vicki, but he wasn't sure she'd go for it.

"We had a bad experience on her first light airplane ride," he said. "The pilot decided to play 'watch this.' It was hot and bumpy, and he was thrashing the airplane around so, she came down feeling really bad and pretty much underwhelmed by her little airplane experience. But she's a strong, game girl, so I set it up to take a trip with a Cirrus dealer in a new airplane with air conditioning. That turned the trick. I looked at her in the backseat and she couldn't have been happier. That was in 2005 and I had total flight time of 65 hours. Since then, I took a lot of training and we've put more than 1,500 hours on the Cirrus, flying all over the U.S., touching down in 39 states, Costa Rica, and every place in between. We pretty much use it like an airliner.

"That got Vicki over her dislike for little airplanes. But it had a pretty serious effect on the Cub project because I got 'glass fever.' I really liked the glass cockpit of the Cirrus. This would be no big deal except that we had the Cub ready to cover and the panel was installed, completely finished and ready to go. But it was all steam gauges. And I wanted glass. So out it came and we designed and built an entirely new one."

Mark's instrument panel is one of the first hints that this is not your usual Super Cub because it's constructed of carbon fiber. Mark said this is a holdover from his race cars. Carbon fiber is a material used a lot in race cars, and they made the molds for it. He also used carbon fiber on the wing root covers and the throttle panel and pillar covers. For the interior, he put imitation leather on .020 aluminum.

Mark opted for a Mattituck, 180-hp IO-360 engine swinging an 84-inch prop. He said so far the engine has been crazy good. "I'm burning one quart of oil in 22 hours, which no one believes, but I swear it's the truth. I went up to the Mattituck shop and watched it go together and I was fascinated. When we installed it, we used a lot of race car stuff like stainless-steel braided hoses, all hard lines, etc. We did everything to race car standards."

When it came time to cover the airplane, Mark went the Poly-Fiber route. He and Richard covered the smaller parts themselves but gave the bigger ones to Jack McCloy at Swamp Air Services in Lakeland, Florida. Mark said, "I had Scheme Designs do the paint layout, something Jack said he'd never do again because he had close to 50 hours in masking alone. Every bit of it is paint. No decals. But I think it's worth the effort. Their design is beautiful and the airplane wouldn't be the same without it."

The movable Mackey slats, from Back Country Super Cub, on the leading edges are another clue that this isn't your granddad's Super Cub. Mark said the slats are absolutely amazing. "They are activated aerodynamically and you don't even know they're working. At normal speeds they are flush with the wing, but as the angle of attack goes up, they start pivoting open and let you do amazing things.

"Power off, flaps down, the plane hangs on down to about 18 mph indicated and does absolutely nothing unusual. At 15 mph, it starts sinking 500 fpm, but there's no stall break. I've tried and I can't get it to break. The slats work unbelievably well.

"Before I flew the airplane, a friend took me out in his Super Cruiser and we did a bunch of landings. At the time he said I did well, and I told him, 'When practicing for races, I generally have a coach criticizing my driving and telling me what to do, so I'm only doing what you're telling me to do. In a way, you're flying the airplane through me, and I learn the skills along the way.'

"One thing about flying the airplane that I'm really working on is the difference between it being just me in the airplane and having someone in the backseat. Aft CG really feels different. So I got a couple of big bags of dog food, and I'm shooting landings with the CG in all sorts of different positions. Although I'm not going to be doing any serious bush flying that has me landing on sandbars and such, we do intend to use the airplane a lot."

So now he has one of the fastest airplanes in the fleet—a Cirrus—and one of the slowest—a Super Cub. How do they fit together?

"The way I look at the Cirrus and the Cub, the Cirrus will do things the Cub can't do, and the Cub will do things the Cirrus couldn't even think about," Mark said. "So they each fit into our lives in different ways and let us really enjoy both." When he finished the Super Cub and started flying it, he couldn't help but love it. It's hard not to like a well-done Super Cub. However, what makes Mark and his airplane unique is that he came into aviation totally cold. He had zero background to draw on. He had a steeper learning curve to climb than most. But he had a self-education method that had stood him in good stead in the past.

"I absolutely love building stuff, so I built our house, I mean really built it," he said, "but when I started, I knew nothing about what was involved. So I bought every book in the Time Life building series and DVDs on everything having to do with a house, from plumbing to electrical, and made learning to build a project easier. I did the same thing with the Cub. I spent a lot of time finding the right resources, and that includes locating people who have all the answers and putting them on speed dial. I knew I was a babe in the woods. But whether you're building houses, boats, or airplanes, there's always a lot to learn, and the educational resources are out there, if you dig deep enough."

Mark said one of the very best moments in building, and then flying, the airplane was on the first flight with Vicki in the backseat. "We were flying along and her voice came over the intercom. She said, 'I never thought I'd be perfectly happy to be flying in an airplane that my husband and his crazy friend built in our backyard.'"

Those kinds of moments only come once or twice in a lifetime. Vindication from the backseat is sacred and very much appreciated. EAA

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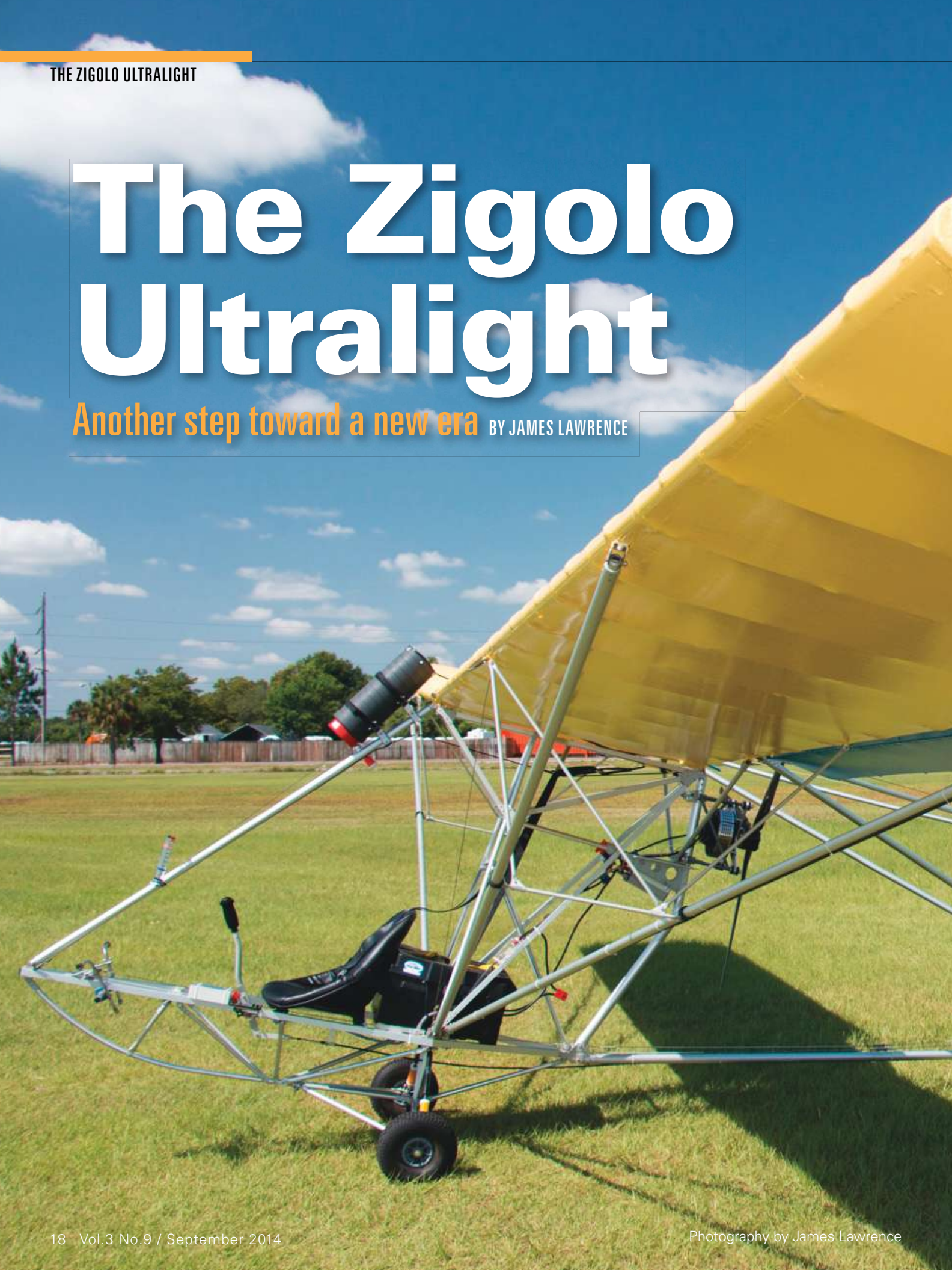
The Zigolo Ultralight

