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EXPERIMENTER

The Spirit of Homebuilt Aviation I www.eaa.org

Gary Green's GA-11
A Homebuilt PA-11

New Engines at Oshkosh 2014
Turbos, Diesels, and More!

One Week Wonder!

2,500 EAAers help build a Zenith CH 750 Cruzer

EAA, We Are Builders

BY JACK J. PELTON

BUILDING OUR OWN airplanes was a founding activity of EAA. But we build so much more. And it is building, maintaining, restoring, and preserving that separates EAA from other associations.

Our most impressive building is, of course, our world class museum. There is no better collection of important private and sport airplanes. And our Eagle Hangar honors all who served with an impressive display of World War II airplanes and artifacts.

Pioneer Airport is the active component of our museum. Its hangars and turf runway accurately re-create a typical airport of the golden age. We restore and maintain dozens of important antique airplanes and regularly fly them off Pioneer's sod.

And we build reminders of the dedicated and visionary people who have made EAA possible. Every year some of their names are added to the Memorial Wall to remind those of us who remain of their lives and contributions to EAA and all of private aviation.

Our largest building efforts are the hundreds of acres we need to conduct our annual fly-in and convention here at Oshkosh every year. Oshkosh is a very special event, and only purpose-built facilities could accommodate thousands of airplanes and hundreds of thousands of people.

Every year we invest in improving the AirVenture facilities. This year one of the most important improvements was new specifically designed workshop buildings where people can learn the basics of aircraft building such as welding and fabric covering.

We also build more camping facilities and amenities for the growing number of thousands who spend the week of Oshkosh camping. Growth in camping is so strong it's almost impossible to keep up with demand, but just think back a few years and you can see how far we have come.

And we build airplanes. Construction of the Zenith kit during the week of Oshkosh by hundreds and hundreds of volunteers created new excitement for so many. The project was dubbed the One Week Wonder, but it was not really a wonder. I never doubted for a moment that the project would be completed, engine run, and airplane taxied before the end of our convention.

All of this activity goes back to our founder, Paul Poberezny. Paul's founding belief that he repeated over and over is that good things happen when we put our hearts, hands, and minds to work.

We put our hearts to work through programs such as Young Eagles that shows youngsters the thrill of flight. We put our hearts behind honoring those who came before by keeping both their memories and the airplanes they flew alive.

We put our minds to work creating new and innovative aircraft. We use the same talents to restore and preserve historic airplanes or to create replicas when no original exists. And we employ our intellectual power to successfully advocate for policies that are fair to private aviation and to make flying available to the greatest number of people.

But none of that really matters until we actually put our hands to work and build something. No airplane design has ever mattered until someone built the first example. And no amount of speechifying or selling has swayed opinion and moved aviation forward until people could see and fly what we are talking about.

Paul had it right. We need to use our minds and hearts, but in the end using our hands to actually build is what pulls everything together. That's why we build so much at EAA. It's in our DNA. EAA

Photography by Jason Toney

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On the cover: Sean Elliott and Charlie Becker fly the One Week Wonder. (Photography by Jason Toney)

Charlie and Tracy Buttles flying the One Week Wonder after completion of flight testing. With the new FAA Additional Pilot Program, two pilots onboard during flight testing is now an option.

The Additional Pilot Program

Another option for flight testing your homebuilt

BY CHARLIE BECKER

SINCE THE BEGINNING of the modern homebuilt movement with the formation of EAA in the early 1950s, flight testing of experimental amateur-built (E-AB) aircraft has always been limited to a single-pilot operation during Phase 1 flight testing...until now. The FAA just recently finalized a new advisory circular, AC 90-116, that will allow an additional pilot to be on board during flight testing. This AC represents the culmination of more than a year of joint work by EAA and the FAA to provide an *optional* path for flight testing a homebuilt.

You may be asking yourself, Is this a good idea? EAA believes it is, and that it will reduce E-AB accidents. Accident data has shown that loss of control is the main factor in about one-third of all flight-test accidents. It is the number one controllable factor in flight-test accidents. By adding a "qualified pilot" to the early flight testing, we will be bringing in someone who is current, experienced, and fundamentally knows how to fly that specific design.

The hurdle to qualify as a "qualified pilot" is a high standard; as it should be. There is no point to adding a second person to the flight-testing scenario if he is not going to bring something to the party. With a seasoned, experienced pilot on board to help manage pilot workload and act as a safety net for the builder pilot, we are confident that lives can be saved.

Some people will point out that adding a pilot goes against the long-established doctrine for civilian and military flight-test programs of having a single pilot only. Admittedly, it does. However, we homebuilders are in a fundamentally different situation; the aircraft being tested is a product of our craftsmanship, not the result of a corporate or government program. And since we just put a major amount of sweat equity into our project, most homebuilders really want to be in that plane for the flight testing. When you look at it from this viewpoint, we will be upping the quality of our homebuilt test flights.

Through the funny way that life works, I found myself in the position of coordinating the flight testing of two Zenith aircraft during the exact same time period this summer. As I hope you all know, more than 2,500 EAA volunteers helped build a Zenith CH 750 Cruzer, known as the "One Week Wonder," during the week of EAA AirVenture Oshkosh 2014. The other recently completed Zenith was a CH 750 STOL that was built by your EAA staff members and was certificated on the Saturday before the start of Oshkosh 2014 (we jokingly refer to this aircraft as the "One *Hundred* Week Wonder"). Unfortunately for our EAA team, even though we knew it was coming, we did not have the option of using this new AC for our flight-testing program. I am absolutely convinced that it would have been beneficial to the transitioning of other test pilots into the aircraft. Instead of simply trying to describe how the aircraft performs, I could have had someone in the right seat to guide me along. Also, as we got beyond the "proving it can fly" stage, it would have been extremely valuable to have a second safety pilot on board to help with the fine-tuning of the glass panel.

Finally, I want to commend the FAA, specifically Mark Giron of the Flight Standards Division, for turning this idea into a reality. The National Transportation Safety Board got this ball rolling by making a recommendation to examine homebuilt flight testing in its 2012 study on amateur-built safety. However, without Mark's commitment to this project, the AC may not have happened. He worked through all the issues, using the accident data and input from flight-test experts, to craft a policy that will allow an improvement in safety. Mark is an example of someone at the FAA who is willing to find a way to solve a problem. (The fact that he flies an RV-6 probably helps.)

Homebuilders have been given a great opportunity with this new AC. It is now up to us to demonstrate that it will reduce E-AB accidents and that the FAA can rely upon homebuilders to use this program as intended. We hope this successful project will pave the way for more regulatory improvements—maybe something like a task-based flight-test period rather than just mandating 40 hours? That's something to work toward. EAA

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EAA Annual Meeting of the Membership

EAA CHAIRMAN Jack J. Pelton opened the annual meeting of the membership on Wednesday morning, July 30, at Theater in the Woods by presenting the association's two highest honors.

The Chairman's Award for service—formerly named the President's Award—was presented to Earl Lawrence. Earl heads up the FAA Small Airplane Directorate and is a major force in helping to modify and streamline certification rules, particularly for installing safety devices such as angle of attack indicators.

Earl had been a member of the EAA staff for several years before going to the FAA post in Kansas City.

The Freedom of Flight Award, created in 1986, is EAA's highest honor and is presented for a lifetime of service to aviation. Steve Wittman was the first recipient.

In presenting the award Chairman Pelton said there is nobody more deserving and who has done more over a lifetime to support EAA and personal aviation than Audrey Poberezny.

Audrey 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." It was a moving moment for everyone.

In his chairman's report, Pelton had a long list of good news. Membership is growing, more than 1,000 new lifetime members joined in the past year, and the crucial EAA volunteer core actually increased in number by several hundred.

He noted that EAA's annual convention and fly-in is off to a great start. The One Week Wonder project to build an airplane during AirVenture is a roaring success, new workshops have been built, EAA is in the second year of a successful program to offer a greater variety of food choices, more water fountains have been installed, more trams are running, the homebuilt aircraft area has been expanded, and a list of other improvements were made on-site.

Jack Pelton and Audrey Poberezny

Jack also said EAA is emphasizing chapters and their importance this year. One part of that effort is a new plan to help chapters form a companion flying club if they wish.

And Jack promised that EAA will continue its strong advocacy efforts, particularly on the issue of third-class medical reform. He said EAA will not relent, and if the FAA does not offer a solution, we will pursue the legislative route with support from Congress.

EAA Treasurer Stuart Auerbach reported that the audited financial statement for the past year was very positive. Membership grew to 189,000, total income set a record, the value of net assets grew by 10 percent overall, expenses were up only 2 percent, and spending was down on general and administrative costs.

There were more than 28,400 members voting either in person or by proxy.

Pelton summed up the past year's results by saying, "EAA is strong and continues to represent all of those involved in GA and recreational aviation."

Directors elected to three-year terms on the board were: Marc Ausman, Richard Beattie, Richard Beebe, Mike Goulian, Keith Kocourek, Dan Majka, and Charlie Precourt.

For the minutes of the annual meeting, visit *www.SportAviation.org*.

EAA Announces Finance Solutions Program

EAA ANNOUNCED ITS NEW Finance Solutions program partnership with National Aircraft Finance Co. (NAFCO) at AirVenture 2014. Some of the exclusive benefits available to EAA members under the program include discounted industry rates, financing new aircraft, and expanding educational resources.

The new program is in response to EAA members requesting a finance benefit more responsive to their needs.

NAFCO finances a wide range of aircraft, including warbirds, custom high-performance aircraft, vintage planes, and kits and homebuilts, whether completed or under construction.

Photography by Jason Toney

Knapp Tops STOL Competition

FRANK KNAPP TOOK top honors at the first STOL competition at EAA AirVenture Oshkosh 2014. Knapp and his airplane, *Lil' Cub* (N85CX), took off in 72 feet, and then landed in 62 feet, giving him a winning total of 134 feet.

Second place went to Bobby Breeden, with a total of 197 feet (72 feet at takeoff and 125 feet at landing), while third place went to Steve Henry at 206 feet (98 and 108).

Knapp, who led the effort to organize STOL flight demos in Oshkosh, said the reception of the STOL planes and pilots from the EAA attendees was incredible. "The people here really care about general aviation, and I think the normal guy can really relate to this and our lifestyle."

Staff-Built Zenith, One Week Wonder Done With Phase 1 Testing

AFTER RECEIVING its airworthiness certificate just before EAA AirVenture Oshkosh 2014, the EAA staff-built Zenith CH 750 STOL recently completed Phase One flight testing. More than 40 staff members participated in the project, which began in September 2012.

Meanwhile, the airplane that thousands had a hand in building—EAA's One Week Wonder Zenith CH 750 Cruzer—also has completed is 40-hour Phase 1 flight-test period, thanks to a cadre of EAA staff pilots eager to take their turn in the left seat. EAA

Photography by Phil Weston

Pipistrel WATTsUP Two-Place Electric Trainer Makes First Flight

PIPISTREL'S NEW proof-of-concept, two-place electric airplane flew for the first time in August. Called the WATTsUP, it's powered by a Siemens AG 85-kilowatt electric motor that weighs just a shade less than 31 pounds yet packs more power than Rotax 912 series engines, according to Pipistrel.

Power comes from a dual-redundant 17-kilowatt-hour battery pack designed to be either quickly replaceable within minutes or charged in less than an hour through the next generation of Pipistrel's battery management technology.

Performance allows for short takeoff distance, 1,000-plus fpm climb, and one hour of flight endurance with 30-minute reserve. Thirteen percent of energy is recaptured on every approach, according to Pipistrel, increasing endurance and at the same time enabling short-field landings.

Pipistrel is aiming at the training market with WATTsUP, according to CEO Ivo Boscarol. "Technologies developed specially for this aircraft cut the cost of ab initio pilot training by as much as 70 percent, making flying more affordable than ever before," he said.

Not only can the airplane be used to train on smaller airfields, its zero CO2 emissions and far less noise make it a potential "game changer," he added.

With a target price below 100,000 euros (about $132,000), WATTsUP meets European microlight and U.S. ASTM light-sport aircraft (LSA) criteria, as well as standards for electric propulsion. Already certified in France, Pipistrel is applying for an exemption with the FAA to allow training operations as a special light-sport aircraft (S-LSA).

Continental Motors and Aircraft Specialties Lubricants announce joint evaluation of CamGuard

CONTINENTAL MOTORS SERVICES (CMS) has entered into an agreement and established a joint evaluation program with Aircraft Specialties Lubricants (ASL) to verify the benefits of CamGuard, an aviation oil additive manufactured by ASL. This program will evaluate CamGuard in engines overhauled or repaired by CMS (formerly Mattituck). Both companies agree the time is appropriate to demonstrate merits of pairing the latest lubricant technology with the current engine technology resulting in less maintenance, lower overall operating cost, and greater longevity.

The evaluation period runs concurrent with the 18-month warranty period offered on overhauled or repaired engines. The standard warranty remains fully in effect during this evaluation. Specific information regarding the program will be provided to the program participants at sign-up. CamGuard will be made available to the participants for the duration of the evaluation.

Participants will be asked to follow a specific break-in and maintenance schedule which is similar to existing guidance. Participants will provide an oil sample at each oil change for analysis. A small number of participants may be requested to have their engines undergo "enhanced" inspections during routine service at no additional cost.

More information is available at *www.ContinentalMotors.aero*.

Sam Aircraft on the Block

SAM AIRCRAFT PRESIDENT Thierry Zibi has put the company up for sale. “I came to the realization that I love designing airplanes, but I am not so keen on running a production company,” he said.

The Sam has flown a full test regimen, which has shown it to be spin-proof at both full-forward and full-aft CG; its Canadian certification has been awarded (and LSA approval is completely documented, awaiting only another production example). Tooling and fixtures are done, production has already started, and orders are in the books.

The Sam, headquartered in Lachute, Quebec, Canada, is certified in Canada as an advanced ultralight and is fully compliant with the LSA regulations in the United States. More information can be found at *www.Sam-Aircraft.com*.

Trig TT31 Transponder Approved for Garmin GNS 400W, 500W

NOW THOUSANDS of aircraft owners in the United States have a cost-effective way to become ADS-B “out” compliant using their existing GPS with a Trig TT31 transponder with the latest TT31 software, Version 3.13. A new STC obtained in late August makes the TT31 an attractive choice for aircraft owners who already own a Garmin navigator.

Trig’s STC covers a wide range of aircraft types, and for those types not currently listed, the FAA allows local field approval. List price is $3,206—certainly making it a solution to consider for the FAA’s 2020 ADS-B mandate.

