Vol.4 No.4 I April 2015

EXPERIMENTER

The Spirit of Homebuilt Aviation I www.eaa.org

A Super-Powered RANS S-7S
Pushed by a Big-Bore Rotax

The Additional Pilot Program
Flight-testing assistance

Meet the Groppo Trail!

Congress to the Rescue

BY JACK J. PELTON

IT HAS BECOME excruciatingly obvious that the FAA's system for creating new and appropriate regulation is frozen.

It has been nine months since the FAA wrote a notice of proposed rulemaking (NPRM) that would modernize the class three medical standards for private flying. More than 10 years of safe and successful LSA flying by pilots using a driver's license as evidence of medical qualification has proven that the current third class medical restrictions are burdensome, costly, and unnecessary.

The FAA agrees with those of us who are convinced change is appropriate and even necessary to keep more pilots flying for personal reasons with no loss of safety. That's why the NPRM was created and sent to the Department of Transportation for review just before EAA AirVenture Oshkosh 2014.

The DOT review is supposed to take less than 30 days. It's been nearly nine months, and nothing has happened. The NPRM contents remain a secret. Nobody outside government knows for sure what rule changes are proposed. None of us even know what the DOT may be objecting to that is holding up publication of the NPRM. The DOT simply won't respond, and the FAA's hands are tied.

I have lost all patience with the process, and I bet you have, too. Most importantly, many members of Congress who support aviation have also exhausted all patience and have introduced the Pilot's Bill of Rights 2 to force the DOT and FAA to act.

The original Pilot's Bill of Rights (PBOR) that was passed and signed into law about two years ago guarantees pilots basic legal protections from FAA enforcement actions. The new PBOR strengthens those legal protections and requires the FAA to change the third class medical standards so that most private flying could be done with a driver's license as medical certificate.

PBOR2, championed by Jim Inhofe of Oklahoma in the Senate and Sam Graves of Missouri in the House, has broad bipartisan support. The bill would require the FAA to modify the rules so that pilots could fly an airplane weighing up to 6,000 pounds as fast as 250 knots, at altitudes up to 14,000 feet carrying as many as five passengers under VFR or IFR without a third class medical certification. The flights must be entirely personal.

This makes perfect sense to me. There is a change in airplane certification requirements at 6,000 pounds max takeoff weight so that is the logical spot to set the medical limit. Flying under IFR as well as VFR also makes sense because IFR has obvious safety advantages for qualified pilots. And the 250 knot speed limit has been long established for all flights below 10,000 feet, and the 14,000-foot ceiling keeps pilots below the level where supplemental oxygen is required at all times.

The senators and congressmen who co-sponsored and wrote the PBOR2 legislation have succeeded in something I never expected to see from Washington—they kept it simple. No restrictions of such things as retractable landing gear, or engine horsepower, or other issues of no real significance. The goal is to assure continued safety for the public matched with logical regulation for pilots, and PBOR2 does exactly that.

I suspect that in response to congressional action we will soon see the FAA NPRM on medical reform. But no matter what the NPRM changes, the PBOR2 is almost certainly a better deal for pilots. I can't imagine the NPRM will be as broad in its changes as PBOR2. And even if it is, there will be at least 90 days to comment on the NPRM, followed by more months for the FAA to consider the comments and most likely make changes. An actual rule change would be a minimum of six months away, and more likely another year.

But if PBOR2 is passed in both the House and Senate and signed into law, it requires immediate change.

Passage of PBOR2 is by no means a sure thing, but the bill has very broad support across party lines. Simplifying regulation and removing added costs for both the government and citizens is something everybody wants.

But your voice is needed. Please go to the Rally Congress section of our website at *www.EAA.org* and send an electronic letter to your senators and congressman. They are read, you will be listened to, and your voice and vote matters.

If we all pull together and get behind PBOR2, it could be law before EAA AirVenture, something that just can't happen with the FAA's frozen regulatory system. EAA

Photography by Jason Toney

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On the cover: The Groppo Trail in flight. (Photography courtesy of Nando Groppo SRL.)

Dick VanGrunsven on the flightline at Oshkosh in the 1970s.

Van's Aircraft ...

9,000 aircraft flying!

BY CHARLIE BECKER

ON MARCH 24, 2015, Airbus announced that it had delivered its 9,000th aircraft—quite an achievement. Out of pure coincidence, Van's Aircraft will be hitting its 9,000th flying aircraft this month as well. Now, *that* is an achievement!

It is interesting to note that Airbus made its first delivery in 1974; Van's Aircraft was founded in 1972 and began selling a few parts for the RV-3. That is about where the similarities end.

Note that I said *flying* RVs, not kit sales. For Airbus to reach the 9,000 milestone, it currently employs 58,000 people to produce its aircraft. Van's, on the other hand, relies on 60 employees, and the rest is done through "volunteer" labor; that's us homebuilders. Sure, Airbus has a lot more employees, but I think it is safe to say it can't match the passion we homebuilders put into our aircraft.

Although there are lots of airplane kit companies, Van's is far and away the leader in sales. If you review the FAA's registry of aircraft, Van's has more aircraft on the list than the other top 10 kit companies combined! The fact that Van's holds such a large percentage of the market is truly amazing given the number of excellent designs available to homebuilders. For airlines, there are basically two choices: Airbus or Boeing. Homebuilders are blessed with dozens of choices.

A great aircraft design by itself doesn't make a successful kit company. You have to be able to produce kits, support the builder, manage inventory, etc. I've often referred to Van's Aircraft as a 40-year overnight success. For many years, Dick "Van" VanGrunsven was designing aircraft, building kits, and keeping his costs in line to provide a tremendous value for the dollar. If you've ever met Van, you'll realize pretty quickly that he is an "all steak and no sizzle" kind of guy. It is safe to say the tremendous success that Van's Aircraft has experienced didn't come about through slick marketing. I would imagine he spent very little on marketing his aircraft as a percentage of his overall operations cost. Instead he let the satisfied customer with the "RV grin" do his selling. Now, 40 years later, "Van's Air Force" is his best salesman.