Another step toward a new era

BY JAMES LAWRENCE



Photography by James Lawrence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Is this any way to start a revolution in flight?

I'm sitting with the redoubtable Chip Erwin, veteran sport aircraft manufacturer and once-and-resurgent ultralight enthusiast, in his hangar off the end of South Lakeland Airport's (X49) lovely grass strip. We're jawing about the light-sport aircraft (LSA) market after 10 years of existence, reflecting on all those older pilots who sold their Bonanzas and Mooneys for fear of losing their medicals, then bought shiny new $100,000 to $150,000 special light-sport aircraft (S-LSA).

The BRS ballistic chute mounted on the Zigolo ... one of two chute options; the other being the Comelli pneumatic chute.

In a few minutes, I hope to take a short hop in his prototype ultralight that lives on the other end of the cost rainbow.

First things first: Chip, who brought the SportCruiser and Mermaid LSA to the United States (and plans to do it again soon), has launched a venture to produce the Aviad Zigolo MG, a repurposed Italian version of the Super Goat rigid-wing primary glider created 10 years ago by aeronautical engineer Mike Sandlin. He's already set up what he calls an "assembly shop" in China to sell almost ready to fly (ARTF) Zigolos to that burgeoning market.

Chip's also busy getting his Aeromarine "manufactory" in Florida up to speed to produce experimental amateur-built (E-AB) kits or ARTF bolt-together versions of two models of Zigolo; one is gas-powered, the other is electric. He expects to have the electric Zig ready for market by this December.

The two-stroke Zigolo costs $14,500 in E-AB kit form and $16,000 as an ARTF. He expects the electric model to come to market at around $21,000. That's a complete package, including airframe parachute (BRS rocket or Comelli pneumatic), proprietary motor in development, ESC controller, and batteries.

Radio-controlled (RC) modelers know all about ARTF. Basically, the airplane is completely fabricated, disassembled, and shipped. When it arrives at your door, it's a half-day assembly project with simple tools to an airworthy craft.

Given how the LSA market has flown away from the budget flier since its inception, Chip and many other sport flying

Chip Erwin reinvents an ultralight.

Photography by James Lawrence

Jim Lawrence taxies out in the electric-powered Zigolo.

veterans, including yours truly, sense a resurgent, untapped appetite for simple, affordable flight. Remember, the ultralight industry sold 30,000 aircraft beginning in the 1980s. No one back in the day expected ultralights to save general aviation (GA). We just expected they would return the word "fun" to flying. Many of us look back on those days as the most enjoyable flying we ever did.

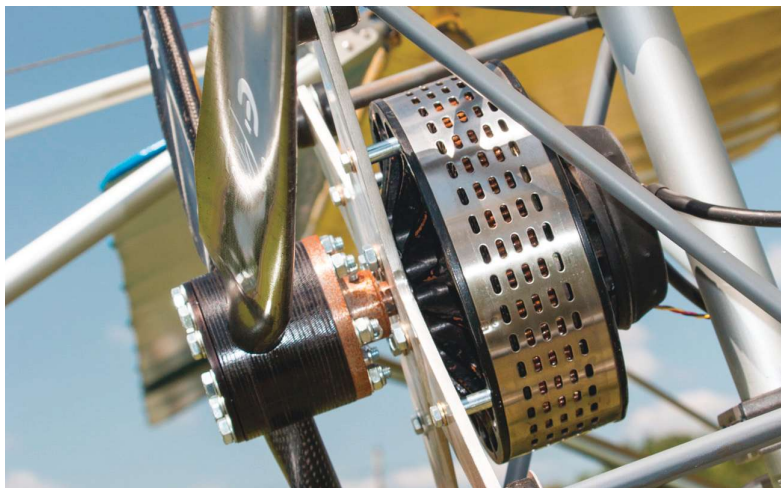
Chip hopes the Zigolo MG 12 is perfectly timed to hit big in the budget flying market. As he quips on his website, "Everything you need and not much else."

But "not much else," we can argue, is just what many existing and would-be aeronauts want. After a decade of dismay watching the LSA "great winged hope" climb ever higher into the pricing stratosphere, Zigolo and others coming on board (Brian Carpenter's EMG-6 glider for one) present new opportunities to enjoy flying again without taking out a second mortgage on the house.

Of course, Zigolo is essentially a powered hang glider. You're not going to go very far. But you will likely smile the whole time. That's what ultralight flying has always promised...and delivered.

A SINGLE DEREGULATED SEAT

The Zigolo serves up recreational flight in a single-seat, deregulated European microlight—a 10-year-proven glider design that's priced way below what many ultralights currently cost. Yes, the Zigolo MG is a tube-and-fabric, bare-



The electric motor on the Zigolo.

bones affair, but it will get you in the air under power to soar around with performance akin to a modern hang glider... and without requiring you to tow up or drive up a mountain, set up a glider, punch off, and when the lift fails, be faced with having to do the drill all over again. Zigolo also trailers nicely, so you can store it in your garage and pull it on long road trips to favorite flying haunts.

And whether you choose gas or electric power, you'll legally fit within the upper empty weight limit of the FAR Part 103 specification as it's written today.

The battery pack for the electric-powered Zigolo.

This is the gas-powered version of the Zigolo.

(Side note: In China, citizens can buy a $600,000 Cirrus. They just can't legally fly it anywhere beyond a 15-mile or so radius. Crazy, right? But there are hundreds of Chinese ultralight clubs and thousands of pilots literally flying under the radar there, because the country's civil aviation body recognizes the United States' FAA Part 103 rule. That might lead to ultralight flying as the first viable step in waking the sleeping GA giant China has promised to become in recent years. And Aeromarine's ARTF Zigolos stand poised to exploit the potential along with Quicksilver, Zenith, and other U.S. and European manufacturers who've been making inroads there.

SEAT O' THE PANTS FLIGHT TEST

Last year at EAA AirVenture Oshkosh 2013 I had the pleasure of flying GreenWing's single-seat eSpyder, an electrified, highly refined Flightstar ultralight with a robust empty weight profile to match (410 pounds). It was a thrill floating around the Ultralight/Light Plane patch in this beautiful, experimental amateur-built electric aircraft.

Performance was about what you'd expect with that much weight behind 32 electric horses: fairly benign. But the quiet, buttery feel of the eSpyder's electric propulsion system was revelatory: no ear-splitting noise, no bone-rattling vibrations, no smelly gas or exhaust/fuel residue flung onto flight surfaces by a two-stroke engine; just smooth, breeze-in-the-face, meditative flight.

Yet $39,900 for an E-AB kit that required 150 hours to complete seems, on reflection, to have been a market overreach, unless you contrast it with even higher-priced S-LSA aircraft. But eSpyder still looks and flies like an ultralight, electric or not.