Trig has a comprehensive dealer network in North America, with a Trig Approved Service Center at Wichita, Kansas. The company also partners with the NextGen GA Fund, providing customers with access to a comprehensive loan scheme—specifically designed to help GA aircraft owners pay for their ADS-B equipment and related install.

Belite Offers Nonheated Pitot

BELITE AIRCRAFT is now offering an aerodynamic, nonheated pitot tube designed for experimental, light-sport (with manufacturer approval), and ultralight aircraft applications.

This new pitot tube is lighter than any other similar product on the market because it is manufactured out of ABS plastic and subsequently stiffened with an internal aluminum liner. The unit then receives a coat of UV-resistant paint.

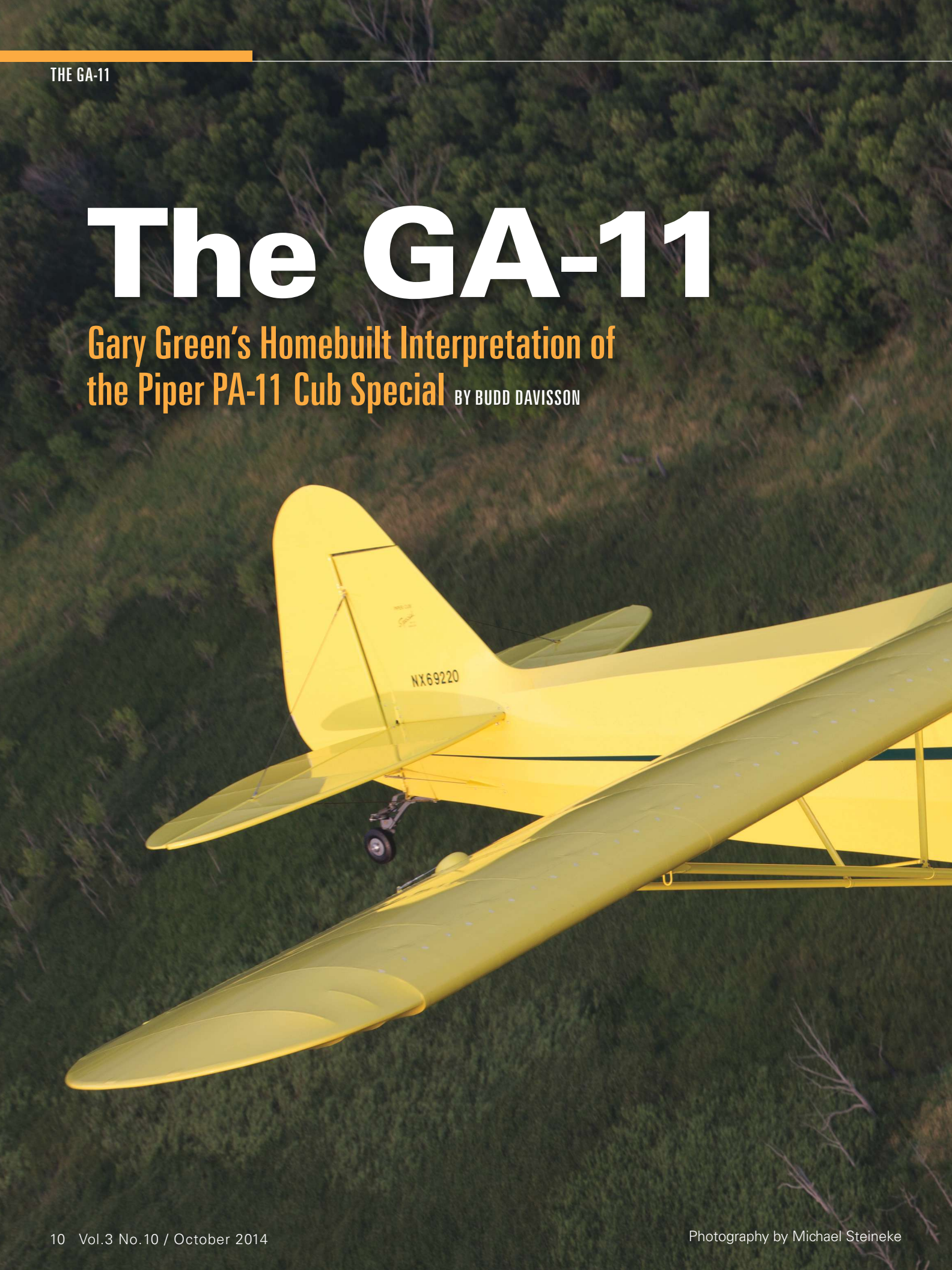
Weighing in at 45 grams (1.6 ounces), the pitot tube is priced at $149. Two mounting bases are available: One is compatible with leading edge (rounded) installations, and the other is compatible with flat installations, such as the underside of a wing. Custom mounts are also available.

The unit is not heated, and it’s designed for VFR use. It does not have a static port. Learn more at *www.BeliteAircraft.com/pdfs/Belite_PITOT_Brochure.pdf*. EAA

The GA-11

Gary Green's Homebuilt Interpretation of the Piper PA-11 Cub Special

BY BUDD DAVISSON

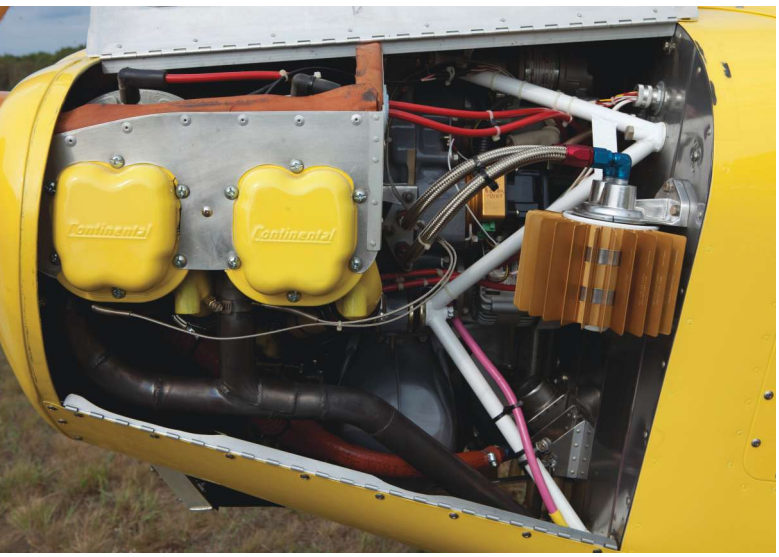


Photography by Michael Steineke

After the J-3 but before the Super Cub, there was the Cub Special. Then, After the Cub Special, there was the Gary Green GA-11: a sort of clone with a lot of Green's innovations.

Gary Green knows what he likes and how to build it.

A Wag-Aero spring landing gear kit replaces the traditional Cub's bungees.



The O-200 has had a C-90 cam installed to improve its torque curve.

"I WAS SITTING AROUND the 'O' Club at Dover Air Force Base where I was flying C-141s when another pilot started talking about this little airplane he was building. It was called a Cassutt. I knew nothing about EAA and was unaware that people were building their own aircraft. I was fascinated. I joined EAA, ordered plans and materials for a Cassutt, and began building an airplane. The Cassutt followed me from base to base and I finished it in 1978."

And that's how Gary Green's fascination with homebuilt aircraft began. His aviation career includes 733 hours over the "Steel Tiger" area of Laos as a forward air controller in a Cessna O-2A Skymaster and wends its way through a variety of U.S. Air Force hardware during his 20 years in the service. That includes C-141As, two tours as a T-38 instructor, a tour in C-5As, some time as a T-37 instructor, and a distasteful turn in the barrel behind a desk. Then he spent 15 years with the airlines before retiring in 2003. With the exception of his O-2A time and his T-41 time in training, all of his "professional" flying was in jets. Some fast, some of them really big. His personal flying was the opposite, with some quite small and relatively fast—and all taildraggers.

Which brings us to the airplane he had at EAA AirVenture Oshkosh 2014—the GA-11.

The GA-11 is *not* his 11th airplane; it is only his fourth. After the Cassutt, he completed a Thorp T-18 in 1980 and another one in 2006. "GA-11" is a play on the designation of the airplane it represents: a sorta-but-not-quite clone of a Piper PA-11 Cub Special (Piper Aircraft/Green Aircraft, get it?).

The PA-11 Cub Special is the almost forgotten link between the J-3 Cub and the PA-18 Super Cub. It was produced for only three years—1947, 1948, and 1949—and although slightly more than 1,500 were built, it is seldom seen today. And when it is, it is often mistaken for its later sibling, the Super Cub.

The PA-11 *is* a J-3; it's just wearing different clothes. It is a typical postwar Piper design in which every effort was made to carry existing components from one airplane to the next but combine them differently. They all shared many of the same components, including wings, tails, and internal subcomponents.

Gary said, "I've been deeply involved with EAA since the Cassutt and have flown to every Oshkosh fly-in since '74, except for two years. I have built three scratchbuilt aircraft and had stated that I'd never build another plans-built airplane. I wanted to build a kit where you just rattle the box and an airplane falls out. But I'd had my eye on this Cub project for several years. Claude Jochmans of Chelsea, Oklahoma, started it but sold it to a good friend of mine, Gary Cotner, as a project. We both knew he'd never find time to finish it, and I finally badgered him to sell it in the spring of 2008. And then I hauled it home to Arkansas.

"Claude Jochmans had done excellent work. The welding was beautiful and the woodwork was like fine cabinet work. All I had to do was clean the dust off the wings and repair the trailing edge of the left wing where the inboard ribs had been damaged.

Photography by Craig Vander Kolk

"The J-3 clone project took a different direction and became much more complex when I attended a Cub restoration seminar by Clyde Smith Jr. at Ponca City, Oklahoma, in the fall of 2008. I took along a photo album of my project and discussed it with Clyde and Merle Helt, an old friend from Ponca City, who had built a Wag-Aero Sport Trainer as a PA-11 replica. Merle and Clyde pumped me up about how easy it'd be to convert this project to a PA-11 and how much better a PA-11 was compared to a J-3. I swallowed their bait—hook, line, and sinker—and started down that path.

"Some people think the Cub Special is just a J-3 with a C-90 on it, but there are lots of subtle changes that aren't obvious. I had an O-200A that I'd picked up a few years ago and planned to use it instead of the A-65 that came with the project. I overhauled the O-200 and installed a C-90 camshaft to improve the rpm/torque curve. Most of the noticeable differences between a J-3 and a PA-11 are ahead of the firewall.

"The outline of a PA-11's nose is different than the J-3, which meant everything up front had to be changed. Before the cowling and engine work could be done, I had to change the fuselage to duplicate the PA-11 structure. I removed the two diagonals the J-3 has in the forward bay under the nose tank and replaced them with a cross-member. The PA-11 had one 11.5-gallon wing tank and no header tank. However, I put a tank in both wings and a header tank.

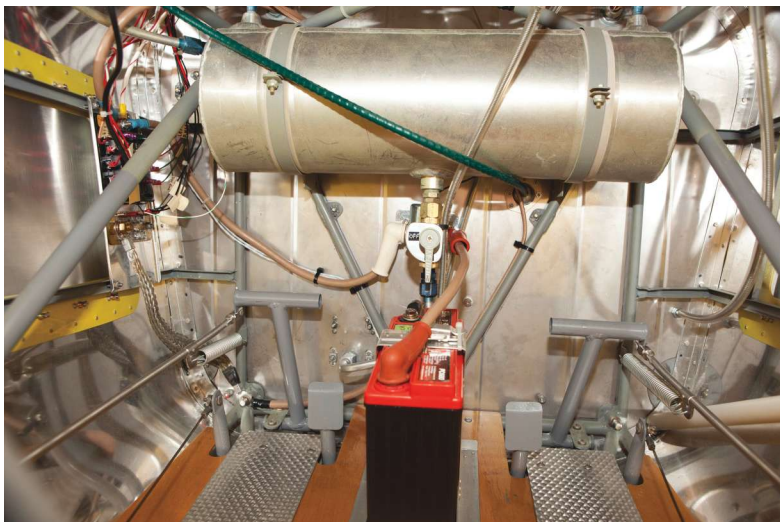
"I bought the 11.5-gallon wing tanks from Wag-Aero and had to move the first ribs outboard from the root rib about an inch outboard to make the tanks fit. Wag-Aero tanks have the fuel pickups at the aft of the tank, so if one is low on fuel and in a nose low attitude, they could un-port the pickups. Wag-Aero also makes a 2-gallon header tank to avoid that problem. I plumbed both wing tanks to 'T' into a common line behind the baggage compartment with flow via a single line to the header tank. The only fuel shutoff valve is at the bottom of the header tank. I have 25 gallons on board.

"The engine on the PA-11 is about 4 inches lower than the J-3, which is why the nose slants down, which gives much better visibility. The windshield is more streamlined, attaching farther forward at the bottom. I made the attaching strip at the bottom in fiberglass.

"The J-3 mount had come from Univair, which was very cooperative in swapping it for a PA-11 mount because I had the original paperwork for it. The fiberglass nose bowl came from Wag-Aero and the firewall from Clyde Smith. I hung the engine and positioned the nose bowl on the crankshaft and started on the cowling. The PA-11 has a pressure cowl rather than a cylinders-in-the-wind J-3 type, so it flows back to the boot cowl in an unbroken line. I mocked up the cowling and the boot cowl using lots of taped-together poster board and started cutting metal.

"I had no plans showing those details, so I depended upon photos of old PA-11s and did what I thought looked about right to fabricate and fit those parts. I really like how the hinge pin installations secure the cowl cheeks. I can have the

The GA-11 has an actual back seat, not a canvas sling as the J-3 did.



Claude Jochmans started to build a Wag Aero J-3 look-alike, but, when Gary bought the project, he went all-out PA-11 and then some with it.

entire cowling off in about 15 minutes without removing the nose bowl.

"At Clyde Smith's suggestion, I installed a belly stringer to hold the fabric off the bottom fuselage cross-tubes."

INSIDE THE GA-11

Inside the cockpit of the GA-11, it's obvious the J-3 lineage has been left behind. The machined throttle units came with the project. Claude Jochmans had machined them from aluminum plate in a manner that was clean and not obtrusive. They don't look like a space-age part in a 1940s environment. Gary said, "Claude also made a metal baggage bin that looks similar to an inverted, bottomless mailbox. It really is a thing of beauty."