The RVs do everything really well and have no bad habits, but they aren't the best at anything. They're not the fastest airplanes; they don't have the best STOL performance; and they aren't the best aerobatic mounts. However, RVs are really good at all of these things, and it is the excellent combination of these traits that makes them so popular.

Van's has four kit designs with more than 1,000 units flying—the RV-4, RV-6/6A, RV-7/7A, and RV-8/8A—and another model, the RV-9/9A, has about 964 aircraft flying. There are more than 2,500 RV-6/6As flying, making it the single most successful homebuilt design in history. Next year, 2016, will mark the 30th anniversary of the RV-6 design. EAA is already planning to have a big celebration at EAA AirVenture Oshkosh 2016 to mark that anniversary.

I'm proud to say that EAA has recognized Dick VanGrunsven's accomplishments over the years. In 1980, Van was awarded EAA's August Raspet Memorial Award for his outstanding contribution to the advancement of light aircraft design. In 1999, we inducted Dick VanGrunsven into the EAA Homebuilders Hall of Fame. The EAA AirVenture Museum houses a number of Van's prototype aircraft, and Dick currently serves on the EAA board of directors.

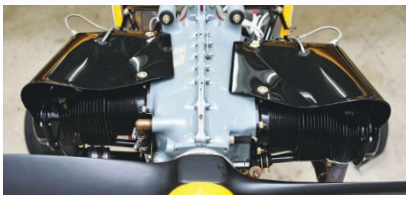
On behalf of EAA, I'd like to thank Dick VanGrunsven, Van's Aircraft employees, and the many RV builders and pilots for their part in advancing the homebuilt movement. Van's Aircraft is an amazing success story! EAA

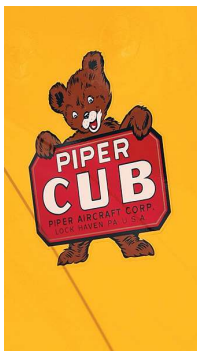
Photography courtesy of EAA Archives

BACK BY POPULAR DEMAND for the

2015 EAA® SWEEPSTAKES

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





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Allied Icons at AirVenture

AN ICONIC ALLIED aircraft that helped secure liberty in World War II returns to Oshkosh as the Canadian Warplane Heritage Museum brings its Avro Lancaster bomber to EAA AirVenture Oshkosh 2015. The aircraft first visited Oshkosh in 2006 and returned in 2009 to help celebrate that year's Canadian centennial of flight. This year the rare RCAF heavy bomber (C-GVRA), along with the museum's B-25 Mitchell bomber *Hot Gen*, will participate in 70th anniversary commemorations of the Allied victory in Europe.

Canadian Warplane Heritage Museum's Avro Lancaster bomber makes its third appearance in Oshkosh this year.

C-GVRA is one of only two remaining airworthy examples in the world today. The other is based in the United Kingdom, owned and operated by the Battle of Britain Memorial Flight.

The museum's B-25J Mitchell (C-GCWM) was one of the last Mitchells off the line in 1945 and was operated as a civilian transport for more than 25 years. The airplane was acquired by the museum in 1975 and underwent extensive restoration.

The aircraft displays the markings of a B-25J of RAF No. 98 Squadron, which fought over northwest Europe from 1944 to 1945, and is dedicated to the Canadians who flew with the 98th. It's been to Oshkosh a number of times, the first after initial refurbishment in the 1970s and most recently accompanying the Lanc in 2009.

EAA's B-17 Part of Huge D.C. Flyover in May

EAA'S B-17 BOMBER *Aluminum Overcast* will participate in the huge "Arsenal of Democracy" flyover in Washington, D.C., on May 8 to commemorate the 70th anniversary of Victory in Europe (V-E) Day marking the end of World War II in the European Theater.

Many members of the EAA Warbirds of America will also be participating in the flyover, which will feature 15 historically sequenced warbird formations representing major battles—from the attack on Pearl Harbor to the end of the war. This flyover is also part of the year-long "Spirit of '45" festivities throughout the country to mark 70 years since the end of the war.

The Spirit of '45 activities will peak on August 15, when all warbird owners are encouraged to fly in honor of the end of all WWII hostilities. EAA and Warbirds of America will continue to provide information on ways to be involved in the coming months and especially during EAA AirVenture Oshkosh 2015.

'Give Flight' at AirVenture This Summer

JUST AS A GROUP of volunteers helped build the One Week Wonder Zenith CH 750 Cruzer airplane during EAA AirVenture Oshkosh 2014, EAA is embarking on another project at Oshkosh this year to highlight aircraft homebuilding and raise awareness of our worldwide chapter network.

The initial goal of "Give Flight" will be to construct five sets of wings for various types of kit-built aircraft during the week. Then those wing sets will be given to five different EAA chapters to jump-start building projects that we hope will lead to the formation of flying clubs.

The volunteer-based project will occur at the main crossroads of the EAA AirVenture grounds on Celebration Way. Volunteers will construct the wings on each of the seven days of the convention, and like last year, anyone who walks by can participate by pulling a rivet.

The chapters will receive the completed wings for free, but they will then be responsible for raising the funds necessary to complete the aircraft. EAA is in the process of determining which kit manufacturers want to participate in the project, said Charlie Becker, EAA homebuilt community manager.

If your chapter is interested in taking on a "Give Flight" building project, e-mail Charlie at cbecker@EAA.org.