Then came a hammer blow: manufacturer/supplier Yuneec of China quietly back-shelved production of the eSpyder for the U.S. market in favor of its consumer-marketed RC multicopter and electric skateboard products. So much for the promise of a practical, fun-flying electric fliv-

Photography by James Lawrence

ver. To date, the eSpyder remains in limbo, and this marks the second time Yuneec has abandoned the electric flight bride at the altar.

Back to the future: Chip Erwin agreed to trust his one-and-only electric prototype to my eager mitts. Now, piloting experience is an elusive genie: It can grant fabulous wishes or bedevil you with anxieties over your imagined deficient skill set. But one look at the Zigolo evoked those early ultralight flying memories. Watching Chip fly it looked like a piece of cake. What? Me worry?

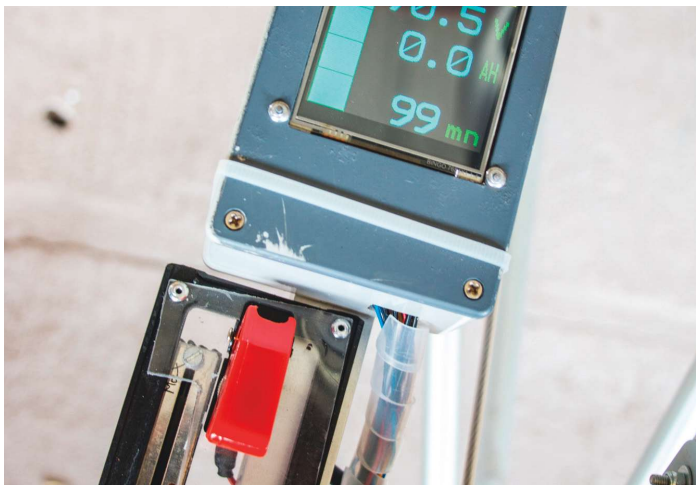
Still, there's always that tension/thrill when you solo a single-seater the first time, especially when there's no two-seat trainer to try out first. You don't know exactly what to expect until the moment you commit to takeoff. And what if I dinged Chip's only flying Zig? Yikes!

But this simple three-axis ultralight comes with a solid pedigree. Many Goat gliders are flying worldwide, primarily as unpowered hang gliders. Chip offers his gas-powered version with the same 25-pound, 25-hp, single-lung Vittorazi Moster 185 two-stroke engine as Italian company Aviad has for years.

MOUNT UP, SOLDIER!

On the Zigolo, the pilot's posterior perch is a molded high back seat out in front of the wing/"fuselage"/landing gear. The well-ventilated taildragger has no windscreen. At a stall-to-VNE speed range of 19 to 50 knots, who needs one? And the catbird seat is comfy. The rudder bars (the production model has aluminum box pedals now) feel ample, and there's a substantial Cub-like stick to give you something reassuring to hang on to in case all that open space might seem a bit daunting.

The motor control sweet spot though is a smallish, left side-mounted "throttle" slider box—about the size and complexity of a wall-mounted electric fan switch. But, that little slider speaks volumes about our flying futures. Push it forward for power and slide it back for no power. There's almost



The "throttle" for the electric motor.

The very ultralight-looking Zigolo with its pneumatic chute.

Yes, the Zigolo MG is a tube-and-fabric, bare-bones affair, but it will get you in the air under power to soar around with performance akin to a modern hang glider…

no resistance. All the way back and the prop stops for soaring or dead-stick landings. There's no choke. No warm up. No CGT or EGT or oil temp gauges to fret over. There is a voltage monitoring LCD to speak to how much electric "fuel" remains in the "tank." (Someday soon we'll have an established electric flight lexicon. For now, gas motor slang will have to suffice. Whatever...we're still saying "horsepower" from the whip and buggy days.)

Sitting with all that air around you—front, sides, above, and below—the lap belt/shoulder harness removes any nattering worries about falling out in bumpy conditions.

The Zigolo is meant for power-off (or glide-boosting idle), thermal-hitching flight. It can handle the bumps just fine with its static-tested +6*g*/-3*g* ultimate load rating. But how does it handle the decent pilotage requirements of ground skimming along at a height of 10 feet down a tree-lined runway? Time to find out.

Following Chip's preflight coaching, I taxi out to the grass strip at South Lakeland. I slide the power knob to the stops... all 3 inches of travel—not much of a macho pilot's move there—but the electric motor rewards that minimal slide with a satisfying, robust surge. I'm quickly rolling, I pop the tail up...and see I'm heading right for two big plastic buckets marking the threshold. Ack!

Luck smiles as I maintain my equanimity, split the 6-foot distance between them, breathe a sigh of relief, check the Hall wind meter disk, see 25 mph, and ease back on the stick...and we're airborne. Not so artful, but the ego will recover.

A quick stick juke left and right tells me the full-span ailerons deliver a decent response indeed, certainly lighter and requiring less rudder than many other ultralights I've flown. Leveling off in ground effect, I feel some decent pops from early thermals, and keep the glider low over the runway as Chip had advised.

The foot pedals provide all the rudder push you could want. After 20 seconds flying down the strip, it's time to "chop" power. We settle back down, and the Zigolo lands on the smooth grass as sweet as you'd ever want with a comforting little float, flare, and touchdown.

That first hop tells me all I need to know: Zigolo is easy in handling, fun to fly, lands like a floater, and responds well to three-axis input. Next flight, please!

The Zigolo and I make another pass, then another, then another, which provides a good thermal pop just after takeoff. Unable to resist, I pull the stick back and gain a quick 150 feet. Out the back side of the bump, we dive down again, kill the power, and glide along for another easy landing.

Sweet. Steady. Smooth. What a very nice little airplane!

THE NEXT STEP

This electric prototype is meant to be a proof-of-concept test bed for the electric propulsion system. Accordingly, it will soon fade into history in favor of a Generation 2 model, with a more powerful, more efficient motor Chip's developing with electrical engineer Don Lineback.

I had a lengthy chat with Don at EAA AirVenture Oshkosh 2014 and can report with some enthusiasm that the new outrunner-type motor package they're developing could be a strong step forward for the fledgling electric flight industry.

Chip hopes to be ready to go with the electric Zigolo by this December. Meanwhile, you can put down $10 for a delivery position right now. Don't want to wait? Buy the gas-powered Zigolo now and take delivery in a few weeks of either a (newly FAA-sanctioned) 100-hour E-AB kit or an ARTF machine. Each comes complete with covered airframe, powerplant and controls, basic instruments, and either a Comelli or BRS airframe emergency reserve parachute.

"I won't sell a Zigolo without a chute; it's standard equipment for the price," Chip said. For those who want both the benefits of quiet electric and traditional gas power, you can buy both: The powerplants are interchangeable in about two hours.

For a treat meanwhile, get your mojo working by searching YouTube for videos of Zigolos flying worldwide. You'll see what a sweet performer it is, power on and off.

Let's wrap up with Chip Erwin's take on electric flight: "It works, it's viable, and I like it. Now I can fly at 500 feet and enjoy that low altitude. It's high enough for the chute to deploy, and quiet enough not to bother anyone.

"Now, instead of 'Get the gun, Martha!' when noisy two-strokers fly overhead, people will wave, if they hear you at all, especially once we reduce the prop noise even further."

All I'll add to the mix is this heartfelt promise: Once you fly electric, aircraft handling and performance issues aside, I'd bet you'll never want to mess with a gas-powered airplane again. Yeah, it's really that cool.

For more information about the Zigolo, visit www.Aeromarine-LSA.com. EAA

SPECIFICATIONS

Wingspan: 36.4 feet
Wing area: 170 square feet
Wing aspect ratio: 7.9
Empty weight, including parachute: 276 pounds (254 pounds plus 24-pound parachute allowance)
Load factor: +4/-2*g* (safety factor 1.5, for +6/-3 ultimate load)
Stall: 22 mph
Cruise: 35 to 40 mph
Sink rate: 276 fpm
Glide ratio: 11-to-1
Anticipated electric motor endurance: 45 minutes

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Introducing the Thatcher CX5

The all-metal two-place flies!