Gary also made some changes to the cockpit itself. He explained his reasoning. "The J-3 is soloed from the rear, and the front seat is tight fore and aft. You're really folded up to fit in and the stick is halfway up your chest. The PA-11 is soloed from the front, and to my knowledge, had the seat in the same location as the J-3. Claude had made the seat exactly per Wag-Aero plans, but it was excruciatingly tight, with the top of the back digging into my backbone below my shoulder blades. So, after the initial flight tests, I moved the front seat aft 1-13/16 inches and cut the seat back off and extended it 4 or 5 inches higher. Moving the seat aft made entry/exit from the front seat much easier and made a world of difference in front seat ergonomics. I had to shorten the rear stick 2 inches so it would clear the front seat back with the stick full forward. I saw photos of Cubs with F. Atlee Dodge 'porch' steps installed on the right-side landing gear. I cootered up my own design, and the step makes getting in and out much easier for a fat old man."

One thing Claude had done that Gary liked is the way he set up the horizontal tail. The Wag-Aero plans show both a standard J-3 tail that is trimmed via a screw jack and a fixed stab with a trim tab; Claude went with the fixed tail, and Gary says it's much simpler and flies really well.

The PA-11 was soloed from the front seat, not the back, as with Cubs, but few were equipped like Gary's GA-11.

Although the landing gear is still essentially a J-3 gear, the PA-11 had faired bungees with airfoil-shaped fairings. But bungees, being nothing more than lots of rubber bands, require constant care and routine changing. Gary said, "Wag-Aero has a conversion kit that replaces the bungees with coil springs, and you don't have to worry about them wearing out. The tires are Carlisle ATV tires from Wicks. They're mounted on 6-inch wheels with Cleveland 600-by-6 brakes, which can be too much brake for a Cub. I used the original, diaphragm-style Scott master cylinders that don't produce enough pressure to lock up the brakes. In a Cub you seldom need brakes for anything but ground maneuvering, and these work fine for that.

"After completing the fuselage mods, I tried cleaning it myself with Scotch-Brite and solvent but soon gave up and took it to a local auto restoration specialist and had him bead-blast and paint it with PPG DP-50 epoxy primer that was gray. That was a mistake. If I were to do it over, I'd definitely use white primer. He did a nice job, but I had to repaint all exposed metal parts with white primer prior to final color coats. You can't paint yellow over gray primer and get good results.

"I had covered my Cassutt with Poly-Fiber and was somewhat familiar with it. I chose that to cover the Cub. Jim and Dondi Miller suggested Ranthane for the color coat, and I love that paint. The base color is Ag Cat Yellow, which is a stock color. The stripe is Forest Green. Using those paints, I didn't have to worry about the aluminum coming out a slightly different color.

"When I took the airplane to Oshkosh 2014, it was my first long cross-country in the airplane, and I didn't know what my actual fuel burn would be. I planned two fuel stops going up. I left home at 7 a.m., and even with two fuel stops, was tying it down at 2:30 p.m. Had I known how well it'd do, I could have made it with one stop. On the way home I only stopped once. The leg from Oshkosh to Quincy, Illinois, was 310 statute miles, and I made it in three hours even and burned 15.1 gallons. The second leg was 261 miles and took 2.5 hours. At one point I was at 8,500 feet to stay above the building cumulus. It was a much easier trip both ways than I anticipated.

"This is the first project that I have kept good records of cost and building time. I haven't totaled up the hours yet; but I did add up the cost and I am too embarrassed to admit what it totaled. Although I don't know how many hours, it took five years at three to four hours a day. Hey, four hours a day is full-time work, isn't it?

"When I started this project, I thought I'd fly it a year or two, then sell it; now I think I'll keep it. After all, it is sport-pilot eligible. It certainly isn't a T-18 for performance, but you'd be hard pressed to find a more docile, pleasant airplane to putter around in locally. More often than not, I find myself dragging the Cub out and leaving the Thorp in the hangar. Sometimes you just want to go flying and go no place in particular. And the Cub does that better than any other airplane." EAA

Photography by Craig Vander Kolk

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One Week Wonder!

The story behind the legacy

BY JONATHAN PORTER

Photography by Jason Toney

One Week Wonder volunteers escort the completed aircraft to Show Center for a quick taxi test to complete the project.

IT ALL STARTED IN A DARK, damp, fuel-and-oil-perfumed hangar. Dim moonlight seeped through a crack in the hangar doors, picking out, with an eerie glimmer, a shiny spinner. That hangar held within it the "spirit of building aircraft."

This was a place where an aircraft had been built. There is nothing more magical, more inspiring, or more emotional than building an airplane and watching it take to the sky. The spirit was truly in that hangar on the EAA grounds, but it felt neglected; it realized that too few people had known the magic of bringing to life a flying machine. So, that spirit decided to seep out into the night, with a mission. It sought out minds that would light a fire for a new generation—an adventure that would start on a Monday morning in July 2014, and in just seven days, ignite a fuse with the potential to change the world.

The spirit found those minds, all associated with EAA, primed from years of exposure to homebuilt aviation. The spirit gave them a challenge—build a plane with thousands of builders in just one week. They met, they spoke in hushed tones, they doubted at times, and yet they convened, planned, and connived. And together they brought to the world—the One Week Wonder at EAA AirVenture Oshkosh 2014.

This is the sight that greeted volunteers as they arrived on Monday morning, July 28, to begin work on the airplane.

BEFORE THE EVENT

Planning for the One Week Wonder started well in advance of July 2014. The team had to get all the parts for the project together. Once the airframe, engine, and avionics were chosen, those parts had to be ordered and delivered to the build site. In the case of the One Week Wonder, the team chose:

- a standard Zenith CH 750 Cruzer "matched hole" kit ready to ship from the factory, exactly the same as for any other builder
- the Rotax 912 iS Sport engine, with dual ignition, dual injectors, dual engine control units, dual generators, and a host of other features that make this engine as simple to operate and maintain as a modern automotive engine. The standard 912 iS Sport firewall-forward kit came from SkyTec in Canada.
- a Dynon SkyView avionics suite with a touch screen and more gizmos and gadgets than you will find on many airliners, built

Some of the major sponsors of the One Week Wonder project—(L-R) EAA Homebuilding Community Manager Charlie Becker; Scheme Designers CEO/Founder Craig Barnett; EAA Chairman of the Board Jack Pelton; Jim Irwin, president of Aircraft Spruce and Specialty; Jack Samuels and Desiree Czaplinski, of Aircraft Spruce; Sebastien Heintz, president of Zenith Aircraft; Chris Throndsen, Sennheiser Aviation; Ian Jordan, Dynon Avionics; Mark Gleason, SteinAir; Mark Paskevitch, Rotax; and Robert Hamilton, president of Dynon Avionics.

Photography by Jason Toney

into a standard customer-ready unit by SteinAir
- files, rivet guns, clamps, rulers, drill bits, snips, etc. Building a plane requires tooling. Aircraft Spruce & Specialty shipped its wares to the site ready for the big day.
- miscellaneous "bits and bobs" that builders generally order as they go, but when you are going to build a plane in a week, you need everything sorted out in advance. Matco wheels, Flightline Interiors upholstery, Sennheiser headsets, Sensenich propeller, etc.

The scene was set. Now we needed the players:

- *the core team*. This is the team that was practically full-time in the "bull pen"—that place where the machine was brought to life. The team members had not met before that day. They did not know each other; they were different folks with different strokes. They were led, coordinated, and herded by Caleb Gebhart from Zenith Aircraft.
- *supporting cast*. Zenith Aircraft designer and aviation guru Chris Heintz, 76 years young, was there to keep an eye on things (he'd done a one week wonder at Oshkosh in 1976), as were three of his sons—Sebastien (president and CEO of Zenith Aircraft Company), Matt, and Nick (from ZenairCanada).
- *the ambassadors*. The ambassadors were people with experience in building planes, who worked "out front" answering questions and teaching wannabe builders how to pull a rivet. Ron Wagner, recently retired from EAA, was in charge of the ambassadors. Charlie Becker, EAA Homebuilt Community manager, ran nonstop to make the whole project go.
- *the public*. Boys, girls, men, and women from so many countries that the United Nations may have considered sending an official jealousy card.

DAY ONE: A DAY OF ACTION

It was a tense moment, all of those people who didn't know each other—about to start building a plane in less than a week. They stood awaiting the order, which came from EAA Chairman Jack Pelton.

The crate was opened and people looked inside, amazed to see there were no surprises; it really was a kit of parts. Nothing was pre-assembled; this was the real deal, a proper challenge.

Parts were passed over the fence from the public area into the bull pen, each part labeled with its part number clearly identifying which aircraft subassembly it would belong to. The clock ticked; nothing but unpacking, sorting, and cleaning up was taking place.

Meanwhile, ambassadors started rivet training using the "How to Pull a Rivet in Three Easy Steps" system that Zenith Aircraft uses. It is a simple "pop" or blind rivet, fitted using a specially adapted head on a rivet gun that "domes" the head of the rivet.

The clock ticked on, and folks learning how to pull a rivet got impatient; the team in the bull pen was not ready to have any rivets pulled. Then, as if by magic, but really by virtue of the Zenith "matched hole technology," subcomponents started to come together.

WHY DO YOU CALL IT 'PULLING A RIVET'?

That was a common question and the answer is simple; the rivet gun (whether manual or pneumatic) literally pulls a steel stem through a specially shaped aluminum body to create a fastening between two or more pieces of metal. At the end of the fastening process, the rivet stem breaks off (since it is no longer needed) with a pop sound, hence a "pop" rivet.

That led to the question, "Why are they sometimes called 'blind' rivets?" The answer is because you do not need to see or work on both sides of the piece, hence you are working "blind" to the other side.

This is different from a "bucked" rivet where you need to have a rivet hammer on one side and a bucking bar on the other. Blind or pop rivets are one of the easiest, and amazingly strong, sheet metal fixations to set, and the process can be learned effectively in a short time by those of all ages and strengths, as demonstrated by the One Week Wonder project!

Each type of metal fixation process has its advantages and disadvantages, and the aircraft designers must choose. Thankfully for the One Week Wonder team, Chris Heintz was more interested in building strong planes that would build and fly well quickly, so he chose the pop rivet system.

Monday afternoon saw quite a few parts come together, as the FAA kept a keen eye on proceedings throughout the week, even pulling some rivets themselves!

FROM AFRICA TO AMERICA, FROM YOUNG TO OLD

To add to the challenge, a group of young people worked on the horizontal tail—the horizontal stabilizer and the elevator—led by Patricia Mawuli (the author's wife) from Ghana, West Africa. Not only was this build international in flavor, but it was also about family unity. The rudder team had a grandfather, son, and grandson working together; it was a great moment for three generations to volunteer in the bull pen.

To ensure that the project was on track, the back of the bull pen had a progress chart, surmounted by "The Damocles Countdown Clock." Each subassembly was ticked off as it was considered complete, allowing those who followed the project, often several times per day, to see what they had missed...and to ensure total transparency in the build.

DRILLING OUT RIVETS

When the team arrived on Day Two, it looked over the work from the day before and noticed some mistakes. That happens on every build. Every builder makes mistakes, so having some mistakes was only to be expected. Luckily, the mistakes were minor and quickly fixed.

The interminable clock ticked down, and a new set of volunteers was introduced into the bull pen. The whole space was buzzing as milestones were being met with increasing frequency.

Industry leaders and celebrities came by, as news about the One Week Wonder spread across the airfield. The "spirit of building aircraft" insisted that visitors from all walks of life were drawn in, engaged, and inspired through assisting in the production of this new flying machine.

Jonathan Porter calls the crowd to attention as the first wing is about to be attached to the fuselage frame.

A countdown clock on the back wall of the hangar along with a step-by-step "scoreboard" of the construction process.

As the day progressed, complacency was starting to build. It looked as if the project was going to be easy. But the team had to keep reminding itself that the devil lives in the details... and the build started to slow down. The "big sections" had come together in a breeze, but the wiring, the plumbing, the joining together and the setting of the controls, etc. were still to be done.

The firewall-forward team was very quiet; it was now fitting the expansion tank for coolant and other necessary items for the engine.

Day Two saw many people get to pull rivets, but not as many as the team would have liked. The day came to a close with a very tired core team, and just five days left to complete the machine.

DAY THREE: THE JOINING OF PARTS

Day Three was going to be the day when the team got an idea of where it was going. The sprint had been done; the plane looked like a plane somehow, but this was not the time to give up. Stay calm and keep building.

Work started on the flaperons, but it did not go fast. The volunteers shuttled parts back and forth across the table. Just like any other build, something that looks simple can be deceivingly challenging! The mating of front and rear fuselage sections was a breeze; the two massive assemblies simply lined up and were clecoed together!

The right wing team surged ahead at this point and completed, minus a few hundred rivets, the right wing. It was sent outside the bull pen for "public rivet participation," albeit they had not completed the wingtip wiring.

Later in the day, the plane had to find its feet, and it did so with music from the Border Patrol Pipes and Drums Ensemble. It added a great deal of pomp and ceremony, raising spirits and pushing the project forward. The pipers struck up a tune, and eyes were seen to spring hydraulic leaks, emotion seeping out into the crowd, as the wheels touched the ground for the first time—a joy only comparable to that of a parent watching his child stand unaided for the first time.

Photography by Jason Toney

The firewall-forward team swam across the bull pen like a shoal of piranhas, anxious to hang the Rotax 912 iS Sport engine. It was a tense moment when the engine was released to its mount. The nose wheel stretched the nose gear bungee, and the plane sat like a patient and well-behaved dog.

Plumbing of all the radiators and wiring was now top priority. It looked like cardiac surgery with all the different people peering into the various orifices, some with pliers, others screwdrivers. Ron turned up with a bottle of pink coolant, reminiscent of a blood transfusion: Life was being breathed, pumped, and wired into the One Week Wonder.

The "proper-looking plane" now got more and more attention. The build crew's spirit was raised—90 percent complete—if you looked at the project visually, and just 90 percent left to go—if you knew what was really to be done!

Many completed parts were put aside, ready for final assembly. Dr. Frankenstein would have been proud. If the tent had been struck by lightning that night, who knows what may have happened!

DAY FOUR: WEIGHT AND CAKE

With all the smaller surfaces completed, Day Four was a day of looking for jobs for the core team not involved in the fuselage or left wing. For those who have built Zenith Aircraft before, this seemed like an easy build, until they all realized that this was a CH 750 Cruzer, so it was different. The team discovered that some detail in the design was relatively new—and brought new learning and challenges. Caleb gave some volunteers a set of weights and said, "Balance the elevator."