Photography by Jason Toney

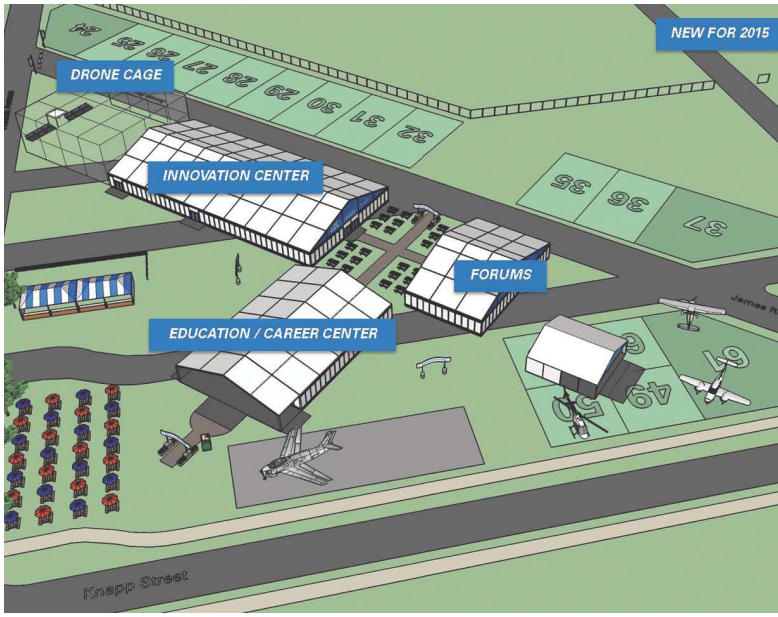
Innovation, Education, and UAVs at AirVenture

CUTTING-EDGE INNOVATIONS, including EAA AirVenture Oshkosh's first drone cage, will be featured at EAA's new Aviation Gateway Park during the Oshkosh convention July 20-26. This new area will be located near the corner of Waukau and Knapp streets—where the successful College Park innovation/education area launched in 2014.

The drone cage will feature daily unmanned aerial vehicle (UAV) demos, educational presentations, and obstacle course contests viewed from all sides of the cage, including from bleachers inside the Park's Innovation Center.

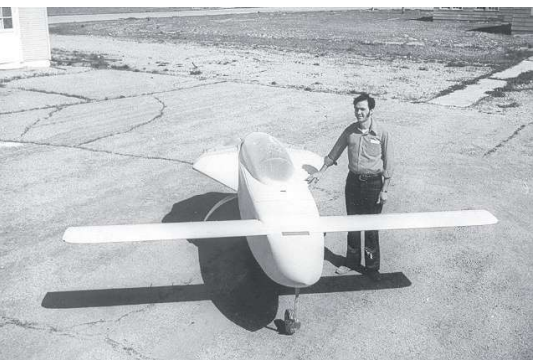
Other features of Aviation Gateway Park include the Innovation Center and the Forums Center presented by the National Air Traffic Controllers Association and the Education & Career Center presented by Embry-Riddle Aeronautical University.

A plaza area between the three main structures will be a popular gathering place and home for some of the returning activities from last year's College Park complex, including a social for college aviation students and an aviation job fair hosted by aviation-related companies seeking employees.



Burt Rutan Returning to Oshkosh in 2015

BURT RUTAN, the visionary aircraft designer whose innovations made history and changed the aviation world, will be back at EAA AirVenture Oshkosh in 2015 to commemorate the 40th anniversary of his iconic VariEze aircraft. Rutan's designs have been groundbreaking for more than 40 years, beginning with the VariViggen in the early 1970s through the concepts that became the SpaceShipOne and SpaceShipTwo vehicles that are launching the era of space tourism.



His use of canard wings and composite materials changed the look and efficiency of homebuilt aircraft, with more than 1,000 airplanes based on his designs now flying in the United States alone.

The VariEze first flew in May 1975, with the prototype causing a sensation at that year's EAA Oshkosh fly-in. That canard design evolved into other Rutan aircraft innovations, such as the Long-EZ, that are still being built today. Rutan's multitude of interests has also led him into successfully exploring space flight and into electric flight.

In honor of the VariEze anniversary, EAA is inviting all Rutan and canard aircraft owners to come to Oshkosh and participate in the festivities. More details on specific dates and events will be released as they are finalized.

See World's Only Flying Privateer at Oshkosh

SEE THE WORLD'S ONLY flying Consolidated Vultee PB4Y-2 Privateer at EAA AirVenture Oshkosh 2015! Based at Casa Grande Municipal Airport, Arizona, the airplane (N2871G) was being prepared to fly to Oshkosh last year, but those plans were nixed by engine issues. With those now solved, all systems appear to be *go* for Oshkosh.

This unique aircraft is owned by 4Y-2 LLC and sponsored by SAC Holdings, an affiliate of U-Haul Corp. It was restored to its original Navy configuration after serving for years as a fire bomber. Restoration to original Navy configuration was performed by Goss-Hawk Unlimited of Casa Grande, led by its president, Dave Goss.

The Privateer is the Navy version of the Consolidated B-24 that served as a patrol bomber in World War II and the Korean War. Modifications to the B-24 included a longer nose, as well as an additional top turret and new waist-powered turrets. Perhaps the most obvious difference is its single vertical tail in place of the B-24's twin tails. N2871G came off the line in 1945. EAA

Sonex Aircraft Delivers First SubSonex Kit

SONEX AIRCRAFT ANNOUNCED the first shipments of SubSonex JSX-2 jet kits from its Oshkosh factory in February. An ultra-quick-build kit for a customer in Durango, Colorado, was the first in a series of seven kit deliveries included in the first kit production run.

Other orders were destined for Ontario, Canada, Pennsylvania, Missouri, Kentucky, and Oklahoma, as well as New South Wales, Australia (via ocean container). Orders are now being accepted for the second run of SubSonex Quick Build Kit production, to commence in August 2015.

In early February, Sonex Aircraft President John Monnett and Sonex CEO Jeremy Monnett traveled to Moriarty, New Mexico, to join designated pilot examiner (DPE) Bob O'Haver and BonusJet flight instructor Billy Hill in making their first flights in the SubSonex JSX-2 and subsequent qualifying flights for SubSonex permanent letters of authorization (LOAs). Moriarty Airport is the home of SubSonex chief test pilot and air show performer Bob Carlton, and it's also the base of Carlton's BonusJet training program through his company, Desert Aerospace. SubSonex customers may obtain dual instruction in the jet-powered TST-14 Bonus sailplane, dubbed the BonusJet, which uses the same PBS TJ-100 turbojet systems used in the SubSonex to contribute toward their SubSonex LOAs. DPE O'Haver is available to the BonusJet program for issuance of SubSonex temporary and permanent LOAs to qualifying pilots.