BY PAT PANZERA, EAA 555743

With special thanks to Dr. Glen Bradley for additional content.

Photography courtesy of Dr. Glen Bradley


CX5
N14GB

Author's note: Mr. David Thatcher Sr. is an octogenarian and the purest form of a gentleman, in addition to being a lifelong supporter of general aviation. As such, I chose to refer to him as Mr. Thatcher throughout this article.

MR. DAVID THATCHER'S BEAUTIFUL single-place CX4 graced the pages of EAA's *Experimenter* e-newsletter in April 2010, May 2010, August 2010, January 2011, February 2011, June 2011, and September 2011 as well as *EAA Sport Aviation* magazine in March 2009. For those who aren't immediately familiar with the little plane, it epitomizes the spirit of homebuilt aircraft by being affordable to build and operate while having beautiful classic lines and performance specs that align perfectly with its mission, within the confines of the light-sport aircraft rule. If it had a flaw, it would be that we as pilots can't share the joy of flying with our friends in this little gem since it only seats one.

But Mr. Thatcher, EAA 65426, has changed that. He recently completed the two-place CX5 prototype with the hopes of taking it to the 2014 Sun 'n Fun International Fly-In & Expo in Lakeland, Florida, but the airplane just wasn't ready in time. Last-minute modifications caused setbacks with the FAA Phase I flight testing program.

But now the CX5 is ready to fly. Dr. Glen Bradley, EAA 164271, of Pensacola, Florida, has not only been Mr. Thatcher's right hand during the build of the prototype but also has been the test pilot throughout the entire test flight program. The following is the story of the journey from Mr. Thatcher's fertile mind through the building and flight testing of this long-awaited, second masterpiece.

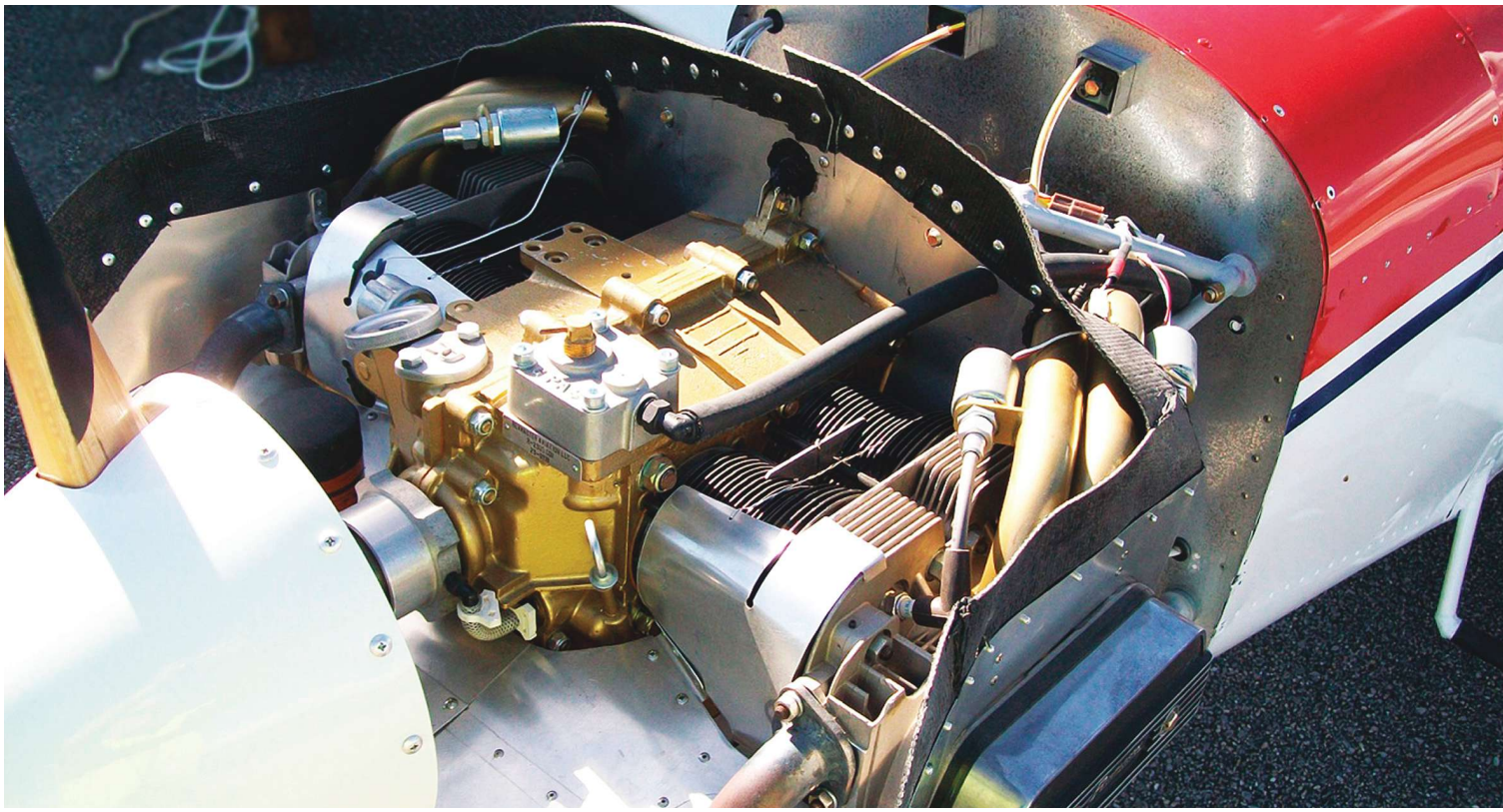
The CX5 began as a wooden mock-up that quickly led to the final design.

HOW'D I GET MYSELF INTO THIS SITUATION?

Like so many builders on the verge of a first flight, this was the question on Glen's mind on December 17, 2013, as he strapped himself into a homebuilt plane that had never flown. Worse yet, this was the prototype of a new design, not one built as a replica of hundreds that had flown before. Glen is a 66-year-old retired college professor and CFI—not a professional test pilot. Surely we can appreciate his apprehension and anxiety.

The CX5 in its actual all-metal configuration.

Photography courtesy of Dr. Glen Bradley

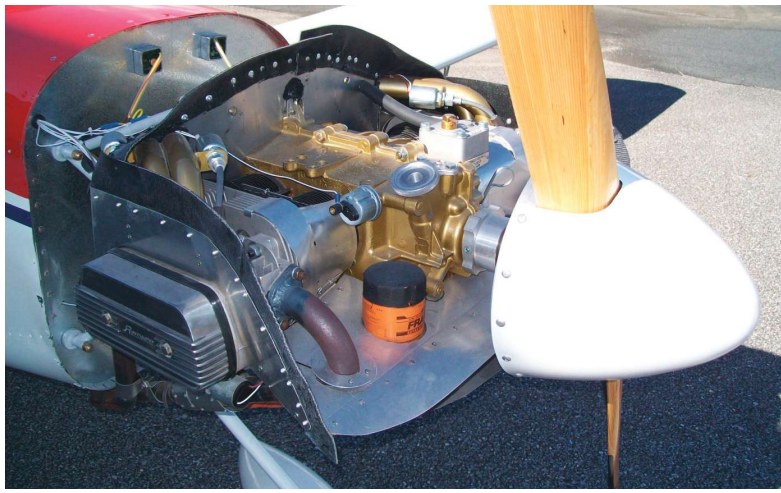


It's no coincidence that the Revmaster R2300 looks at home on the nose of the CX5. It was selected as the engine of choice from the beginning.