The principles were quickly established, and once set up, a quick lookover by Chris Heintz was proffered. Everybody was learning together, and it was a moment of positive pride for designers, volunteers, the core team, and the factory gurus!

As the day progressed, the horizontal surface was moved to the airframe and bolted on. Time was taken to ensure that the surface of the horizontal stab was aligned with the cabin frame, and then work started on how to set up the control wires for proper elevator movement. This was complicated by people working in the cabin area getting in the way of the center stick.

The team tasked with fitting the flaperons to the wings got stuck, until the team found that it lacked a certain size drill bit for an angle head drill. After some quick running around and thanks to the kindness of the lady at the Avery Tools display, the right size stubby bit was in hand.

The firewall-forward team added hoses, clips, lines, and even oil. That engine looked so sweet hanging on the front with clean green vanity covers and a sleek, black, keel-shaped crankcase! The electrical team looked like it was running an Italian spaghetti bistro. Finally, the cowling appeared to be fitted. It looked like the deadlines might actually be met.

DAY FIVE: WILL IT OR WON'T IT?

Friday, less than two days to go, everybody finally realized that somebody had been lying to the team. This was not a seven-day challenge. Seven days would have given the team until 0800 on Monday morning. The organizers had a hidden agenda; the plane would be inspected by FAA on *Sunday* and needed full FAA certification before 3 p.m. so that a public taxi test could take place.

With neither wing completed and the firewall-forward team asking, "When are we going to test the engine?" Caleb said sharply, "On *Sunday* morning." It all added to the stress, as did the ever-increasing interest from the press and the public. Friday was a stressful, stressful day!

The vertical stab started being fitted, and the elevator cables routed. Clearances were tight, and a lot of discussion was taking place at the tail end. This was not helped by the fact that the cockpit crew kept hitting the stick, and then the levels were all off for setting the deflections. Never before in the building of an aircraft have so many people exhaled deeply—and *not* shouted at each other!

Small children came with their parents, some too small to reach the rivets, needing to stand on the backs of volunteers who bent down to provide a makeshift ladder for the future aviators and engineers of the world. *"Standing on the shoulders of those who came before"* took on a new meaning. This build was in the public domain in more ways than had ever been anticipated.

The Dynon team came and checked to make sure that the near IMAX experience cockpit was set, and then silence was called for. It was time to test the electronics. Charlie, with the widest grin of the week so far, called the tower and asked which frequency to use for a radio test. The system was powered up. The tension in the air was so crisp that you could snap it in your fingers. Then someone said, "We are waiting for the screens to boot," and we waited and waited, but they failed to boot. Something was wrong. Charlie stopped smiling for the first time in the whole week. Silence hung in the air for a few seconds; heads dropped, spirits sagged.

Disappointment swept over the team, and the whole crowd exhaled in unison with a noise reminiscent of a balloon being let down. The electronics team members went silent as their eyes and fingers moved at speeds only matched by electrons in a plasma stream.

Ten minutes later, it was time to try again. The electrical bus was powered up, and the first screen booted—it came alive in Technicolor. A gentle, still-unsure-if-it-was-real murmuring

THE DAY OF CAKE

Day Four also was known as "the day of cake." It was Patricia Mawuli's birthday! Unbeknownst to her, Charlie had ordered a cake for her. We all ate cake and celebrated together! Patricia did not grow up celebrating birthdays; she didn't even have a birth certificate until six years ago, but now, as part of the fellowship of aviators, she has every reason to celebrate. She earned her pilot certificate on July 31 five years ago.

cheer came from the crowd. Then the second screen lit up like Times Square on New Year's Eve, and the intercom scratched alive noises into the Sennheiser headsets! The crowd seemed powered by much more voltage than 12 volts. The whole team took energy from the moment. Success and exhilaration were now within the grasp!

The first radio call was relayed over the intercom, and as the tower acknowledged clear comms, the shout of One Week Wonder reached every corner of Wisconsin! One step closer, but many left to take.

A young volunteer signs the construction logbook after pulling a rivet. Some 2,500 adults and children lent their hand to the One Week Wonder project.

Caleb wanted the wings on the plane by Friday night, but it was not going to happen. There was too much pressure and not enough hours, and all that electrical stuff had eaten up access time to the airframe, too.

The day ended with everybody tense about the remaining full day and how much that had to be achieved.

DAY SIX: BURNING THE MIDNIGHT OIL

Saturday morning was a blur. Nobody could remember his or her own name anymore. Thankfully, everything was being accounted for, but the team was visibly slowing down. Caution was being applied, because everybody knew that it was better to miss the deadline than make a mistake that could jeopardize the long-term benefits from this punctuation mark in aviation history.

It was time to rearrange the bull pen. Moving wings around in a smallish bull pen with spectators, volunteers, press, and pipe and drum ensembles can only be likened to working on completing a Rubik's Cube one-handed. Up, down, left, right, duck, dive, turn, lower, and watch out for the pitot tube connection on that left wing. It wasn't mayhem; it was coordinated, but it really was a dance. Everything looked ready to mount.

The wings would be fitted *inside* the bull pen, dihedral set, and then they would be removed and refitted *outside*, ready for final plumbing and engine testing.

To set the dihedral, you offer up the two wings, drill the wing roots to the cabin frame, and then set them at the correct

As tens of thousands of AirVenture attendees enjoyed the Saturday night air show and fireworks, volunteers on the One Week Wonder project burned a bit of "midnight oil" to ensure that the aircraft would be completed the next day.

Photography by Jason Toney

angle to each other and the cabin frame. Of course, it becomes a bigger challenge when time is against you and you have a few hundred people watching.

Nonetheless, able-bodied wing holders held those wings in place, whilst the angles were set and the wing struts cut, set, and checked. With the day slipping away and just a few rivets left to pull, it was time to take the wings off and cordon off the outside area where final work would take place.

Plumbing, prop, header tank, and a host of little works suddenly could now take place, in the failing light. Floodlights were brought out, and the amazing gift of power provided brightness to those who would burn their candles at both ends in the sprint toward the finish line.

As they worked, the crowds departed after the night air show.

Would it all come together in the morning? It was an open bet, but the belief in the "spirit of building aircraft" was growing, and the majority remained cautiously optimistic.

DAY SEVEN: THE DAY THEY STOLE 16 HOURS

Arriving on Sunday morning, nobody felt rested, but everybody felt totally exhilarated. The One Week Wonder sat out front looking like a toddler about to go out in its push chair for the first time, full of anticipation, ready for an adventure, but looking so innocent and unprepared. It was 99 percent ready, and with just 50 percent left to go! But that 50 percent was going to be a challenge.

The EAA management sent a man to reset the clock to just seven hours left. At 3 p.m., the clock would show 00:00:00, and it would all be over. Just seven hours—and there were still no doors and no seats and not all the rivets had been pulled; it was a long shot. But where there is the "spirit of building aircraft," there is a way. And the Force was strong in the team; if only the weather would hold.

The FAA man was coming, so the team must be ready.

More folks wanted to pull a rivet, sign the builder's log, and share some stories with the crowd that had now grown to the size of a small town. This was a day of making wishes come true, and so they did pull rivets and sign the log.

A sudden, violent storm came through; everything got wet or drenched, people were holding down wings on aircraft all around, and crowds took shelter in the One Week Wonder Tent, where just hours before it was a delivery room for the new baby now sitting out in the rain. Nonetheless, the front moved past and the sun revived the spirits. And work continued.

Necessary tasks were done in broad daylight, with full participation of the crowd. Fuel test, weight and balance, engine checks, and tidying up those last little niggles were close at hand.

With a big crowd on hand, it was time to spread that "spirit of building aircraft" wide. A narrative was established. As the barker, I informed the crowd: "Rob is doing the final checks on the Rotax 912 iS Sport. This is based on the 25-year-old, proven and reliable concept of the Rotax 912 aircraft engine series, but updated to an ultramodern, light, and powerful engine." Nuggets of information and inspiration seeds could land on the ears of anybody passing by; perhaps some would grow.

Each volunteer who pulled a rivet on the airplane was invited to sign his or her name adjacent to the rivet.

It was time for the fuel flow test, and the crowd grew even bigger, waiting to hear the engine start for the first time. Never before has a two-seat aircraft had so many observers as it pissed fuel into a calibrated vessel while being timed. The One Week Wonder passed its urological test with flying colors.

The crowd was pushed back, ready for the first engine test. Nobody wanted to move; they just wanted to be near the airframe, to feel its energy, to be a part of the event that had taken Oshkosh 2014 from an aviation event to *a life experience extraordinaire*." The engine would be run for a very short time, at low revs as part of that was for priming the fuel system, and frankly, just to see if it all worked.

Rob warned that it might take a few turns before it started since the fuel system is run at 45 psi with a maximum of 120 liters per hour while consuming a mere 13 liters (about 3 U.S. gallons) per hour in cruise flight.

One lady standing at the front, eyes pinned on the machine before her, started muttering that aircraft engines are always hard to start the first time. Then as the start procedure was undertaken, everybody was thrilled when the engine didn't even miss a beat, as it fired up and ran as smoothly as a sewing machine that had just been oiled. Tickity, tickity, tickity. The lady in the front row shouted, "Yay, first time and *so smooth*. I want one!"

The only difficult part of aviation is convincing people that it is not difficult! The One Week Wonder team handled the task like a pro! The "spirit of building aircraft" was getting stronger, infecting more and more, and the emotions were running higher than cruise level for the SR-71 Blackbird!

As the team drained fuel and fixed the final components, the scales were brought out to weigh the aircraft.

The One Week Wonder "weighed in." To enable greater understanding, Patricia and a 12-year-old girl from the crowd demonstrated what center of gravity meant, by using a plank of wood and a fulcrum. The opportunity to educate the crowd was greater than anticipated, and it soaked up the knowledge like sponges dried in the desert and then tossed into the sea.

EAA Chairman of the Board Jack Pelton (in the blue shirt) assists with the attachment of the first wing onto the CH 750 Cruzer.

The clock was ticking down; less than two hours to go...the team had not quite finished.

Then...*the FAA man* arrived.

He looked serious, he walked serious, he talked serious, and his name was Bobby Thomas. Bobby was involved in the last build-a-plane-at-Oshkosh event in 1976 when Chris Heintz built a plane in eight days. All the same, he was not being lenient or compassionate in any way. Remember, he was, is, and always will be *the FAA man*.

Bobby set his eagle eye over *everything*. This project was one that needed inspection to the top notch, and all in the public eye as well. The FAA man asked for some little things to be done here and there, and they were completed as he walked around. He didn't smile, but he did have a determined face on. He wanted to do a thorough job, and he wanted the team to win, but only by the rules.

When he asked for a full engine test, the crowd was pushed back with the clock ticking down to just minutes to go. But Bobby wanted the crowd farther back, and an immovable barrier in front of the aircraft in case it jumped the chocks. The crowd was not cooperating; people wanted to be close to the machine when its heart started to beat.

The cry was given out: "By order of the FAA, you must move back; move back and stay back."

Moses couldn't have parted the Red Sea any quicker. Those words "By order of the FAA" were enough to make the crowd move like a model of fluid dynamics!

No aircraft has ever started so smoothly or sweetly than the One Week Wonder, and the crowd responded with a cheer.

Bobby smiled a little bit, almost imperceivable, but he smiled. There was less than five minutes to the 00:00:00 moment and the end of the challenge.

Charlie, Bobby, and Caleb moved to the back of the tent, and as if planned but definitely not, the crowd counted down the last few seconds...10...9...8...7...6...5...4...3...2...1...

Charlie shouted, "He signed off!"

The crowd responded with "One Week Wonder."

The One Week Wonder had won!

THE THUNDERBIRDS TRIBUTE

With FAA papers in hand, a new order was issued: "Move that plane *now*!"

The Thunderbirds were ready to close the whole week's events, but they couldn't just yet. The crowd was on the line, and the Thunderbirds had their jet engines running. But they were not being given the "go" until after the One Week Wonder did its first ever, under-its-own-power taxi.

There was only a little problem—500 yards to show center. A host of airplanes were in the way, and the crowd was waiting to watch the Thunderbirds. But there would be no go for those F-16s until one little CH 750 did a dance after the physical touch, contact, and input of 2,500 builders that pulsated in every molecule of 6061 T6 and 4130 steel of the machine. That little plane would make it to the show; it really would.

The Thunderbirds waited patiently for the unpainted, newly hatched aircraft that was about to make its first major public performance. It took a few moments, and as the crowds parted to allow the entourage to pass, the Thunderbirds' engines could be heard at the end of the main runway, not impatient to fly but shouting their encouragement to the One Week Wonder aircraft.

A loud "Clear prop" echoed and the Rotax 912 iS Sport came to life, calling back across the airfield to the jet engines of the Thunderbirds. *"I am alive, and I will dance."*Less than a week ago, this airplane was nothing more than a set of parts in a box and the dream of a small group of people led by passion.

The little plane made a proud taxi around the apron, shaking its tail and waggling its control surfaces. It came to a standstill face-to-face with Chris Heintz, Caleb, and the entire team. Smiles spilled out like M&M's from factory storage bins—sweet, multicolored, and full of happiness. Thumbs went up, and the "One Week Wonder" cheer echoed along the show line.

N140WW was now the front drop to the Thunderbirds as they blasted down the runway, afterburners saluting the latest aircraft to be born.

EPILOGUE

It had been done, but this was only the beginning. The One Week Wonder aircraft is set to make its way around the country, saluting the world, thanking its builders, and sowing seeds of inspiration and passion in many more ways than it did during Oshkosh 2014. Long live the "spirit of building aircraft" and long live the One Week Wonder! *www.eaa.org/oneweekwonder* EAA

Jonathan Porter, also known as Captain Yaw, is a pilot, engineer, humanitarian, and aviation nutcase. He was also the "barker" during the One Week Wonder event. He works with his wife, Patricia Mawuli, in leading the Medicine on the Move health and education outreach programs, using aviation and engineering to change lives in Ghana, West Africa. Medicine on the Move is a registered 501(c)(3) charity in the United States. Visit www.MedicineOnTheMove.org.