For more information, visit www.SonexAircraft.com.

Dynon and ForeFlight Hook Up Via Wi-Fi

DYNON AVIONICS HAS created a compact Wi-Fi adapter that links its popular SkyView glass avionics systems to the ForeFlight flight planning app running on an iPad. The Wi-Fi link is bidirectional so ForeFlight planning data on your iPad can flow into the SkyView while the Dynon system exports GPS, attitude, and other data into ForeFlight.

The tiny Dynon Wi-Fi adapter plugs into the USB port on the avionics display with no need for other wiring changes. The adapter is priced at $35 and you will need one adapter for each SkyView display installed in your airplane. You will need to be subscribed to the more advanced Mobile Pro version of ForeFlight, and the SkyView displays must be operating on version 12.0 software.

For more information and to see the SkyView and ForeFlight link in action, visit www.DynonAvionics.com.

Continental Motors' IO-360-AF Alternative Fuel Engine Receives FAA Type Certification

Continental Motors Group received type certification from the FAA in January 2015 for its IO-360-AF (alternative fuel) engine model. The six-cylinder IO-360-AF is certified for standard 100LL as well as unleaded 91UL avgas now available in several countries. Flight Design GmbH is expected to take delivery of the first certified engine soon.

The IO-360-AF is the first engine in its class to be certified for alternative fuels benefiting certain markets where 100LL avgas is relatively expensive and with the expanding availability of 91UL. Beyond the alternative fuel advantage, the IO-360 series has a reputation for reliability, long life, and smooth operation. It is the lightest of all Continental's six-cylinder aircraft powerplants.

The IO-360-AF engine family offers a maximum power output of 195 hp at 2800 rpm and a 2,200-hour time between overhaul, and it's backed by Continental's warranty and service support. Flight Design will use the IO-360-AF engine derated to 180 hp as required for its C4, producing power at a reduced 2550 rpm and resulting in quieter operation.

Help for Homebuilders Wiring Experimental Aircraft

THE AIRCRAFT WIRING GUIDE is a new book available for the aircraft homebuilder that explains the ins and outs of wiring a modern experimental aircraft. If you're building, maintaining, upgrading, or repairing an experimental category aircraft, this book can help you uncover the mysteries of aircraft wiring.

After talking to thousands of fellow homebuilders and giving many presentations at fly-ins around the country, author Marc Ausman realized there was a need for information about designing and building the newer, more complex electrical systems found in modern aircraft. *The Aircraft Wiring Guide* takes that experience and condenses it into 85 pages of information and guidance. Filled with images, pictures, text, and drawings, this book has a wealth of practical information.

"The wiring system in small aircraft used to be fairly simple because many of the systems were mechanical or simply did not exist when compared with modern avionics," Ausman said. "Today there are electronic stall and angle-of-attack warning systems, GPS receivers, glass cockpit displays, autopilots, backup batteries and buses, electric trim and flap motors, ADS-B receivers, multiple power plugs, powered headsets, and a host of other modern electronics. Therefore, the electrical system is a much more important part of the aircraft than it used to be.

"This book is for experimental aircraft builders who want to know how to plan and wire their aircraft. First-time builders will learn how to start thinking about and planning for the electrical system. Advanced builders can keep abreast of the latest technologies and products."

The book is available worldwide as an 8.5-by-11 spiral-bound notebook for $30 from www.AircraftWiringGuide.com.

Wicks Aircraft Supply to Warehouse Parts for ULPower Engines

WICKS AIRCRAFT SUPPLY of Highland, Illinois, will be the exclusive North American distributor of spare, warranty, and replacement parts for the full line of ULPower (www.ULPower.com) experimental aircraft engines.

Kit-builder Dave Ferrell, whose Zenith CH 650 is powered by a 130-hp UL350iS, said, "It's especially reassuring and convenient to know that Wicks will be there for me with parts when I'll need them."

ULPower produces eight models of traditional-layout (horizontally opposed, direct-drive, air-cooled) engines in four- and six-cylinder configurations from 97 to 200 hp for a wide variety of experimental aircraft. With features such as multiport fuel injection and full authority digital engine control, and better power-to-weight, footprint, and price than comparable engines, these modern powerplants are now installed in some 1,000 airplanes around the world, including an increasing number of original equipment manufacturer applications.

More information is available at www.ULPower.com or www.WicksAircraft.com.

Briefly Noted...

Three Zenith pilots flying CH 701 aircraft took the top three spots in the third annual Healthy Bastards Bush Pilot Championship held at Omaka Airfield in Blenheim, New Zealand.

Chris Anderson, Jock Struthers, and Deane Philip took first, second, and third place in the third annual STOL and Precision Landing competition on January 31, 2015.

NavWorx Inc. announced its ADS600-EXP Universal Access Transceiver, an affordable ADS-B technology solution for experimental/light-sport aircraft owners. The NavWorx ADS600-EXP is now available for installation in experimental and light-sport aircraft and performs to the requirements of the FAA's ADS-B rule. Learn more at www.NavWorx.com. EAA

A Big Bore RANS Super S-7S

Powerful fun!

BY DAN GRUNLOH

Hal on the ultralight runway at AirVenture 2014 waiting for the next flying session to begin.

Photography by Dan Grunloh

BIG BORE ROTAX IS the nickname for Rotax 912 series engines that have been modified to produce more horsepower with larger cylinders and pistons using an aftermarket kit called the Zipper 1484. Hal Stockman of Elko, Nevada, the person behind the upgrade kit, brought his RANS S-7S Courier that he calls the Super-7S to EAA AirVenture Oshkosh 2014, where it was displayed and flown from the ultralight/lightplane runway. The S-7S was built especially for short takeoff and landing (STOL) performance. The engine had 200 hours on the new cylinders and pistons when Hal arrived in Oshkosh after the 1,400-mile flight from Nevada, and he had logged 320 hours by the end of 2014.