Glen had already shaken down the plane as much as possible. Many hours of taxi testing, including high-speed runs, led up to this point. There was nothing left to do but to fly it. He told his ground crew that he would do a "land back" (crow hop), and then if all went well, he'd taxi back to the departure end and take off for flight number one. The hop went as expected, so Glen headed to the departure end and taxied into position. As he eased in the throttle, he was quite surprised at the acceleration. "Wow! That 85-hp Revmaster is pulling really well," he thought as he eased back on the stick to take the weight off the nose wheel. Glen figured he'd wait a bit to rotate in order to build some extra speed, but the next thing he knew he was off and climbing like mad.

Glen had estimated that by the time he would be at the end of the runway, he'd be at 500 feet above the ground, but when he arrived there, he was stunned to see that he was at 1,000 feet! His plan was to conduct a standard right-hand pattern and return to terra firma. As he headed along the downwind leg, already at pattern altitude, he had a short moment to relax and check his instruments and was shocked to see his fuel pressure gauge was reading quite low. He should have had 2 psi or better, but he was showing less than 1. "Almost certainly a sending unit issue," he thought, since he had both mechanical and electrical pumps going. But this was the first flight of a new plane—why chance it? Prudent thing to do was to expedite his landing.

Glen was set up for a "normal" pattern, but his decision to expedite now placed him a bit high, so he pulled carb heat, cut power, and banked toward the runway for a short final. This is when Glen discovered the CX5's gliding ability. So a slip was executed all the way down to final. According to Glen, it felt a lot like the CX4 in which he has almost 200 hours, so he felt at home.



The landing was very smooth and uneventful, so he taxied back into smiles all around. Mr. Thatcher seemed quite pleased and said it sounded and looked great! A short flight for sure, but it told Glen that the plane handled well, was predictable, climbed like a rocket, and landed just as it should.

A postflight debriefing with Mr. Thatcher determined that the fuel pressure was not an actual concern after all. As it turned out, running the electric pump along with the mechanical pump caused a conflict between the two, resulting in low but seemingly adequate fuel pressure. So the fix was simple; don't run the electric pump unless the mechanical unit fails. The pumps are plumbed in parallel since the mechanical pump won't allow fuel to pass if it fails. This was tested this early on.

The second flight used the same routine at first: a climb to 1,000 feet, leveling off in the pattern, and if all instruments were in the green, continue to 2,500 feet. On the first flight, climb speed was set at 80 mph. On the second flight, from 1,000 feet on up, Glen increased the speed to 90 mph at about 24 inches of manifold pressure (MP) and still indicated 500 fpm.

At altitude, Glen reduced the throttle to 22 inches MP and was indicating 115 mph. He said he tried to relax and just enjoy the moment—checking the instruments constantly, of course. The oil temp crept up to 190°F or so, and Glen made a mental note that it was a bit high for a winter day. Glen flew for about 20 minutes, feeling the controls. Ailerons were very responsive, almost as good as the smaller, lighter, shorter-wingspan CX4. No adverse yaw was detected; elevator was very responsive. The landing was less eventful than the first.

The things that struck Glen the most on the first two first flights were the climb rate and the view out the canopy. With the low cowl and instrument panel and the wing back out of the way, Glen felt he could see everything—the best of any plane he has ever flown and that is saying a lot. Glen has flown about 60 different designs in all, and he equates the CX5 to a bit "better than a Beech T-34 Mentor." While the CX4 also has superb visibility, the CX5 beats it.

THE REFINEMENT OF A GOOD DESIGN

Since those first flights, Glen has completed the required 40 hours of Phase I flight testing, and in the process, Mr. Thatcher tuned the airplane exactly the way he wanted it to be and has begun offering plan sets. "Good is not good enough; it must be better than good—it must feel natural to taxi and fly," Glen told us. "It should never fight the pilot in any way."

The three main areas that were tweaked as a result of Glen's testing and feedback are the tail feathers, engine cooling, dive brake, and wheel brakes. The initial taxi runs showed that it needed more elevator authority and that the engine wasn't cooling well enough for flight. So vents were added to the bottom of the cowl, the oil cooler inlet was enlarged a little, and a new horizontal stabilizer and elevator was built, painted, and installed.

The cowl changes made a huge difference and now everything is in the green for cruise—the oil temperature is down to 185°F and cylinder head temps (CHT) to 350°F while at cruise. The brake system was changed several times to get it the way they wanted. Changes included different master cylinders as well as linkage geometry modifications.

THE REVMASTER R-2300

Mr. Thatcher is exceedingly pleased with his choice of the 2331-cc Revmaster R-2300 engine featured in the November 2011 issue of *Experimenter*. Chosen for its power and the company's reputation, the engine has a self-reliant ignition system and a built-in mechanical fuel pump, qualities that Mr. Thatcher likes. The intent was to have an engine that's completely self-sustaining during a total electrical failure. With the redundant ignition systems, dual internal charging systems, and mechanical fuel pump, it is; one can lose the entire electrical system and the engine will still run just fine.

The engine came with an aftermarket oil cooler attached to the bottom of the engine. It also has a spin-on oil filter. Typically, VW engines simply have a mesh screen that only captures pieces that are too large to cause any real problems. It's the small particles that get past the screen and into the bearings and rings that cause problems. These particles can now be caught by the FRAM oil filter. Joe Horvath of Revmaster Aviation recommends 20-50 multiviscosity oil. Glen and Mr. Thatcher prefer to use Valvoline 20-50 racing oil because of its zinc content.

The CX5's fuel system is set up so that one can run off either the left or the right fuel tank, or both. One can also shut off the fuel completely. Each tank has 10 gallons usable fuel, and Revmaster recommends 91 octane fuel or better. Glen started out flying on 100LL but gradually added non-ethanol premium auto fuel.

Fuel burn on the 1600-cc VW in the prototype CX4 is amazingly meager. Glen reports that he can fly conservatively and burn less than 3 gallons per hour (gph), and he can include 40 minutes of touch-and-goes. Of course, the fuel burn on the 2331-cc VW-powered CX5 is higher, but it is still possible to match the CX4's 3 gph at very low speed with 4 gph being burned at 65 percent power.

As previously stated, Mr. Thatcher and Glen are happy with the Revmaster engine. It's reported to pull very well. Glen is not a small person (250 pounds plus) and is usually flying with full fuel most of the time, putting his operating weight right up there with the all-up weight of two "normal"-sized people. And yet he still sees a 1,000-fpm climb rate.

CONTROL AND STABILITY

The controls in the CX5 are standard three-axis. The throttle quadrant is mounted on the left with the elevator trim on the right, in both the front and rear cockpits. The front cockpit has the instrument panel, nav/comm radios, electric speed brake switch, and aileron trim. The fuel selector is in front as well. Both cockpits have tons of room and good canopy clearance. Glen is 5 feet 10 inches tall and has a good 5 inches of head clearance even while sitting on a 3-inch cushion.

The plane is reported to be stable, staying put where the pilot leaves it. It has neutral spiral stability, so after entering a bank and with the stick returned, the plane continues to turn exactly as it was left; it doesn't tend to steepen or come out of the bank.

Photography courtesy of Dr. Glen Bradley

Nose to nose; compare the profiles; two-place at left. The CX5 cockpit is barely distinguishable from the CX4's, but it is several inches wider and taller, measuring a full 28 inches in width (25 inches between the seatback longerons) and nearly 36 inches from the seat bottom to the top of the roll bar.

The longitudinal stability is nice as well. When trimmed for straight-and-level flight, as the nose is raised and the speed drops by 20 mph, if the stick is released, the plane gently lowers the nose below the horizon, gains about 30 mph, and then slowly returns to level flight as the excess 10 mph bleeds off.