Photography by Jason Toney

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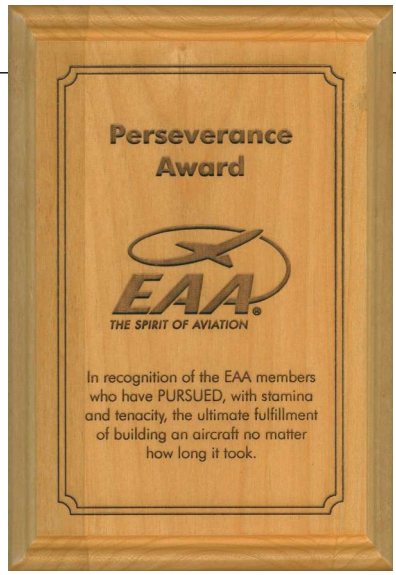


2014 Perseverance Awards

Celebrating builders' success

BY JOHN MANGOLD

STARTING THIS MONTH, EAA is happy to recognize several homebuilders who brought their aircraft to EAA AirVenture Oshkosh for the first time since completing them. Each year, those builders are recognized with a Perseverance Award to acknowledge the work and investment they made to complete their projects.

The Perseverance Award was founded by Doc and Miss Buddy Brokaw (now deceased) who built and flew a Brokaw Bullet for many years. The award continues in their honor and to fulfill their wish that homebuilders be recognized for their perseverance.

Over the next few months, we will share photos of several aircraft that made their first appearance at Oshkosh 2014. — *Mary Jones*

RV-9A, N194GB

Glen Brasch built this RV-9A that he calls *10 10 22* because it took him 10 years, 10 months, and 22 days to complete. The airplane was certificated in September 2013 and made its first flight in October 2013. It is powered by a Lycoming O-360 engine. Notice the subtle artwork on the top of the vertical tail—the American flag waving between the Twin Towers in tribute to 9/11.

SUPER REBEL, N46DJ

Don Jeffries and his wife, Joy, built this Murphy SR250 Super Rebel. The aircraft was certificated on August 20, 2013, and flown on August 23 after 13 years of build time. The airplane is powered by a Lycoming O-540 of 260 hp. The couple flew to Oshkosh from Louisville, Kentucky. Don also worked as a volunteer photographer in the homebuilt area while he was attending AirVenture 2014.

Photography by John Mangold

THATCHER CX4, N147HL

Brandon Burgdorf is the owner/builder of this Thatcher CX4. It was certificated in April 2014 and first flew in the same month. The aircraft took 800 hours and 18 months to complete. Brandon said that Thatcher has a good set of plans and that the airplane was easy to build. He made the flight from Evansville, Indiana, to AirVenture in one day. The plane is powered by a Hummel VW engine of 2180 cc.

RV-8, N801BC

Brent Crabe flew this RV-8 from Conroe, Texas, to Oshkosh powered by an Aero Sport IO-360 engine. The airplane was awarded its airworthiness certificate in January 2012 and made its first flight a few days later on January 13, 2012. The building process took 9 years. The airplane's paint scheme combines elements from World War II, invasions stripes, the stars and bars from 1947, and the markings used on today's Air Force aircraft.

RV-8, N812TE

Tom Ellis' RV-8 earned an airworthiness certificate in August 2013 and first flew in May 2014. The nose art on the aircraft, *Diana Jean*, is in honor of his late mother. The airplane is powered by a Mattituck IO-360 engine and took 7 years to build. The paint scheme is a loose interpretation of the 352nd Fighter Group, and the aircraft carries its serial number on the tail.

RV-7, N56DE

Dave Edtl flew to AirVenture from Hubbard, Oregon. This RV-7 took 2.5 years to build using a quick-build fuselage. The aircraft was certificated and first flown in November 2013. It is powered by an IO-360-M1B engine rated at 180 hp.

TITAN T-51

Gale Haskins flew his Titan T-51 75-percent scale P-51 to AirVenture from the Houston, Texas area. The retired Lt. Colonel holds membership in the Octogenarian Pilots Group and admits only to being 80 years old plus, but he won't say how much the "plus" is. The airplane was certificated in June 2014. It's powered by a Honda J35A engine producing 245 hp. Gale's plane is painted to replicate its big brother P-51 that is part of the Commemorative Air Force's inventory.

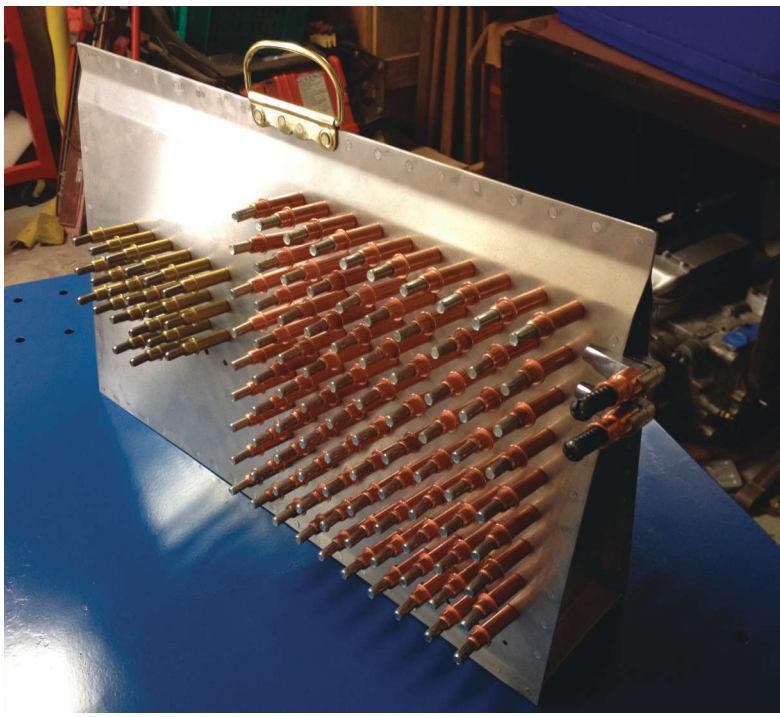
SONEX N885CW

Bruce Watkin's Sonex, N885CW, was certificated in February 2014 and first flew in March of 2014, after 8 years of build time. The CW in the N number are his younger daughter's initials. The paint is Sublime Green and is the same color used on Dodge's sportier cars. Bruce and his wife volunteer in the Homebuilt area. This year, Bruce drove his recreational vehicle to Oshkosh, then flew commercial back home to Houston and flew his Sonex to AirVenture. At the end of the week he flew the Sonex home, flew back commercially and then drove the motorhome back to Houston. That's dedication! EAA

A Simple Cleco Holder

A quick way to keep clecos in order

BY RICHARD KOEHLER



I AM SURE THAT after I turn out the lights and leave my shop that the clecos come out to play. The proof of this is that they seem to continually decrease in number, which I am sure is due to some of them sneaking away in the night.

My normal storage method for my clecos is a combination of Ziploc bags and various cups and cans. I have no idea of how many I have of each size, and thus I could not tell you if any are missing. When I have to use them at a different location, I usually have to find a cardboard box to haul them, piling bags, cups, and cans randomly in the box. If I need a particular size cleco, I have to rummage through the collection to find the right size.

HINTS FOR HOMEBUILDERS VIDEOS

THE FOLLOWING HINTS ARE JUST A SMALL SAMPLE OF THE MORE THAN 400 HINTS FOR HOMEBUILDERS VIDEOS CURRENTLY AVAILABLE FOR VIEWING ONLINE HERE.

Cable End Treatment
Brian Carpenter from Rainbow Aviation Services demonstrates a way to permanently eliminate frayed cable ends.

Clecos - Types and Uses
Roger Dubbert from Zenith Aircraft shows the different types of clecos and their uses along with how to use the cleco pliers.

Making a Fiberglass Layup
EAA Technical Counselor Mike Busch demonstrates how to apply two layers of fiberglass cloth over a foam core.

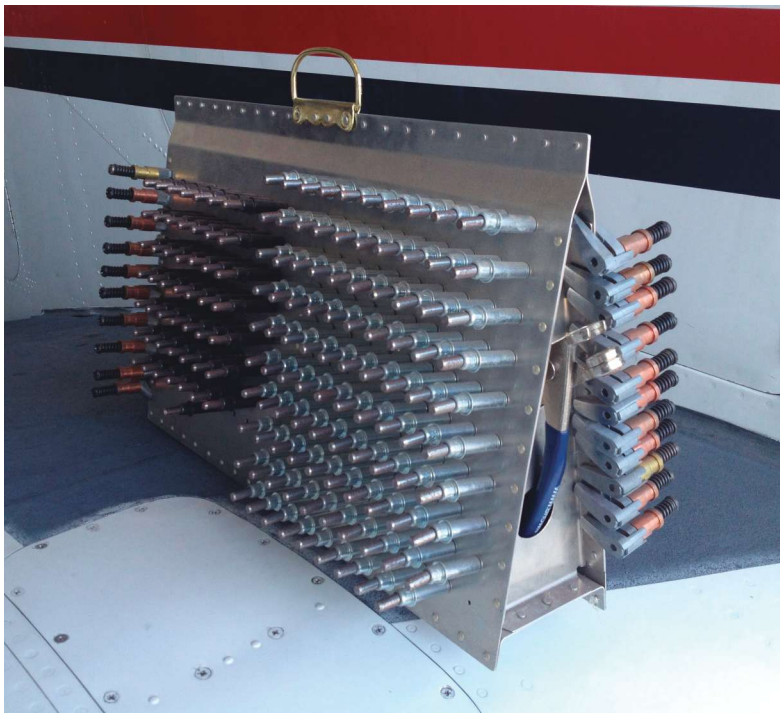
Spray Painting - Hang Those Parts
EAA aircraft mechanic Mike Peer shows how to hang parts while spray painting to provide a nice finish.

Photography by George Steed

Recently, fellow EAAer George Steed of Silverdale, Washington, showed me a neat solution for storing and transporting clecos. George had taken a riveting class at an A&P school where each student made an aft wing section, spar to trailing edge. He brought his finished project home as a souvenir, but it had little intrinsic value except as a remembrance of his class exercise. (Similar wing sections are made as part of the EAA SportAir sheet metal and RV builders workshops.) Then the light bulb came on in George's mind.

By drilling uniform holes of the correct size and adding a handle, the wing section became a neat and portable storage rack for clecos. If you drill exactly the number of holes for each size of cleco you have, you will be able to instantly tell if any are missing. If you buy more clecos in the future, you can just add holes for them. Clamps can be placed along the edge flange. The handle on top makes the whole unit easily portable. You can buy a handle in most hardware stores, but make sure it comes with a flat flange. After a little sheet metal work with a hammer, the flange can be bent to fit over the trailing edge of the airfoil and riveted in place.

Hope this little hint helps you keep your tools in order so that you can always have them readily available for building and/or repairs. EAA



The six-cylinder diesel Continental CD-300 engine.

Engines at Oshkosh 2014

BY MARINO BORIC

I'VE BEEN TOLD THAT EAA Founder Paul Poberezny often said, "You have to have the engine before you can build the airplane." You don't have to be a prophet to understand this statement, but the reality—especially in the past—was much different. An eager aircraft designer would create a capable airframe/aircraft. But projects often disappeared because the appropriate engines were missing. In those days, lots of homebuilders started "inventing" their own engines. This often led to projects coming to a complete stop.

In the past decade, we have witnessed more new engines getting to the market quicker and becoming available to experimental builders and even to the certified aircraft world. The best example for this is the Rotax 912 engine.

At EAA AirVenture Oshkosh 2014, we saw numerous new aviation gasoline and turbo-diesel engines on display in various states of development. The biggest news was in the diesel field; these compression-ignited engines run on Jet A and diesel fuels rather than on avgas, a fuel that's increasingly hard if not impossible to find outside of the Americas and Europe. Avgas costs north of $14 per gallon in certain parts of the world, and it contains lead, which is potentially harmful to the ecosystem. So, several traditional general aviation (GA) engine manufacturers and a few newcomers are rushing into the new turbo-diesel engine field that is promising a big share on new markets.

Contrary to traditional diesels that are fitted with mechanical injection pumps (such as with SMA), most of the new automotive originating diesel engines are fitted with electrically powered, full-authority digital engine controls that need, besides traditional batteries, additional or enhanced electric current reserves/redundancy. The result is that those new engines are much more fuel efficient than their gasoline counterparts (especially on cruise power settings), but due to the sophisticated technology used, they tend to be more complicated. In short, the new diesel engines have lost weight, sip fuel but (still) have short TBOs, and are (much) more expensive than traditional powerplants.

Here's a look at some of the engines we saw at AirVenture 2014.

CONTINENTAL MOTORS GROUP

For the Continental Motors Group Co. Ltd. of Hong Kong, China, AirVenture was one of the busiest events in recent history. The most important message was the announcement of a new V-6 diesel engine called the CD-300.

The CD-300 series engine has 3-liter displacement and generates up to 310 hp (228 kilowatts) at 2,300 rpm for low operating noise. Continental equips all of its CD range engines with single-level control and an electronic engine management system. The CD-300 features common rail technology, direct injection, turbocharging, liquid cooling, and an advanced reduction gear system. Just like the smaller CD-100 engine, the new CD-300 is based on a proven German automotive-based core (Mercedes) adapted for aviation use. Continental's reach in the diesel market expanded quickly after it acquired the Germany-based Thielert a year ago, giving it a certified line with the Centurion series. The new engine is an extension of that expertise, designed by the team in Germany.

Photography by Marino Boric

The CD-300 achieved its maiden flight in July at Continental's German development center in Altenburg in a Cirrus airframe. The company's flying test bed exhibited rates of climb and cruise performance that exceeded engineers' expectations. The CD-300 has gone from "concept to first flight in under nine months," according to Continental.

Continental has started the type certification process for its 300 series diesel aircraft engines. This will be the sixth jet fuel aircraft engine to be certified by Continental Motors for GA aircraft. The type certification will be conducted in accordance with the requirements of the European Aviation Safety Agency (EASA), followed by FAA and Chinese CAAC validation. The engine is expected to be certified in 2016 according to Continental.

Together with the debut of the new CD-300 engine, Continental Motors Group (CMG) moves forward with forming a one-stop shop for GA engines under one single brand. The diesel engines, known and sold under the brand name Centurion, are renamed to Continental Diesel, abbreviated as "CD." For example, the former Centurion 2.0s is now called CD-155.