This was not Hal's first trip to Oshkosh or his first RANS S-7. He attended AirVenture ten years ago with a RANS S-7 (a short-tail version) but stayed in the homebuilt camping area. Before the RANS, he flew a Kolb FireStar. His new RANS S-7S was completed in 2010, but it was not initially Rotax powered. Hal is a diesel mechanic, and it made sense that he should have a diesel airplane; so he planned for a Gemini diesel. However, when the new Courier neared completion, Gemini engine deliveries were delayed, so he installed a Subaru engine instead. Soon after that he began working on a big bore conversion for Rotax 912 engines with Wayne Flemington of Southland Rotax in Winchester, California.

The prototype Vetterman dual exhaust system is visible with engine cowling removed.

Hal is a machinist and an engine builder who, in his day job, runs a field service truck for Joy Global, a company that builds and services mining equipment. His truck is a rolling repair and machine shop that can handle tasks most of us can't even imagine. He is not the first to offer oversize cylinders for the Rotax 912. At first he tried boring out the stock Rotax 79.8-millimeter cast aluminum cylinders and installing steel sleeves, a tried-and-true method already in use. It worked, but piston-to-cylinder tolerances had to be set higher to allow for different rates of thermal expansion between the steel sleeves and the aluminum piston. The result was more power but also more oil burning and poor heat transfer.

It was then he decided to borrow from the well-established Porsche off-road racing technology. He designed 88-millimeter aluminum billet cylinders for oversizing the Rotax 912. They are cut out of a solid round of aluminum with a lathe, and most of the aluminum ends up on the floor. The cylinders are then Nikasil plated and fitted with forged aluminum JE pistons especially manufactured for the Zipper kit. The low-expansion pistons could be run much tighter in the billet cylinders, and they cool better with no oil burning.

Hal on takeoff at AirVenture 2014 with a young passenger getting a free ride.

Photography by Dan Grunloh

This cockpit view reveals a lightweight lithium battery on the firewall and HACman mixture control (red knob) on a simple panel.

THE ENGINE HAS CRUISED MANY HOURS AT 6000 RPM

The new cylinders are lighter and stronger than the original cast aluminum Rotax versions. If you drop a cast cylinder on the floor, it can break off a fin and be damaged, but the billet cylinder can be struck with a hammer and will only bend a fin. There is 35 percent more cooling capacity with 14 fins per cylinder instead of the original nine. Hal picked a low-tension, nitride-coated ring that allows for higher rpm but requires compression for sealing at low rpm. As a result, it uses a little bit of oil, but so far Hal's customers haven't complained. It's a trade-off for more power and more durability. The aftermarket cylinders, pistons, and rings cost less than stock Rotax parts, and they reduce total engine weight by 3 pounds. The lower reciprocating weight allows for a faster throttle response to further boost the STOL performance.

Details and testing of the kit were completed, including dyno testing of the engines to confirm the calculated power output. However, Hal was still flying a Subaru on his personal airplane. He said it was awkward to be promoting a kit he himself was not flying. In 2013 he purchased a used Rotax 912 in running condition off another airplane for $5,000, installed the upgrade kit now called the Zipper 1484, and swapped it with the Subaru. The kit comes in two versions. The low-compression pistons will allow any 80-hp Rotax 912 or 100-hp 912S to produce 104 hp with regular 87 octane auto fuel. A high-compression version boosts the output to 114 hp but requires 91 octane fuel or avgas.

Hold on to your hat. Normal cruise rpm for the modified engine is 5700 to 5800. Rotax limits rpm over 5 minutes to 5500 and specifies a redline speed of 5800. Hal said he runs the engines at higher rpm because they can, and that's where you get the extra power. His engine can cruise at 6000 rpm and has cruised many hours at 6000 rpm. Heat is rarely an issue with those 14 cooling fins. When in a hurry to catch up with someone, he has run it at 6100 or 6200 rpm. Normal cruise for his RANS Super-7S is about 105 to 110 mph, where it burns 5 to 5.5 gallons per hour. Maximum climb is 1,000 fpm at 40 mph. With reduced pitch on the Whirlwind prop, it will climb much faster.

When bystanders ask why they should consider the Zipper kit, Hal's answer always comes to the same point. This kit is for folks who need more power than the standard Rotax 912 series for whatever reason (including floats) and also for those who need or want to run on regular auto fuel. Hal flies out at 5,300 MSL from a 700-foot sagebrush runway on the side of a hill with obstacles in Nevada's northern high country, so he needs to get in and out in hot weather at high-density altitude.

AIRFRAME CHANGES

Hal gives the bulk of the credit for the amazing takeoff performance seen at AirVenture to the power of the engine,

A right-side door provides wide, easy entry to the cockpit.

but a close look at the airframe reveals numerous small changes that could make a big difference. The wingtips plates and large tires give it the look of a purpose-built STOL aircraft. The wingtip plates were actually installed purely for hangar clearance. Hal said he believes they may help with low-speed handling. The tires are sand-racing tires that cost $65 each and work just fine compared to $1,500 bush tires.

The RANS Courier normally has a door on both sides of the airplane. Hal realized he never opened the left side on his first RANS, so he eliminated it and saved some weight. Instead the window has been oversized by lowering the bottom edge, and he put gas lift struts on both sides. You don't have to latch the windows, and they don't fall closed when exiting or entering the airplane. He can fly with the window open, which is great for photography.

Ailerons and flaps were covered with metal, and the trailing edges were extended and refined to a thinner edge by extending sheet metal beyond the tube frame. It increases the chord of the ailerons and flaps about 1.5 inches and should make them more effective. The rudder trailing edge was also modified. Hal believes the trailing edge modifications increased his speed a little. An extra-heavy, double-fork, 8-inch tail wheel replaced the stock 6-inch wheel to handle Hal's rough airstrip. An access door on the left side provides for a much needed baggage compartment behind the rear seat. It can hold two 5-gallon fuel cans and accommodate up to 35 pounds. A lithium battery weighing 2.5 pounds replaced a 13-pound lead-acid battery.