The rudder is appropriately responsive but not overly so and allows good forward and side slips. At gross weight the CX5 has the same wing loading as the CX4, about 10 pounds per square foot. Solo it's less, of course, so it tends to float in ground effect. The electric speed brake helps to slow it, working off a momentary toggle switch; 3 seconds for full down (about 80 degrees) and 3 seconds up. It can be stopped anywhere in between. Increasing drag reduces the floating tendency; however, it does affect the pitching moment and causes a very slight nose-up pitch while producing 500 fpm extra rate of descent if the speed is kept the same.

The CX5 was designed to carry two big guys (230 pounds each), full fuel (20 gallons usable), and 20 pounds of baggage and still be within the center of gravity range. It's also designed to be almost impossible to load outside the CG limits. One can have a huge pilot and no passenger with low fuel and be near the front CG limit or with a 250-pound passenger and a 100-pound pilot with full fuel and still be within the CG range.

The instrument panel is designed for traditional round instruments, but ingenious builders will no doubt find room for some "glass," too.

DAVID THATCHER

Mr. Thatcher is a man of few words, but his words are very well chosen. He's honest in word and deed. Because his every move in the shop is nearly always the exactly correct one, he never seems to move very fast, he never wastes a second, and he demands quality as well as good-looking workmanship. He gets the fundamentals of life and ethics right—he is a truly spiritual man. Mr. Thatcher doesn't try to impress, but by not trying to do so, does.

Mr. Thatcher approaches his aircraft design the same way that he approaches life. The whole idea is to have a plane that looks honest and is honest. A plane that a guy with zero experience can build, with minimal tools, in a small space, and have a plane that's elegant looking, flies naturally, and is economical

After the CX5 was complete and painted, it was trucked from Pensacola, Florida, to Jack Edwards National Airport, Gulf Shores, Alabama, for FAA Phase 1 flight testing.

to build, own, and operate. A CX5 truly can be built for under $25,000 without any extraordinary effort.

IT'S ALL IN THE DETAILS

Mr. Thatcher is an artist. He's created oil paintings of various aircraft for aircraft owners and others. He has an eye for form and detail; he's even been known to lay out rivet lines freehand. Mr. Thatcher's planes are well thought out. As an example, the fiberglass wing root fairing fits the fuselage and the wing so well that it goes almost unnoticed. The little vertical fin fairing, though very small, makes the transition to the fuselage smooth and pleasing to the eye. Some of the artistic details of Mr. Thatcher's aircraft are also useful aerodynamically and structurally. The rear portion of the wing root fairing is pleasing to look at but also adds structural rigidity to that region of the fuselage.

RECENT PROGRESS ON PARTS AND KITS

Greg Westberry of Cloudland, Georgia (Westberry Manufacturing LLC), has an agreement with Mr. Thatcher to provide parts that Mr. Thatcher doesn't provide. So far Mr. Thatcher provides windshields, canopies, welded controls, exhausts, and a nose gear for the tri-gear versions of the CX4 and CX5. Greg developed a complete CNC hole-matched kit for the CX4 and has most of the CX5 ready. Additionally, one of Greg's wing kits was used for static load testing. One wing was mounted on a load test fixture and loaded to both positive 3.8*g* and 5.7*g* levels. Negative loading wasn't conducted, nor was the center section tested.

Fiberglass parts (wheelpants, wingtips, wing fillets, and the cowl) are made by and available from Earnest Martin (www.CX4community.com/emartin.htm).

KEEPING INFORMED

The CX4/CX5 Yahoo group (membership almost 2,000), https://groups.Yahoo.com/neo/groups/CX4/info, is a great bunch of people who post photos of their build progress, and they respond well to questions from anyone in the group. The CX4 and CX5 Builder Community News site, www.CX4community.com (by Todd Henning), is a super website with a wealth of information, including photos, videos, builder lists, pilot reports, and more.

While the Thatcher CX4 plans are available for both tricycle gear and conventional gear (tail wheel), the new CX5 is only (currently) available in tricycle gear. However, the plane was designed with conventional gear in mind, and plans will soon be available for either configuration. For more information, including the price of the plans and a list of available premade parts, please visit www.ThatcherCX4.com/parts.htm. EAA

In addition to being the founding editor of the Experimenter *e-newsletter, the current editor and publisher of* Contact! Magazine, *and a regular contributor to* Kitplanes, *Patrick Panzera is an experienced homebuilder, EAA technical counselor, AirVenture forums presenter, EAA Young Eagles pilot, and an instrument-rated private pilot.*

Photography courtesy of Dr. Glen Bradley

The Long Game

Getting my Chinook +2 airborne

BY MICHAEL MCCUSKER, EAA 587200

The Chinook +2 and its very basic interior.

MY PLANE ITSELF is quite simple—tube and fabric, a few basic instruments, a Rotax in the back. With full tanks, this two-seat experimental amateur-built aircraft weighs in at 502 pounds. This lends the plane a degree of "responsiveness" that I did not anticipate. As I explain to friends, if I'm flying over you and you look up and sneeze, I might gain 100 feet of altitude. But the flying stories are for another day. This is the story of the build that took approximately nine years, 3,000 miles, three different EAA technical counselors, and one marriage.

With a vague notion that I wanted to know every nut, bolt, and rivet on the collection of parts that was keeping me in the air, I sold my share in a 1978 Piper Archer and spent a few months researching the various kit planes that were available in 2001. I settled on the Chinook +2 because it seemed a straightforward build; it could be placed on skis, floats, or amphibious floats; and the wings could be removed in about 30 minutes. I had no building experience and knew no one who had built a plane. Undeterred by my own ignorance, I placed my order in August 2001. I eagerly anticipated the "cool" factor once I was done. *Yep, I built it, all by myself.* Little did I realize that a project like this would require many hands.

Like most Americans, I was struggling after the events of 9/11 and trying to figure out what I could do for my country in the days after. My version of service morphed into joining the Navy Reserve, and I was inducted just a few days after my 35th birthday. By the time the kit arrived that cold January 2002 evening, I was going to have at least one fewer weekend per month to work on the plane. But I still believed I could be flying by the late spring, as the manufacturer estimated the total build time to be 200 to 250 hours.

As I helped the freight truck driver unload the (seemingly endless) stream of boxes and crates, I started to get the first inkling that I may have bitten off more than I could chew. What made me think I could build a plane? I'd never even built a doghouse, let alone one that could take to the air. Fearing that I'd made a huge mistake, I opened the paperwork from the kit maker. The first thing they suggested was that I unpack and catalog everything, making sure what was on the parts list was actually present in my narrow one-car garage.

After two days of sorting and trying to find space and some sort of logical system to place things, I determined that indeed I had an entire airplane in the garage, albeit the "before" version. I looked at the "after" pictures and could not envision how I would make that connection.

The builder's manual was generally excellent. I suspect that anyone who had done any plane building, or even assisted with a build, would have made much faster progress than I did. But I found myself reading the directions for a given step, gathering the required pieces, lining everything up, then rereading the directions, checking the alignment of any predrilled holes, rereading the directions again, then sitting back and questioning if I was doing any of this correctly. As a result, I spent a lot of time overanalyzing each step of the build, especially in the beginning when I was so unsure of myself and of the overall process.

Life has an annoying habit of getting in the way of our aviation dreams. So it was for me. Those first winter weekends were too cold for me to do much in that unheated garage. The Reserve was taking more time than I anticipated. My wife, while completely supportive of all my crazy schemes, still wanted and deserved some time on the week-

Photography courtesy of Michael McCusker

ends for us. My 90-year-old house always seemed to have a new demand every few weeks, and house projects are much like plane projects—they will take twice as much time and money as you expected.

Early progress on the build was in fits and starts. One weekend I might get two or three steps done, or mostly done, but would leave out one or two things that I wasn't 100 percent sure of. Do I place the locknut on now, even though I'm pretty sure it will have to be removed for a later step? How can I be totally sure that the control cables are not rubbing against that bolt inside the main tube? What do I do if a rivet shaft didn't fully pop off? I had no one to turn to for these basic questions. I joined EAA for a year when I first became a pilot, but at that time, I remember scanning each monthly magazine thinking, *I'm never gonna build a plane. None of this stuff is relevant to me.* My membership lapsed before I ever understood all that EAA had to offer, and long before I bought this kit.