The diesel products belong now to three engine series:

CD-100 series—the Centurion 2.0/2.0s, four-cylinder, in-line engines with 135 and 155 hp

CD-200 series—the former Continental TD-300, flat, diesel engines with 230 and 245 hp

CD-300 series—the Continental's newest V-6 diesel will start the CD-300 series with its first product rated at 310 hp. More powerful versions up to 360 hp are likely to be presented in the next year. For more information, visit *www.continentalmotors.aero*.

SMA

French diesel-engine manufacturer SMA (Société de Motorisations Aéronautiques) announced that the company is working with Cessna and Lycoming to prepare for deliveries of Cessna's Turbo Skylane 182 JT-A, certification of which is expected this fall. The company's SR305-230E engine currently develops 227 hp in the Skylane installation, but SMA plans to introduce a more powerful version soon. This announcement means that SMA is developing a version in the 265- to 285-hp range. This stronger version of the SR305 engine has already been endurance-tested in SMA test cells. Some 90 engines of the SR305 will be delivered by the end of 2014, according to SMA.

Last year, SMA presented a six-cylinder concept diesel, the SR460, which is designed to deliver 350 to 400 hp. Since then, the engine has been built, and it has been undergoing bench tests since April 2014. According to SMA, the SR460 prototype engine has fully achieved its expectations. The SR460 engine could be developed and certified within two years. For more information, visit *www.SMAengines.com*.

DELTAHAWK

Wisconsin-based DeltaHawk Engines Inc. flew a Cirrus SR20 powered by a Jet-A-burning diesel engine to Oshkosh this year. The proof-of-concept prototype is currently undergoing flight testing, and the company is aiming for an engine STC as soon as type certification is obtained, expected in 2015. The airplane had logged 14 hours of flight and recently flew from Vero Beach, Florida, to Oshkosh. The two-stroke V-4 engine is rated at 180 hp.

Test pilots are Nathan Zucker, a Cirrus-certificated instructor, and Doug Doers, DeltaHawk chief technology officer. "I am very impressed with the DeltaHawk engine," Zucker said. "Through the testing process, the engine has proved to run very smoothly, with minimal vibration. The efficiency of the engine is remarkable. We completed a 6-hour, nonstop, unrefueled leg, with IFR reserves. This engine has unbelievable potential." According to the aircraft owner, John Brooks, the SR20 recorded a fuel burn rate of 7.1 gph during its last flights. DeltaHawk claims 30 to 40 percent better fuel efficiency compared to avgas engines.

The SMA SR305-230E engine currently develops 227 hp.

A DeltaHawk-powered Cirrus SR20 at AirVenture 2014.

DeltaHawk V-4 two-stroke engines are both turbo and supercharged, providing exceptional higher-altitude performance. Redundant air, fuel, and cooling systems provide peace of mind, while single-lever control lessens pilot workload. More than 40 aircraft worldwide are being designed around the engine. Production of noncertified engines will start in the fourth quarter this year. Visit *www.DeltaHawkEngines.com* for more information.

EPS

Engineered Propulsion Systems Inc. (EPS) from New Richmond, Wisconsin, displayed the first iteration of its V-8 diesel engine, which can achieve between 320 and 450 hp using either diesel, kerosene, or Jet-A fuels.

Last year EPS showcased the Vision 350 engine in the Innovations Pavilion; it's a prototype of a lightweight diesel aircraft powerplant in the 350-hp range that is small enough to fit into the cowls of current production single-engine aircraft. This year the proof-of-concept version of this same engine is currently in flight test in Mojave, California, under the guidance of test pilot Dick Rutan, who spoke about his experiences flying the engine in a forum during AirVenture.

Rutan said he has validated calibration in the Cirrus SR22 test bed up to 10,000 feet, and he also tested the engine's liquid cooling system in a rapid descent from 10,000 to 3,000 feet and found the combustion stable and the cooling thermostat functioning well. With about 15 hours flying time, he stressed that there remains a significant amount of flying to be done to complete the test program for the engine and ensure that everything about its performance has been confirmed before locking in the design for the preproduction engine, which is the next step before seeking FAA certification. EPS said it expects that certification will be granted by the end of 2016. Design of the preproduction engine is well underway, said EPS Vice President Steven Weinzierl. He noted that the core of the engine is already designed and preproduction castings have recently emerged from the foundry. For more information, visit *www.EPS.aero*.

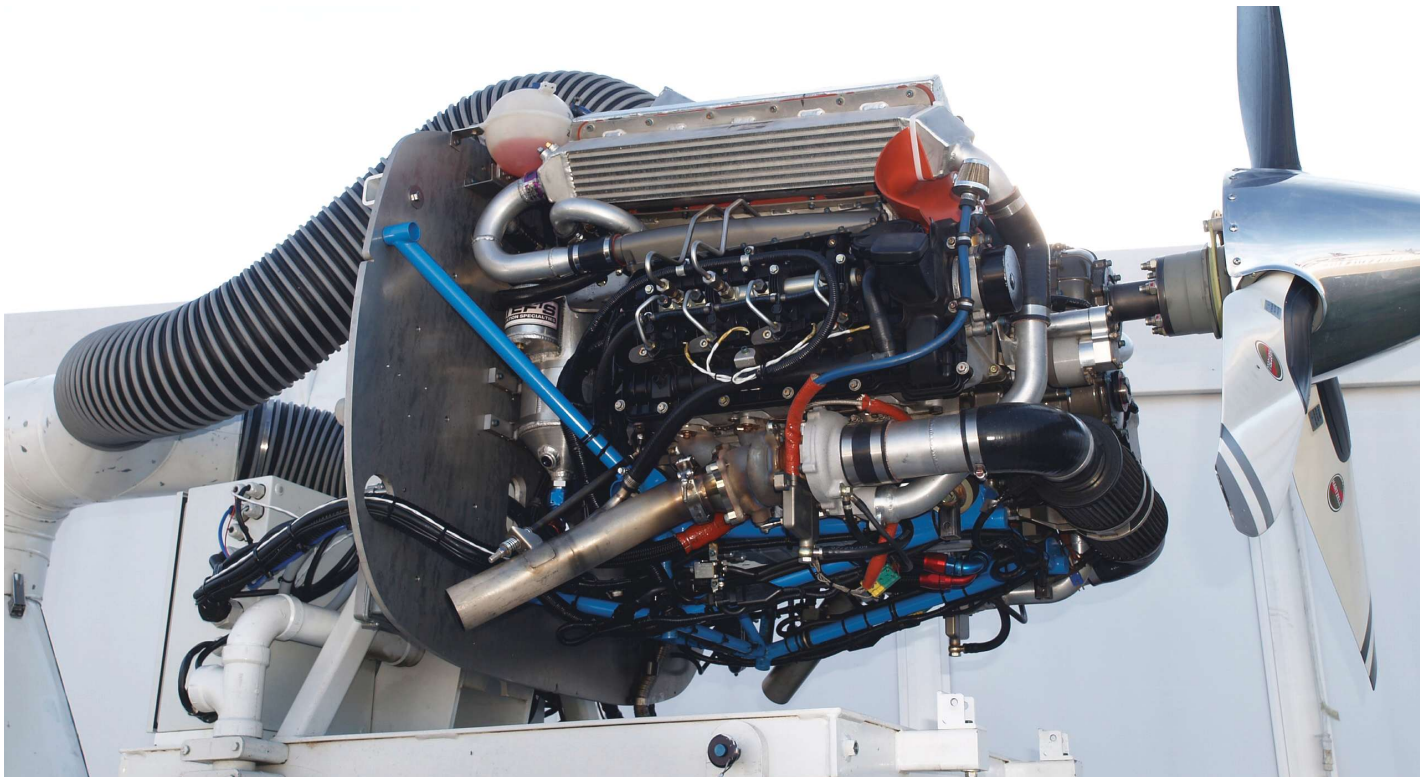
ADEPT AIRMOTIVE 2014

Adept Airmotive from Durban, South Africa, displayed its 320T engine. Visitors had the opportunity to explore the current state of development of this compact V-6 geared, gasoline aviation engine developed to run on mogas; 100LL could be used, but this is not being recommended, especially for longer use.

Adept Airmotive has designed and is developing the following range of GA engines for light aircraft:

- 320T—320-hp turbocharged engine
- 280N—260- to 280-hp normally aspirated engine
- 300R—Plus-300-hp normally aspirated competition racing engine.

Several Adept engines fly on board of experimental test aircraft, and on March 4, 2014, Adept's first customer engine was delivered to VliegMasjien in Johannesburg, South Africa.

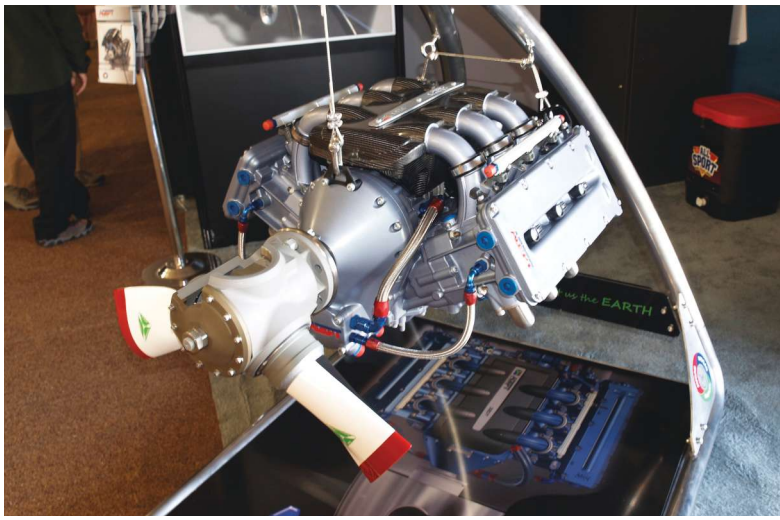


The EPS V-8 diesel engine.

Photography by Marino Boric

At AirVenture 2014, Adept displayed its 3.2-liter OHC V-6 engine, developing 320 hp, that is on the path to be certified in the next two to three years. The company is now pushing the 350-hp engine that is specifically being developed for an original equipment manufacturer in the United States that will partner with Adept for certification. The Adept technicians expect to have the engine certified by 2017. Production is expected to start in 2015, while the yearly production rate of 300 units is expected to be reached by 2017 or 2018. The 320T engine is comparable with the Lycoming TSIO-550 engine but half as long, 12 inches narrower, and 4 to 5 inches lower. Weight saving is 143 pounds (65 kilograms) compared to the Lycoming installed in a same aircraft.

This engine will be delivered as a complete, firewall-forward package. The Adept engine package will include a full firewall-forward package which includes the engine management unit, lubrication, electrical and cooling systems, starter, alternators, constant-speed pump, and vacuum pump. The Adept V-6 is a geared engine, and it will be delivered with two different gear ratios that will allow either 2300 or 2700 prop rpm operation. The propeller is not included in the package, but the company says it can facilitate the purchase of an MT or Hartzell propeller. Visit *www.AdeptAirmotive.com* for more information.



Adept Airmotive's 320T V-6 geared engine.

Marc Becker, Rotax's manager of Aviation Service, and EAA's Charlie Becker celebrate the installation of a Rotax 912iS Sport engine in the One Week Wonder. Rotax donated the engine to the project.

ROTAX

The market implementation of the Rotax 912 iS engine to the newly released iS Sport with slightly more power and greater torque is going very well, officials from Rotax BRP reported. "One hundred percent of OEMs using the 912 iS engine will switch to the Sport upgrade, thanks to more improved fuel consumption as well as stronger takeoff and climb performance," Rotax Manager Christian Mundigler said.

Rotax received certification for the fuel-injected 912 iSc Sport just prior to AirVenture. The 912 iSc ("c" stands for "certified") will be used worldwide in applications for commercial use, such as flight schools or commercial activities requiring certified aircraft engines.

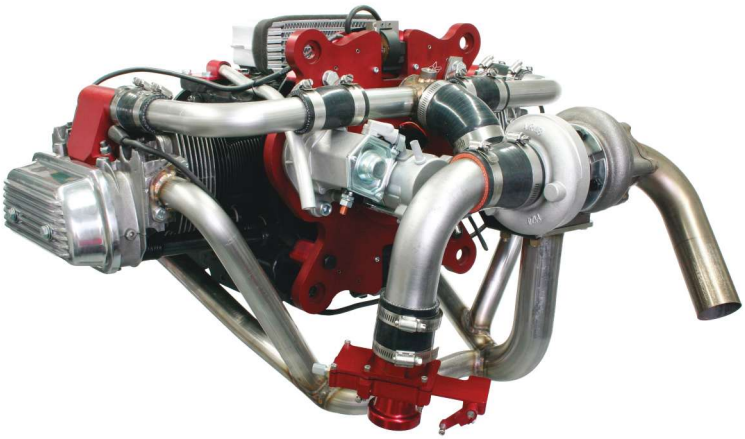
During AirVenture 2014, Rotax started an international contest that will award a new 912 iS Sport engine to the first school to log 2,000 flight-training hours in a training aircraft using a Rotax 912 iS powerplant. Value of the new engine is about $25,000.

Rotax supported EAA's One Week Wonder project by donating a 912 iS Sport engine. The Rotax 912 iS Sport engine is currently under the cowl of 44 different airplane models, and soon that number will rise to 70, Mundigler said. For more information, visit *www.flyRotax.com*.

SONEX AND THE AEROVEE TURBO

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 turbocharged AeroVee variant raises the power of the existing AeroVee engines from 80 hp to 100 hp. According to Sonex CEO Jeremy Monnett, this is "a huge added benefit. You're going to outperform engines rated 120 hp or approaching 130 hp, because you have (the turbocharger) working for you." Monnett said the adoption of turbocharging increases climb rate by 200 to 300 feet per minute and cruise speed by 25 mph compared to non-turbo-powered aircraft. The AeroVee Turbo engine is priced at $10,995, and an upgrade package for normally aspirated AeroVees costs $3,995. Deliveries of the engine are scheduled for the end of this year. According to Sonex, 500 to 700 upgradable AeroVees are currently in operation.

The AeroVee Turbo is the result of an extensive Sonex R&D effort dating back to 2010. After much refinement, the current version of the system fits all propeller-driven models of Sonex Aircraft and has undergone significant testing in Sonex Aircraft's test cell facility and in flight. "By far the biggest surprise to me has been outstanding cooling performance of the AeroVee Tur-



The new AeroVee Turbo engine.

The Aero Concept's V-2 four-stroke engine.

bo," Monnett remarked. "The key engine parameters are similar (almost identical) to parameters seen on non-turbo AeroVee engines and have been running well within the green arc including CHTs, EGTs, oil temp, and oil pressure." Really important is the fact that the Turbo fits all actual Sonex engine mounts.