The different sound of the Super-7S comes in part because it was equipped with a new prototype dual exhaust system by Vetterman Exhaust, which has been producing exhaust systems for the Van's RV series since 1990. It is designed to allow the engine to produce more power. The prototype exhaust is expected to evolve into a standard model for the S-7S. For a sample of the in-cockpit sound of the Vetterman exhaust in the RANS, watch the YouTube video "EAA AirVenture 2014: RANS S-7S Flight" posted by a volunteer, one of many youngsters who got a free ride from Hal while at AirVenture. It provides a nice view of the flight around the ultralight pattern.

Hal uses a HACman mixture control on his Big Bore Rotax. The Rotax Bing carburetors are autocompensating up to 6,000 feet, but above that they become too rich. The controller works by reducing the ambient pressure in the carburetor float bowls. He described tests in hot weather over Washington state at 12,000 feet in his RANS Super-7S. His fuel burn without leaning was between 5 to 5.5 gph at 1,100 degrees on the exhaust gas temperature (EGT) gauge. After leaning with the HACman to 1,400 EGT, the fuel flow indicated 3.5 gph. He clearly recommends the device, and it would seem obvious you must have a working EGT gauge to

Photography by Dan Grunloh

employ it. The HACman mixture control comes from www.GreenSkyAdventures.com.

THE ORATEX CONNECTION

Hal's airplane was displayed at AirVenture at a prime spot in front of the commercial booth for Oratex fabric. Company spokesman Lars Gleitsmann noted there were at least four others at the show covered with Oratex, including the Valdez STOL champion *Lil Cub* by Frank Knapp. This new-technology, prefinished fabric is already flying on 200 airplanes worldwide. Installation is very fast. Glue it on, shrink it, and go fly. It does not have to be painted but can be if desired. Color choices are limited. The heat-activated adhesive is nontoxic. The fabric is tough, strong, and certified for aircraft in Europe. The cost is similar to painted Dacron. But the covering time required is much less, and the weight savings can be 15 to 20 pounds on the entire airplane.

Hal decided to replace his stock 9-gallon wing tanks with new RANS 13-gallon poly fuel tanks, so the wings needed recovering. Hal doesn't mind covering, but he doesn't care to paint, so he decided to give Oratex a try. He said there was a little bit of a learning curve; but he caught on quickly and covering went very well. Because the fabric is lighter, the fuel tank upgrade didn't increase the airframe weight. Learn more about Oratex fabric covering and watch an interview with Hal Stockman at AirVenture 2014 on the website www.BetterAircraftFabric.com.

KITS AVAILABLE AND MORE CONVERSIONS COMING

The 88-millimeter Big Bore Zipper 1484 kits are available in 104-hp and 114-hp versions and will work on all Rotax 912 UL and 912 ULS engines. The cost is under $4,500. Hal personally matches up the components and packages and ships the kits, which include cylinders, pistons, rings, and wrist pins. He will install it on your airplane if you fly to his location. It's a simple bolt-on conversion that requires no engine modifications. Around 25 kits have been installed

Cylinders (left to right): 92-millimeter Big Big Bore with matching piston, 88-millimeter Zipper 1484, stock Rotax cylinder and piston.

Lightweight door to a cargo compartment that can hold two 5-gallon fuel cans.

The RANS Courier normally has a door on both sides of the airplane. Hal realized he never opened the left side on his first RANS, so he eliminated it and saved some weight.

without any reported problems. Hal and Wayne both believe the piston and cylinder durability will be as good as or better than stock Rotax. The technology is more advanced and has been proven by a decade of Porsche off-road racing where these types of pistons and cylinders are subjected to much higher power levels. Hal says they are loafing in the Rotax 912.

Naturally Bombardier-Rotax does not approve of modifications to its aircraft engines. However, in experimental aircraft, once you buy the kit, it's your experiment. It's true for airplane kits such as the RANS and for engine kits such as the Zipper. The parts are top-notch quality and Hal stands behind his work if he installs the kit. After that, it's your experiment because he can't know how you will operate the engine.

Two additional projects are currently being tested. The first is a Big Big Bore (BBB) conversion for 912 engines that puts 92-millimeter forged pistons in billet cylinders with a measured output of 118 hp. The Zipper 1662 pushes the very limits of the Rotax 912 case, which must be opened and machined to accept the oversize cylinders. One such engine has more than 100 hours of flight time. Hal has calculated that 125 hp might be possible. A second, perhaps more practical engine design is the Zipper Turbo 1417, an 86-millimeter, low-compression version for the Rotax 914 that is currently being tested by Wayne Flemington. The slightly smaller diameter provides for a strong cylinder wall needed for the higher forces involved. It could theoretically produce 135 hp.

Information about the latest developments can be found, along with pictures and customer reports, on Internet aviation bulletin boards such as www.TeamKitfox.com or www.RANSclan.com/forums. The largest trove of comments comes from a thread of 128 posts on www.BackcountryPilot.org. To order a kit, call Hal Stockman at 775-934-5714. Wayne Flemington of Southland Rotax in California can be reached at 951-255-9144. Jay Stewart in Nevada can be contacted at 775-388-2046 and will be setting up a website for ordering kits. EAA

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

This oversize left window can be opened in flight for photography, thanks to the gas lift struts.

Photography by Dan Grunloh


750XF
SPENCER
COLEMAN

The Additional Pilot Program

The FAA blesses having a second pilot involved in E-AB flight testing

BY BUDD DAVISSON

THE FAA'S ADDITIONAL PILOT Program, a new policy that formally allows a second pilot on board while flight-testing homebuilt aircraft, is now a reality. This is big news! One of the fastest moving EAA/FAA programs ever to come to fruition, the Additional Pilot Program (APP) may also be one of the most important in terms of improving the safety of testing experimental amateur-built (E-AB) aircraft. At the same time it increases flexibility during the test period.

In less than 18 months the two bodies (with the help of lots of volunteers and input from the homebuilt community) developed AC 90-116, which outlines the ways that the initial test flights of a homebuilt can be accomplished with more than one pilot in the airplane.