So I muddled along, making what seemed and felt like very little progress. Thoughts began to creep in that I would never get this done, and this was going to be an expensive lesson in learning my limits. Friends who knew of my project would ask excitedly in the beginning about my progress. As time dragged on, and they could see the disappointment on my own face every time they made an inquiry, the questions became fewer and fewer.

Then, in late 2005, a stroke of luck occurred. A pilot friend mentioned in passing that he thought EAA might be able to help, as he recalled it had some sort of program for builders. I looked into it immediately and was soon a member and connected with a technical counselor who lived about 30 miles away. He enthusiastically came out a few times to offer suggestions, guidance, and help. The biggest benefit was the mental boost, as he convinced me that I was much farther along than I realized, and that I could absolutely finish this project.

Right around that same time, Jim and I became friends. He had his private pilot certificate and wasn't necessarily thinking about building. He just loved all things aviation and was finally at a place in life where he could start to indulge that passion. He would often just drop by because he wanted to work on the kit, which of course spurred me to drop whatever non-plane thing I was doing.

With the help of Jim and a second tech counselor, we soon got to the stage of covering and painting. This process alone could have sucked up a few hundred hours, due to my lack of experience and my sometimes perfectionist tendencies. Soon it dawned on me that I had no need to build the prettiest Chinook +2 in the world. It just needed to be safe and airworthy. Jim and I did the best we could with covering and painting, but my plane will never win any awards.

As this progress was being made, my life had taken a few more turns over the five years to this point. I left my teaching career to become a physician's assistant. During that training and the first year I was in practice, I had no time to consider anything related to plane building. As if this weren't enough of a time suck, I had convinced my wife (and myself) of the need to move from Pennsylvania to Oregon. A cross-country move is a bit more complicated than a move across town, and again, plane work got bumped ever further down the list.

The day after Memorial Day 2007, we loaded a 27-foot Penske truck with as much of our stuff as we could, but not before first carefully placing the plane, with a wing lying along either side, secured and padded as best I could. I still have a twinge of guilt that I never got to give Jim any flights in the project with which he helped so much.

After getting to our new home, the plane spent the first year or so in a much larger two-car garage. Project depression had set in, as I thought about the absurdity of having to truck an almost-completed airplane across the country. Now that the plane seemed to be at the "90 percent done, with just 90 percent remaining" phase, how would I ever finish it? I was in a new town with no aviation friends yet, and I wasn't even sure of what I needed to do to make this plane fly.

If I was lucky back east with meeting Jim and the EAA technical counselors, I hit the lottery with living in Corvallis, Oregon. We are just 22 nautical miles from Independence airport where an incredibly active EAA chapter resides (Chapter 292). I was soon connected with Ernie, tech counselor and builder extraordinaire, and general all-around go-to man for everything from plane building to fabric work to beekeeping. Ernie had specific things he suggested I do (or redo, in some cases), and I had the wisdom to defer in all cases to his judgment and experience.

The delays at this point were now due to my budding awareness that this homebuilt plane would soon be airworthy, and would therefore need to be flight tested. I had *good stuff*, but not the *right stuff*. There was no way *I* was going to test fly this thing! Ernie, fortunately, had someone in mind.

I don't think there is anything Robin couldn't do in a plane. If the wings fell off and the engine died, Robin would know exactly what angle to hold his hands out either window to get just enough lift to land the plane safely.

On a beautiful September 2010 morning, after an aileron control cable fiasco that called into question my entire build (and a story for another day), Robin made the first flight. With Ernie, my then-wife Julie, and I standing by on the ramp, we watched as this plane did exactly what a plane was supposed to do. I couldn't hold back the tears even if I wanted to.

A few days later, I made my first flight in 7048A. My wife and I split a few months later (nothing to do with the plane), which took some of the joy from the whole process as she was the one who first encouraged me to become a pilot.

Friends, careers, time zones, and marital status all changed over this tumultuous decade, but the one constant was this plane. With the help of all these people, and the EAA, I'm still flying and thinking about the next project. EAA


Figure 1

Metal Propeller Repair

BY RICHARD KOEHLER, EAA 161427

THE OTHER DAY I received a phone call from a friend with a dinged propeller on his Cessna 182. This article details the process in repairing such a propeller. Repairs of this type on certificated aircraft require the supervision of a mechanic with at least a powerplant rating. However, on experimental amateur-built (E-AB) planes, anyone can do the work and log it.

The propeller in question had been overhauled not too long ago, and its leading edge was protected with Prop Guard polyurethane tape. Prop Guard went out of production a few years ago but has been brought back by another company. It has an STC; but the FAA has declared that it is a minor alteration since it is not much different than a couple of coats of paint. For the industrious, you can buy the components of Prop Guard from 3M and create your own "kit."

The tape is used primarily as an anti-erosion coating. Sand and even rain can chew up the leading edge of your prop at a surprisingly rapid rate. The tape is sacrificial, eroding in place of the paint or metal. This erosion occurs most at the tip of a blade, so I have found myself replacing the last 4 to 5 inches on my prop on a regular basis. For this reason, I now splice on a 4- to 5-inch piece on the tip end of the prop for easy replacement. Although anti-erosion tape will mitigate the effects of a stone hit, it will not eliminate damage to the prop. Such had happened on my friend's C-182. The damage was in the tip section, and it looked like a 3/16-inch bolt had slammed sideways into the leading edge of the prop. The tape was massively torn and required replacement as well. See Figure 1.

Before beginning a propeller repair, consult the propeller manufacturer's maintenance manual for your propeller for acceptable repairs. Also check the type certificate data sheet for allowable dimensions, particularly if any shortening of the diameter is involved. If you cannot find manufacturer's data, then consult Advisory Circular (AC) 43.13-1B, Chapter 8, Section 4, which provides acceptable data for metal propeller repair. Figure 8-24 is perhaps the most useful, particularly for the repair I needed to do, with Repair Example B a near perfect match. See Figure 2. The other critical factor you need to look at is the allowable repair depth limits per Figure 8-27 of the AC.

As you go nearer the tip of the prop, you can remove more material. In this case the damage was about 2 inches from the

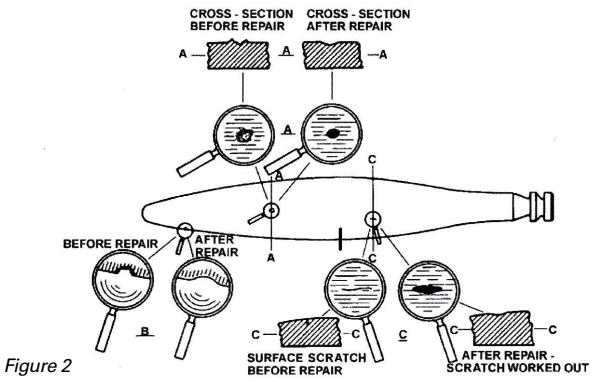


Figure 2


Figure 3


Figure 4


Figure 5

Photography by Dick Koehler

tip of an 82-inch-diameter propeller, or at the 95-percent-span radius. Going to 8-27 shows that up to 12.5 percent of the blade chord could be removed, or at a blade width of about 4 inches, I could remove up to a half inch of the leading edge! This repair was going to be well below this limit. The ding was about 3/32-inch deep. See Figure 3. The tools you will need for propeller repair include a set of fine flat and round files, spoon files, and fine (600 grit) wet/dry sandpaper or crocus cloth. See Figure 4. Start with a wide, fine, flat file, using it to smooth out the bulge in the outer airfoil shape of the propeller caused by the impact of the stone or whatever. Next, blend the dent into the edge of the airfoil with about a 6-to-1 slope. In other words, for a dent depth of 3/32 inch, times 6 gives an 18/32- or 9/16-inch taper. The bottom of the dent must also be cleaned out to ensure there is no crack. After getting the slope contour and bottom of the dent cleaned out, examine the area with a magnifying glass to make sure no crack remains. The surface should be etched with something like Zep, Alumiprep, or Alodine to expose any residual cracking. Once satisfied that the area is completely cleaned of damaged material, round the edge to match the airfoil profile and blend the repair into the surrounding area. Polish with crocus cloth or 600 grit wet sandpaper to remove all traces of file marks. See Figure 5.