The AeroVee Turbo is a pull-through turbo arrangement using the standard AeroVee-sized 32-millimeter AeroInjector (throttle-body). The turbo engine has a pretty conservative 8-to-1 compression ratio for sound longevity; the manifold air pressure boost is approximately 5 to 6 inches Hg higher than on the non-turbo engines. As a "free-floating" system, boost is controlled only by throttle setting limited by a fixed waste gate (spring controlled—either open or closed), and power still diminishes with altitude; but losses are not nearly as drastic as those with a normally aspirated engine. This allows the cruise speed of an AeroVee Turbo in a Sonex aircraft at altitude to exceed the performance of the 120-hp Jabiru 3300 engine.

The total weight of the AeroVee Turbo is 185 pounds while the turbo conversion weighs 25 pounds. Sonex is more than compensating for the added weight of the turbo by raising the gross weight of turbo-fitted aircraft by 50 pounds. The kit includes all necessary parts for the conversion, including lots of custom tubes, silicone couplers, new secondary oil pump for the turbo, oil filter mount, oil supply lines, and intake and exhaust tubes. Possible options include the air filter and oil separator.

Any power and performance boost is usually not free, so besides the price, the turbo engine has a higher fuel consumption at wide open throttle, up to 8 gallons per hour, according to Sonex. The turbo engine is intended only for 100LL use; no avgas use (yet). For more information, visit *www.SonexAircraft.com*.

SODEMO AERO CONCEPT PRODUCTS

Sodemo Aero Concept Products from France surprised visitors with a new V-2 engine specially developed for the experimental and light-sport aircraft market. According to the manufacturer, the V-2, four-stroke, fuel-injected engine weighs only 120 pounds (55 kilograms) and develops 102 hp at 6500 rpm. A reduction gear (1-to-2.75 ratio) lowers the cruise rpm of the prop to 2,000 revolutions/minute.

The engine will enter production in two displacements, at 992 and 1200 cc, developing 102 and 136 hp, respectively. Each two cylinders features four OHC chain-driven valves and two spark plugs and two ECUs for redundancy. The very compact engine looks extraordinarily clean and features several smart solutions. One of them is the built-in oil tank of the dry-sump engine and the conveniently located, easy-to-reach, automotive-style oil filter. The engines will be available by mid-2016.

The same company is offering an interesting electronic fuel injection kit for the Rotax four-stroke engines priced at approximately $4,000. For more information, visit *www.Aero-Concept-Project.com*.

MW FLY AEROPOWER 150-HP ENGINE

This year promises to be an important milestone for the Italian engine manufacturing company MW Fly with the market introduction of the B25R engine, rated 150 hp at 4550 rpm from a 2.5-liter displacement. The B25R, 2.5 I engine, which was introduced during AirVenture 2013, is based on the B22 (95-, 115-, 130-hp) engine range with 2.2-liter displacement and features a greater cylinder bore. Total weight of the 150-hp engine is 185 pounds with all necessary components for proper engine operation such as the oil and water tank, electronic control unit, generator, and starter.

The engine comes as a ready-to-install bolt-on engine. The most interesting detail of the engine is its low-revolution, vibration-dampening system that doesn't use propeller/gearbox dampeners but rather a proprietary system that lowers the engine compression ratio at low engine rpm.

The MW Fly B22R engine was also on display at AirVenture, powering a vintage Wittman Tailwind. The 130-hp B22R engine is now available in Canada and the United States, with a flight-training unit and commercial maintenance facility, MW Fly North America, located in Ottawa, Canada. All MW Fly's

Photography by Marino Boric

engines are flat, four-cylinder, liquid-cooled, FADEC-equipped powerplants offering 95, 115, 130, or 150 hp. For more information, visit *www.MWfly.it*.

FLYING LEGEND'S FLYGAS ROTAX TURBO

In addition to a Tucano replica inspired by the Brazilian fighter-trainer originally produced by Embraer, Italian manufacturer Flying Legend also showed a Rotax 912 ULS engine fitted with a centrifugal supercharger. Flying Legend has been marketing a replica of the Tucano Emb312 since 2011. Currently a Tucano is being tested in Italy with a 132 to 143 hp, supercharged version of the Rotax 912S engine; a video can be viewed on the company's website.

Flying Legend uses a centrifugal compressor/supercharger developed by Italian manufacturer Flygas. The supercharger is belt driven by the Rotax 912 or 912 ULS engine. Flying Legend owner Franco Rummolino said he chose this system because in case of a supercharger failure the Rotax engine will not stop and will run on lower power, delivering its original 80 or 100 hp. The price of the whole system that retains the Rotax original carburetors is expected to be approximately $6,500 to $7,000 U.S. (4,950 euros). For more information, visit *www.FlyingLegend.it* and *www.Flygas.info*.

AEROMOMENTUM

The AeroMomentum Aircraft Engines company showed up with two new engines based on auto engines for use on experimental and light-sport aircraft. The 1.3- and 1.5-liter engines, called the AM 13 and AM 15, are based on Suzuki "G" car engines. The numbers refer to the engines' displacement, and they deliver 100 and 117 hp, respectively. They weigh 174 and 186 pounds, without coolant and radiator, and cost $8,500 and $8,990.

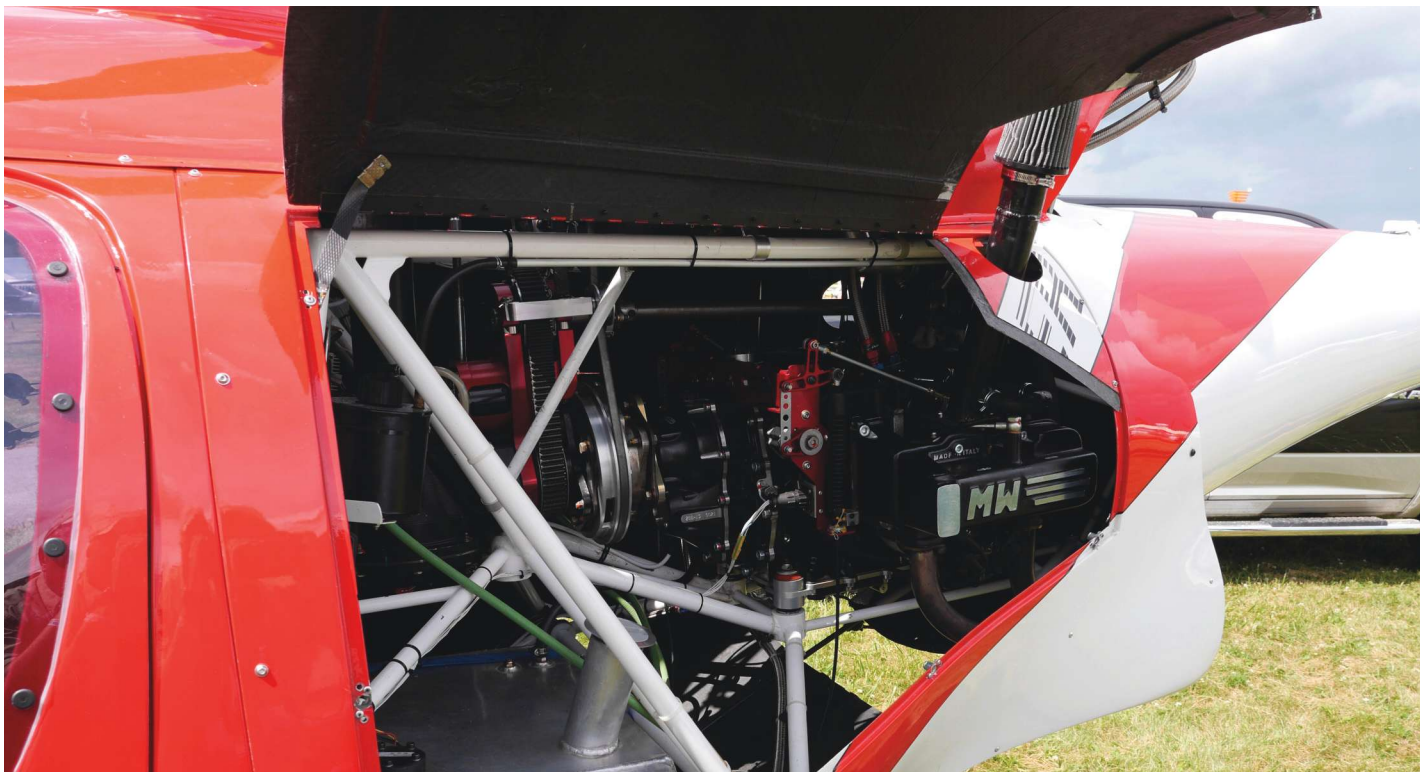
The engines can be installed either vertically or 70 degrees inclined to the side. Some of the modern features included are: FADEC, four valves per cylinder, steel-lined cylinders, tuned exhaust, and choice of mounting. The only drawback (similar to many other auto conversions) is only one spark plug per cylinder. For more information, visit *www.AeroMomentum.com*.

ELECTRIC AIRCRAFT AT AIRVENTURE 2014

Remember the big electric buzz at AirVenture 2010 or 2011? Electric aircraft were quite apparent when EAA sponsored the Electric Aircraft World Symposium. At the same time, the Lindbergh Foundation awarded its aviation prize for electric aircraft, and NASA and the Comparative Aircraft Flight Efficiency (CAFE) Foundation announced a competition for battery-powered flight.

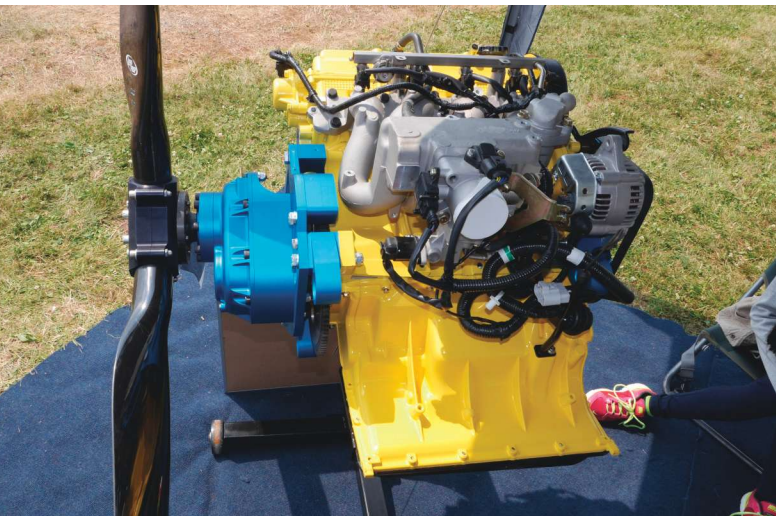
At AirVenture 2014, we could find only a few electric aircraft. Even EAA didn't expect a high number of aircraft that would need an electrical outlet after landing, as it provided only four or five plug-in charging stations in the aircraft parking areas.

Where have electric aircraft gone? Well, after the initial hype, pilots and manufacturers understood that electric aircraft



The MW Fly B25R engine.

Flying Legend's supercharged Rotax 912 engine.



The AeroMomentum engines are based on Suzuki "G" model automotive engines.

The electric ICE motor, which can develop from 25 to 75 hp.

are still only marginally useful as the batteries are expensive and operating times are still short. Just as with computer technology, buyers are putting off a buying decision as they know battery technology is advancing rapidly; perhaps the "next" battery generation is going to be the right one.

Europe is progressing much faster in this field. At AERO Friedrichshafen 2014, we saw a nice choice of electric aircraft, including the E-Volo helicopter, the GreenWing International single-seat eSpyder, and the Pipistrel two-seat glider, which is in regular production in Slovenia.

As of August 22, 2014, there is another shooting star in this field, the Pipistrel WATTsUP. This new two-seat, all-electric trainer is powered by an 85-kilowatt electric motor (weighing 14 kilograms/34 pounds) and in conjunction with the 17-kilowatt battery pack, it's capable of one-hour operation plus 30 minutes reserve.

In Europe, the price of fuel is putting much greater pressure on aircraft developers to electric aircraft. Even Airbus intends to bring out a two-seat e-Fan and then the four-seat version. Stay tuned; we will soon fly this e-Fan and will report about several other interesting projects that are still considered as "classified."

At AirVenture 2014, Mark Beierle of Earthstar Aircraft was flying a Joby Energy Inc. motor with 20-kilowatt output that he helped develop. It's powered by two 2.8-kilowatts/hour lithium-polymer batteries from Zero Motorcycles. Those batteries have an endurance of up to 40 minutes, although using a larger 11.4-kilowatts/hour battery would allow the aircraft to stay airborne for 70 minutes. An onboard charger allows the batteries to recharge in seven hours, but a larger ground unit can give a one-hour turnaround.

Beierle said that electric aircraft are now viable for sport aviation, given that a recent survey of ultralight pilots showed their average flights were only 40 minutes, with a minority claiming they want to stay much longer airborne. For more information, visit *www.ThunderGull.com*.

Also during AirVenture 2014, we had the opportunity to talk to Dan Lineback, owner of the Florida-based ICE Motor, who displayed an unusual variable electric motor. The actual specifications, cost, and test results will be released later this year, but for now Lineback only could give us his target data. The motor is mostly made from composites so the weight should come in as low as 12 pounds. Instead of making many sizes of motors, Lineback will make just one. Because it is internally water-cooled with a special circulatory system, the power output can be as high as 75 hp. ICE motors can achieve from 25 to 75 hp only by using the proper controller size for the desired power output. According to Lineback, this is possible because the axial flux motor runs at maximum efficiency at any rpm. The target price for the controller, special propellers, pitch controller, batteries (depending on flight-time requirements), motor, and all the electronics—in other words "plug-and-go" solution—should cost from $5,000 to $10,000. EAA

Photography by Marino Boric

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December 6-7	Composite Construction, Fabric Covering, Sheet Metal, Electrical Systems, & Gas Welding	Houston, TX
December 13-14	Van's RV Assembly	Riverside, CA
January 10-11	TIG Welding	Griffin, GA
January 17-11	Van's RV Assembly	Frederick, MO

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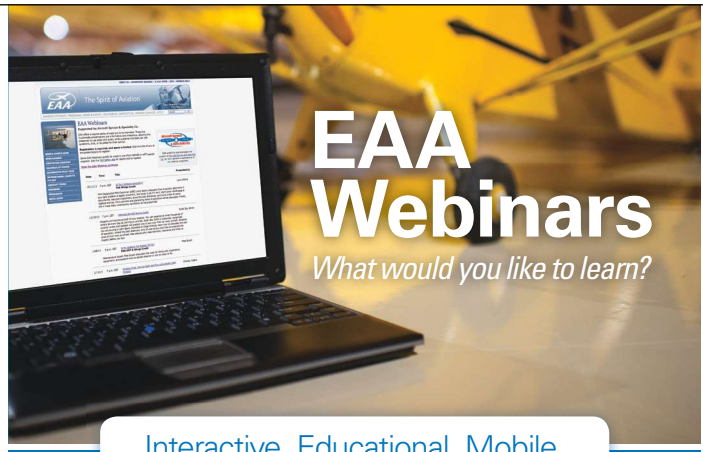

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AirVenture 2014 ...