Under the new provisions, the owner/builder can now be accompanied by a pilot who is more experienced and qualified to help with the test flights. The program also outlines ground tests for the powerplant and suggests test programs for both the aircraft and the pilot that are aimed at increasing the safety through building experience while doing the Phase 1 testing. Phase 1 includes all of the flight time prior to getting the restrictions flown off (typically 40 hours).

The new program is not a requirement. It is an option. The old test policies still remain in place allowing a builder/owner of the aircraft to do the testing himself (solo) or get someone he feels is more qualified to do it. The APP allows the builder/owner pilot to experience the thrill of the first flight while having a more experienced and qualified pilot at his side to ride herd on the proceedings, ready to head off any potential problems and to lend a helping hand if problems do occur.

THE BACKGROUND OF A GOOD IDEA

There are several reasons this program escaped the seemingly endless delays that are often a part of altering federal policies. EAA has long advocated some sort of provision that would allow more qualified pilots to assist in the testing. However, the real push to get that done came from the NTSB. When it reviewed E-AB accidents that occurred during 2011 (a representative year), the board came to the conclusion that having more experienced pilots in the airplanes could reduce the accidents, especially those ending in fatalities.

The statistics clearly show that the causes of accidents fall almost equally into three distinct categories: powerplant problems, pilot loss of control, and incidents that indicate a lack of experience, proficiency, or qualifications such as hard landings. With those statistics in hand, the NTSB tasked the FAA to work with EAA in developing a program that would lower accident rates. It opined that would probably involve a second pilot.

After the causes of accidents in 2011 were researched in the light of having another, more qualified person on board, the FAA, with EAA's input, came to its own conclusions:

- Powerplant problems were often caused by some sort of fuel system deficiency, so tests to help prevent those problems should be recommended in the APP. At the same time, many of the powerplant accidents on record were made worse by poor decisions or poor skills on the part of the sole pilot on board. It was determined that the handling of the aircraft during a powerplant emergency would be greatly improved by having a more experienced pilot at the controls.
- Loss of control accidents were almost always the result of a builder/pilot being over his head in the type of airplane being flown for the first time, usually because of a lack of currency and eroded skills. Of the loss of control accidents, 20 percent happened on the first flight, but 65 percent happened in the first eight hours. So, the APP not only includes allowing a second, more qualified pilot in the cockpit, but also spells out some maneuvers the builder pilot (BP) should do in the airplane to gain familiarity with it while the qualified pilot (QP) is at his side.
- "Other" category accidents included any number of factors, some beyond the pilot's control, but many of them could have been avoided had the pilot been more skilled and proficient. These included things like landing short, being overcome by a crosswind, and other varied causes.

The research made it obvious that during the test period the pilot was being tested just as much as the aircraft was, and the Additional Pilot Program was designed to deal with both factors.

ELIGIBILITY: THERE ARE PILOTS AND THEN THERE ARE PILOTS

The way the program is organized, there are actually three different "grades" of pilots, each of which must meet eligibility, currency, and experience requirements.

AC 90-116 goes into much more detail than a magazine article can deliver, so it is suggested that the PDF be downloaded at www.EAA.org/sportaviation to get all of the details.

The three pilot types that are designated in the APP are:

- Builder pilot (BP): To be eligible for the program the pilot must be the builder and/or at least part owner of the airplane in question. In the event there are multiple owners, the same series of requirements has to be met by each owner.
- Qualified pilot (QP) is the individual who meets the requirements to ride in the other seat from the first flight onward.
- Observer pilots (OP) are those who, after the BP demonstrates familiarity with the aircraft by meeting certain requirements, can ride along to perform tasks such as note taking, watching for traffic, etc. He has to have a purpose to be in the flights and isn't just going on a joyride. He is also not necessarily qualified to fly the airplane himself.

All pilots have to meet the same operational criteria that would be expected to fly any airplane: a certificate that matches the category of airplane, a current flight review (formerly known as BFR) and medical (if required by the category), and the prescribed FAA definition of currency.

The requirements for a QP are much more codified and require filling out the two worksheets/matrices shown in the AC. Although at first glance they appear complicated, if they are read several times it becomes clear what each matrix is meant to accomplish. One establishes "recency/currency" not unlike the way FARs do for currency for every pilot (three takeoffs and landings in 90 days, etc.), but the parameters are raised for QPs under the APP. For instance, rather than three takeoffs and landings in 90 days, anything less than 10 takeoffs and landings in the same period is a disqualifier as is anything less than 40 hours of flying in the last 12 months. It raises the bar for currency, which only makes sense.

The matrix, which is aimed at determining a pilot's ability to act as a "qualified" test pilot, is as stringent as you'd expect and is designed to meet EAA/FAA's goal of seeking out experienced, well-qualified pilots but is not so tough that there isn't a large number of pilots who can easily meet the requirements. Also, if the pilot seeking to be qualified is lacking in some area—for example, not enough landings in the prescribed period—he or she can quickly do what is required to match the requirement and simply fill the matrix out again and attach to the logbook.

All of the matrices and qualification gymnastics are dealt with between the QP and BP. The FAA isn't directly involved or looking over anyone's shoulders. It's an honor system, but the intent of going with the APP has to be clearly spelled out with the DAR/inspector who's overseeing this particular aircraft's testing and certification. The intentions to use the APP system must be written into the operating limitations before the first flight.

CLARIFYING THE QUALIFIED PILOT WORKSHEETS

Two points need clarification on the qualification matrix. First is the definition of "model family of aircraft." Basically each matrix asks for the pilot's experience in different specific areas (total time in same category and class, etc.). It awards the applicant "points" for different factors—a pilot who has 500 hours in the same category and class as the aircraft gets 20 points, one with 1,000 hours gets 35 points, etc. Points awarded for the different areas must add up to a minimum of 90. When it comes to the time flown in the same "model family" as the subject airplane, it is referring to how closely the airplane flown matches the subject airplane. The time doesn't have to be in the same make and model. However, it must be in an aircraft that approximates the flight characteristics and operation of the subject airplane.