Finish the prop with primer and colored paint, in this case, flat black. See Figure 6. We added white to the tip and allowed it to cure a few days prior to replacing the leading edge tape.

To clean up any edge on the paint or other imperfections, we wet-sanded the paint with 1200 grit sandpaper prior to applying the tape. It is now almost impossible to see the repaired damage. Due to the relatively small volume of aluminum removed, the prop did not have to be balanced again prior to use. EAA

Figure 6

A typical view of Illinois fields from the trike.

I'll Never Do That Again...

In a trike

BY DAN GRUNLOH

IN 1982 I WAS INTERESTED in weight-shift-controlled, hang-glider trikes when I read an article called "Trikes Are Different" in an EAA publication. The author warned prospective pilots that these new aircraft were quite different from conventional airplanes and cautioned against bringing conventional aviation knowledge into the situation. Trikes were rare at the time, with only a few coming from Europe, and dual instruction was practically nonexistent. We had only the advice of those who had survived teaching themselves. Faced with these conditions, I pursued conventional fixed-wing ultralights and benefitted greatly from the knowledge accumulated over decades of aircraft design.

Some 15 years later, the trike scene was a different picture with a variety of imported two-seat trikes available and instructors operating under a training exemption. By 1998 I had taken transition training and was flying my own weight-shift-controlled trike. In conventional flight maneuvers, these fun but strange aircraft fly just like any other airplane. It is still simply an "air-craft" that climbs, glides, turns, and lands like most other airplanes. The controls are different, but that's not an issue; we drive cars, motorcycles, boats, and tractors jumping back and forth with no problem. It's just another machine.

Within the first 50 hours of flying a trike I learned three lessons in the "I'll never do that again category." That writer back in 1982 was correct. Trikes are fun and capable, but they are also different, and they can surprise you. Some differences are mundane and will only cost you money. Others will give you a good scare.

THE SOUND OF FALLING LADDERS

It should be obvious that a high-wing, tailless aircraft with a pivoting wing needs to be tied down well, but old habits are hard to break. While your fixed-wing friends can simply hop out and walk into the local pancake breakfast, trike pilots need to fuss with tiedowns and ropes. More than a few trike owners have paid the price for that knowledge in the first year of ownership, and I am one. I've learned that two ropes are not enough. Some trikes can flip upside down while still attached to the ropes. It's usually backward, but some can flip forward. I like a third rope directly under the trike that will stop all of that nonsense. Permanent tiedown rings mounted at airports are not spaced for this method, so I sometimes push onto the grass. If the lower keel isn't available for a tiedown spot, you need four ropes to include the trike nose and an aft position.

Fortunately most trikes feature a folding mast, making it possible to lower the wing until the control bar is on the ground

Photography courtesy of Dan Grunloh

in front of the trike with the wing still attached. It only takes a few minutes and makes it possible for the trike to endure very strong winds. For really severe weather, pulling out some of the wing ribs (if possible) will help kill any lift from the wing.

One final emergency tip is that wheel chocks don't work all that well with light aircraft. Instead, try parking the main gear in a ditch or hole. As a storm approached a microlight championship in France in 2005, I watched a pilot pull out a big knife and carve two divots in the sod for his rear wheels. (The divots were carefully replaced later, and you didn't learn about it here.) Finally, there is an unwritten rule in aviation that you should never tie down to a movable object. That's the rule I broke.

I was building a house in the country, and sometimes I would fly to the site in my trike and leave it there all day while working on the house. The winds were light and the ground was dry and hard as iron, so I tied my trike to two heavy 12-inch concrete blocks. One day while working on the back side of the house, I heard the unmistakable sound of someone throwing a bunch of aluminum ladders off the back of a truck. I knew exactly what it was.

An unexpected thermal gust or passing dust devil had picked up the blocks and the trike, flipping it on its back with the concrete blocks still attached. The blocks flew through the air and did not damage the wing, but I had a broken prop, bent ribs, and a bent keel tube. It took nearly a month and $700 to get back into the air, and you can be certain I said I'll never do that again.

AMBER WAVES OF GRAIN

My second incident involves the hazard of low-level flying over crops, something not limited to trikes. Imagine an easy-to-fly, highly maneuverable aircraft that can fly safely at 40 mph, has a climb rate of 1,000 fpm, is very stall resistant, cannot spin, and offers nearly 360-degree visibility. That is a description of a trike, and a few other ultralights. I could look down directly between my legs and see the ground, or look behind and underneath. Anyone flying a traditional ultralight knows the mystery and magic of flight is intensified at slow speeds and near the surface. In such aircraft, low-level flying is almost too much fun to resist, though common sense

A trike provides basic open-cockpit flying fun.

A trike with a folding mast and wing tied down for weather.

Dan Grunloh after returning from a 600-mile round trip to EAA AirVenture Oshkosh 2007. His dog was happy to welcome him home.

dictates it should be done only over a surface upon which you could land.

With less than one year on the trike I flew at a chapter event on a private airfield with a mature wheat field next to the runway. Making a low pass along the side of the runway I noticed the downwash of air from my wing created a beautiful wake in the wheat field, not unlike the wake of a boat in water. The wheat bent over gracefully as I passed and then stood back up again undamaged. It was a beautiful sight unavailable to spectators on the ground. I was studying the effect on a second pass at a little lower altitude when I encountered a slight rise or bump in the middle of the field. I felt a sudden deceleration as the wheat rose up and grabbed my two rear, wheelbarrow-sized tires now dragging through the wheat at 40 mph. A burst of full throttle for four or five seconds broke me free, and you know exactly what I said to myself at that instant. (I'll never do that again.) I could have rolled it into a ball of expensive tubes and cables in front of all my friends. I'm still not cured of low flying, but I never do it over crops.

YOU ARE NOT A TEST PILOT

My third lesson came while attempting some fairly tame wingovers. I found myself pointed steeply down and going pretty fast when I encountered something I had only read about. At the bottom of the pull-out when substantial extra *g*-load was felt, the control bar moved outward toward the front strut, and it took all my strength to prevent it from zooming up into a steep climb. It wasn't fun, and I thought then and there I would never do that again.

The explanation comes from a standard trike question about what happens to the trim speed when you increase the load (such as add a passenger). Trim speed decreases at increased load because the wingtips flex, the washout increases, and the center of lift moves forward. Most wings probably do it to some degree, but those with flexible tips and more sweepback may show it more. I didn't know then the escape maneuver is to bank the wing and convert the steep climb into a climbing turn. Trike manufacturers typically recommend limiting bank angles to 60 degrees and pitch angles to 30 degrees. It doesn't sound like much, and they are not kidding.

My three lessons about trikes occurred in the first 50 hours of flying. I believe most trike instructors will recommend taking it extra easy the first 50 hours until you learn how trikes are different. Good advice for any new aircraft. By 50 hours you will have "bonded with the wing," as we say in trike circles, and you will understand why these aircraft are so popular all around the world.

Please send your comments to dangrunloh2@gmail.com. Happy triking! EAA

Dan Grunloh has logged 1,200 hours in trikes, and he won the 2002 and 2004 U.S. National Microlight Championships in a trike.

Photography courtesy of Dan Grunloh