From the Fun Fly Zone

BY DAN GRUNLOH

EAA RENAMED THE ULTRALIGHT/LIGHT Plane Area on the AirVenture grounds as the "Fun Fly Zone," and it's a name that definitely fits! Here's a look at some of the fun that was happening in the "Zone" at EAA AirVenture Oshkosh 2014.

This Ukrainian-built Aeroprakt A22 Vista Cruiser was flown in by Dennis Long; it's a regular attendee at fly-ins all around the Midwest.

The Aerolite 103 ultralight was designed by Terry Raber, but it is now owned and produced as a ready-to-fly ultralight by Dennis Carley of U-Fly-It Ultralights Ltd. www.uflyit.com

This Aerolite 103 ultralight built by Dennis Carley features flaps, tricycle gear, brakes, a windscreen, control yoke, and emergency parachute.

This 1981 Robertson B1-RD ultralight, modified by Lee Fischer of Larsen, Wisconsin, to accommodate a 65-hp Rotax 582 has nearly twice the power of the original design.

Photography by Dan Grunloh

Larry Smith's Back Yard Flyer features lightweight welded aluminum tube construction, a Volkswagen engine with a belt drive, and amazing STOL performance. www.culverprops.com/BackYardFlyerUL.html.

Belite creator James Wiebe flew this single-cylinder, Polini-powered Belite ProCub ultralight to AirVenture 2014 all the way from Wichita, Kansas. Here's a video of his flight. www.beliteaircraft.com

The foam and carbon fiber Belite ProCub ultralight can be flown without the optional turtledeck, but it diminishes the Cub-like styling.

This 2005 Quad City Challenger II on floats, built by Tom Scully of New Lisbon, Wisconsin, returned to AirVenture after winning the light-sport Honorable Mention plaque in 2013.

The Skyreach BushCat from Africa is available as a special light-sport aircraft, an experimental light-sport aircraft, or as an experimental amateur-built kit. http://aerosportplanes.com

Powered paraglider pilot John Vining with a GoPro chase camera in tow.

18-year-old Landon Clipp flew his Phoenix powered parachute at AirVenture for his third consecutive year.

Dennis and Barb Crowley of Tucson, Arizona, with the Reserve Grand Champion Light-Sport Lindy trophy they earned for their highly customized Just Aircraft Escapade.

Rick Pearson's custom Eipper GT 400 loaded with clever improvements earned the Honorable Mention plaque in the light-sport category.

Team Mini-Max's new wide-body SuperMax design for VW engines is now available in economical kit form with everything but paint included. www.teammini-max.com

A Just Aircraft SuperStol about to land; this model evolved from the Highlander with the addition of automatic leading edge flaps and a long stroke landing gear. www.justaircraft.com

Allen Oehlke of the Microlight Flyers, EAA Ultralight Chapter 1 based in Milwaukee, Wisconsin, briefs a future pilot on the basic principles of good airmanship.

Photography by Dan Grunloh

Bob Jones tours the U.S. with a conversion van and a Kitfox in a trailer, taking photographs of beautiful scenery and sharing his experiences one-on-one, and in a presentation in the Ultralight Forum tent.

Musician and Kolb pilot Jerry 'Engine' Anderson in the tower with announcer Pat Schmitz as he performs a song about ultralight flying called "Knees in the Breese."

Les Homan of Pleasanton, California, taxis his Legal Eagle XL for takeoff after the GoPro factory team mounted seven cameras on his aircraft, including one on his forehead.

Dan Grimm lands the M-Squared Breese 2 light-sport aircraft, in which more than 1,000 rides have been given.

EAA lifetime member Mike Ostrander has been bringing this award-winning 1984 Quicksilver MX to EAA conventions for 20 years, and he has the jacket patches to match.

A modified Quicksilver MX takes off in the Fun Fly Zone.

Larry Mednick of Evolution Trikes in Florida brought a large contingent of their deluxe, U.S.-built Revo trikes capable of cruising at 100 mph. www.evolutiontrikes.com

This RANS S-7S built by Hal Stockman of Elko, Nevada, features a Rotax 912 engine modified with oversize pistons and cylinders to give spectacular climb performance. The 80-hp engine now delivers 105 hp.

The Zlin Aviation Savage Cub LSA built in the Czech Republic strikes a classic pose while parked in the Fun Fly Zone. www.sportair.aero

John Glynn of Shoreview, Minnesota, and his Rotax 503-powered Flying K SkyRaider completed in 2000.

Photography by Dan Grunloh

Paula Crevier of Essex, Illinois, gets acquainted with fabric covering using the Stewart Systems method in the Ultralight Workshop tent. www.stewartsystems.aero

The Friday evening Valdez-style STOL competition on the Fun Fly Zone runway gave spectators a close-up view of the action.

Valdez 2013 winner Frank Knapp of Palmer, Alaska, takes off from the runway in his 100-hp experimental Cub-type aircraft, which was destroyed by a hangar fire this spring and completely rebuilt in time to fly at AirVenture 2014.

Everyone at AirVenture is making videos, including the passenger in Bob Trembly's Viking-powered Just Aircraft Escapade.

Bill Esker brought his Kawasaki-powered Weedhopper C all the way from White Mt. Lake, Arizona, to fly at AirVenture 2014.

A Legal Eagle airframe built by volunteers is on display in the Ultralight Workshop tent.

Rigging Tricks

For homebuilts

BY RICHARD KOEHLER

RECENTLY I WAS PRESSED into service to help my brother Bob and his friend Kevin, who were repairing a wrecked Navion for a mutual friend. Seems the Navion owner got invited to land in a farmer's field that wasn't quite big enough. The plane went through the fence, down a hill, and ended up in a ravine. The gear was damaged, wing destroyed, and the nose, including engine and prop, were bent. The going-in position of the insurance company was that the plane was not economically repairable, so the salvage operation was not done carefully. The wings were cut off with a chain saw!

Bob and Kevin repaired the engine (500 hours since new TCM IO-550) that needed, among other things, a new crankshaft. They found a suitable used prop for $4,200, and they found a used but serviceable set of wings. The wings on a Navion are held on with six bolts! They disassembled the landing gear, repaired, repainted, and reinstalled it. Most of the hydraulic lines had to be remade since the old ones were either damaged in the crash or by the salvagers. When I arrived, they had mated the fuselage to the wings and installed the tail surfaces. I got to help install all the flight control surfaces and "rig" them. (See photo.)

Rigging information in the aircraft's FAA type certificate was in degrees of movement up/down or left/right. It doesn't matter if you are building a homebuilt or putting together a disassembled certificated plane; you must get the flight controls rigged correctly. This means that the controls will displace to their maximum limits and do so with no interference from anything. At an aircraft factory, with multiple aircraft deliveries per day, they typically use devices called "throw boards" to check the deflection of the control surfaces. These throw boards are usually made of plywood or aluminum and are designed to fit on the primary flight surface contour and hang over the movable surface. They rapidly and easily show the deflection angles of the flight control surfaces. You could make throw boards for your project, but the time and effort usually are not worth it unless you are making multiple planes, such as on a production line.

The alternative is to use a protractor and measure the actual angles achieved. Put the control surface in the neutral or zero degree position, and shim the protractor to also read zero and tape it in place. Then deflect the surface to its maximum limits and read the angles. Adjust as necessary.

If you have some extra bucks in your budget, you can use a digital angle finder, such as Home Depot's Model No. 822, for about $20. You can simply tape it to the aileron or elevator, zero the reading, and then do the maximum deflections. A less expensive alternative is to buy a Johnson Pitch and Angle Locator, Model No. 50 (Home Depot, $8). (See photo.) Again, tape it on the horizontal flight control surface, shimmed to read zero. Do the deflections and take the readings. Adjust as necessary.

If you have been following closely, you have noticed that I only covered the ailerons and elevators. A mechanical protractor will work for the rudder but not the digital unit or the Angle Locator. Probably the easiest way to rig the rudder is to calculate the inches of deflection at a measurable point on the control surface for the equivalent degrees of deflection. You will need to go back to high school trigonometry. For instance, for a 25-degree deflection on a rudder that extends 12 inches, the math shows the sine of 25 degrees to be 0.422, so the 12-inch surface would deflect 0.422 x 12 = 5.06 or about 5-1/16 inches. Set a step ladder, chair, box, or similar item just behind the flight control surface at the 12-inch deflection point, set the surface to zero or neutral, mark the location on the ladder or whatever, and then deflect to the maximum and measure from the zero point to the edge of the deflected surface. Adjust as necessary.

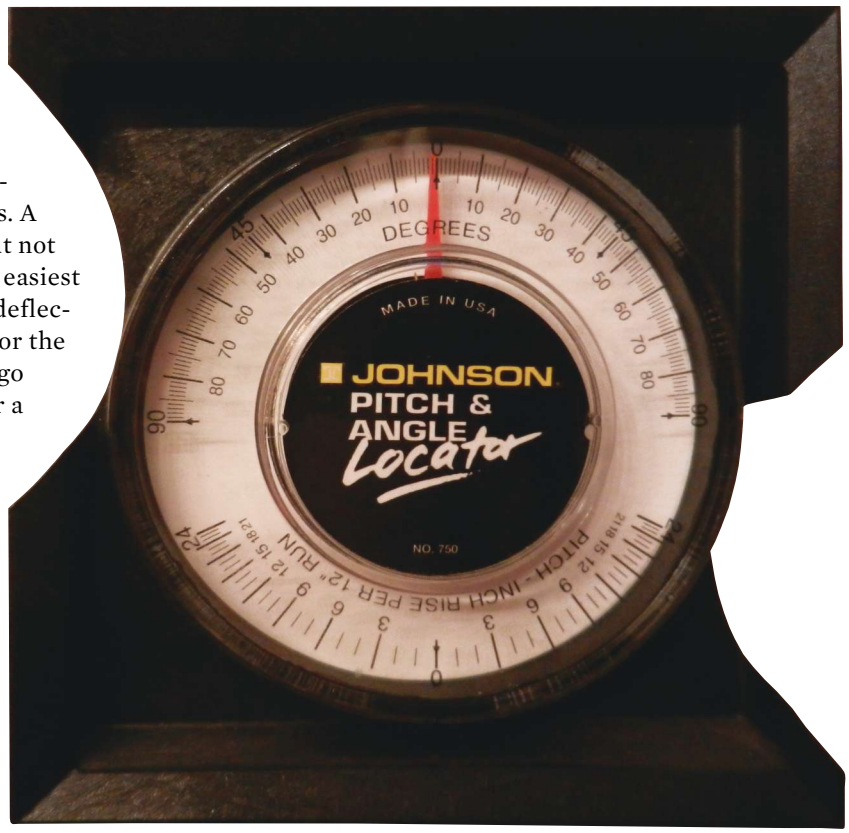
Again, this approach works best for the rudder, but it can be used on ailerons and elevators just as well. Of course, remember that the ailerons work differentially. I did see a plane with both going up and down together!

Smooth uninterrupted controls are an absolute must. Maximum deflections should be achieved, usually ±2 degrees. Overdeflection can be just as bad as not enough. For instance, overdeflection on a rudder can lead to structural failure on many planes!

After you get the controls properly rigged, check full deflection in the cockpit by "wiping out" the cockpit with the controls ensuring full deflections and no binding or "funny" noises. Do it in a quiet area and carefully listen. There should be no rubbing, scraping, or chattering noises. If so, investigate and correct. I have seen several RVs where one or the other of the control sticks hit something in the cockpit, such as seat cushions, instrument panels, and human body parts. In one particularly bad situation, the pilot's stick would jam under the throttle, if you put in full down elevator and right aileron!

The wrecked Navion had many bent parts and pieces from at least two different airframes, so rigging it was a challenge. But we completed it with all surfaces perfectly in limits. When it flew, the pilot said it was rigged perfectly and flew hands off. The time and patience we spent in the rigging paid off with a happy owner.

Hope this little discussion helps you with the building or repair and maintenance of your bird.



AirVenture Fun in the Homebuilt Area

Recapping EAA AirVenture Oshkosh 2014

BY CHARLIE BECKER

EAA Volunteer photographer John Mangold captured these images of the myriad of activities that took place in the homebuilt area during EAA AirVenture Oshkosh 2014.

The volunteers at Homebuilder's Headquarters gathered for this commemorative photo. EAA thanks all the volunteers in the Homebuilt area for their efforts in making AirVenture successful.

Rob Unger and several other of the volunteers who organized the Breezy anniversary celebration gathered around the original Breezy in the EAA AirVenture Museum.

Homebuilt Community volunteers enjoyed a brat fry to thank them for their service to fellow members. Right, Jack Pelton and Charlie Becker offer their appreciation to volunteers.

Photography by John Mangold

Charlie Precourt (left) Safety Committee Chairman on the EAA Board of Directors, receiving the Society of Experimental Test Pilots' Association Test Pilot of the Year award, as Homebuilt Aircraft Council President Rick Weiss looks on.

Several hundred homebuilders gathered in the Nature Center Pavilion for the annual Homebuilders' Dinner.

Many thanks, also, to the parking volunteers who assisted EAA homebuilders arriving with their aircraft at Oshkosh 2014.

Zenair founder Chris Heintz approaches the podium to address the crowd at the annual Homebuilders' Dinner in the Nature Center Pavilion.

The dates of "Oshkosh" each year coincide nicely with the ripening of sweet corn in the Midwest, making a corn roast an annual event in the homebuilt community.

EAA Homebuilding Community Chairman Charlie Becker (left) presents an EAA Major Achievement Award to Paul Dye, editor of Kitplanes magazine, in celebration of the magazine's 30 years of covering homebuilt activities.