It is up to the BP and the QP applicant to determine whether the airplanes the BP has experience in are similar enough to the aircraft to be tested and that the QP's skills in one would transfer to the other. A Stearman probably wouldn't be in the same "model family" as an RV-6, but any other RV definitely would be. Presumably, a Thorp T-18 would be, too. A Bonanza, probably not. The decision that determines the similarity is made by the BP and QP. No one else gets involved. However, if there is any doubt as to the similarity between types, the AC strongly encourages contacting the kit manufacturer or type clubs.

The other area that needs clarification is the area marked "Phase 1 Experience." This needs discussion because, if the applicant doesn't have any time flying a homebuilt during Phase 1 testing, he gets a 75-point penalty. If that's the case, you can have all sorts of flight time and be a graduate of the Naval Test Pilot School and still might not get 90 points. However, that's not a deal-breaker: Only one flight in Phase 1 in any airplane eliminates the 75-point penalty. So, if the applicant makes the initial flight in the subject airplane or flies some Phase 1 time in any other airplane, he's instantly qualified, and the BP can be on board for every flight after that.

Once the BP completes the required maneuvers and has flown the flight time outlined in the aircraft initial test requirements under the watchful eye of the QP, he's qualified in the airplane and can have an OP fly with him.

QUALIFYING AS AN OBSERVER PILOT

Since the OPs will be flying with BPs who have been qualified to be PIC on the airplane, the OP qualifications aren't as stringent. In fact, an OP only needs a recreational or sport pilot certificate (if it is an LSA) and, of course, the appropriate category and class ratings for the test aircraft; to be endorsed for the flight environment; and to have a current flight review and medical.

LOGBOOK DOCUMENTATION

The logbook entries required to document the APP are fairly simple and matched to the type of second pilot involved as well as tests performed.

The BP must log:

- The name of the QP on each flight where one is used. A typical log entry might read, "Wings-level stall tests. John Doe was my QP."
- Each of the aircraft tests called for in the initial test program must be logged.
- Each of the maneuvers required in the BP maneuver list (BPML) laid out in the APP has to be documented. The maneuvers are designed to verify the airplane performance in various situations as well as increase the BP's familiarity with the aircraft in those areas.

The QP must fill out the QP worksheet and recency matrix. The worksheet is filled out only before the initial flight and must be attached to the logbook. The recency matrix must be filled out before each flight, but there is no formal requirement to attach the recency paperwork to the logbook; however, it would be wise to keep it readily available for the FAA, should the need arise. The OP must fill out the OP worksheet before the initial flight and attach it to the logbook. This doesn't need to be done on any except the first flight as an OP.

ABOUT THE POWERPLANT AND FUEL SYSTEM

Because power failures appear to be a major cause of accidents in the first eight hours, the FAA has made tests of various

powerplant systems part of the APP and outlined them clearly in AC 90-116. These too must be documented in the logbook in some detail and signed off by the person doing them. The BP can do the sign off himself, but they should be treated in the same manner as documentation of the aircraft building process was handled (photos, notes, etc.).

Based on the recommendations of AC 90-89 and industry testing of the powerplant and fuel system, the following tests, if applicable, are required:

- Mixture and idle speed
- Magneto
- Cold cylinder
- Carburetor heat
- Fuel flow
- Unusable fuel
- Compression

WHAT ARE THE QUALIFYING TESTS FOR MAN AND MACHINE?

Inasmuch as both the pilot and the airplane are untested prior to any kind of a flight-test program, the FAA has developed a short list of items meant to prove the airplane and another list that proves the pilot. When these two lists are combined (aircraft initial tests and BPML), they compose the total initial test package.

Aircraft Initial Tests (AIT)

Those test items that are aimed at the airplane include:

- Eight hours of total time on test aircraft
- Taxi testing
- Gear and flaps check
- Verify pitot/static system
- Stalls (wings-level and turning in clean and landing configurations)

Builder Pilot Maneuvers List (BPML)

Those items aimed at the BP and that must be performed by him/her solely with the QP watching include:

- Eight hours' total flight time in test aircraft
- Steep turns
- Stalls (wings-level and turning in clean and landing configurations)
- Takeoff and landing (normal and crosswind)
- Slow flight
- Go-arounds
- Simulated emergency approach and landing

Each BP who owns part of the airplane must accomplish the same check items and have them signed off in his or her logbook by the QP.

FLIGHT DECK COORDINATION

The APP recognizes that the inclusion of a second pilot in the cockpit automatically requires a certain amount of preflight planning as to whom will be PIC during different portions of the flight. Additionally, the question of who will be flying the airplane in the event of a problem occurring and who will carry out certain tasks will be answered in the preflight briefing.

WHAT ABOUT THE AIRPLANES?

At this time, the APP does not apply to all homebuilt aircraft or all powerplants. Specifically, it applies only to aircraft constructed from FAA-approved kits. Plansbuilt aircraft do not qualify, even if the plans are for a popular kit airplane. Also, only those engines recommended by, or specifically approved by, the kit manufacturer are qualified for the program. It doesn't make any difference what that engine is (automotive, etc.), it will be allowed access to the program as long as the kit manufacturer has specifically given its blessing to it. However, factory approved or not, turbine engines will not be permitted in the program at this time.

The approach to the APP has purposely been conservative. However, it is expected by both sides that, if successful, the program will eventually be expanded to include plansbuilt aircraft of many types as well as other engine types.

THE FUTURE LIES IN OUR HANDS

Over the years, EAA has worked with the FAA to put policies into effect that will make life for the homebuilt community much easier and safer. In reality, it could be said that the APP is a test program to determine how successful an advocacy program such as this can be. It is a first step, and both the FAA and EAA are hoping it works well so they can expand it and move on to other equally beneficial parallel programs. It is up to us to show good faith and prove to the FAA that additional reforms are worthwhile. It's important not to abuse the additional rights they've given homebuilders by stepping over the line and viewing the APP as a relaxation of the older "no passengers" rules. Our future is bright and getting brighter, but only we can make it stay that way. EAA

Budd Davisson, EAA 22483, is an aeronautical engineer, has flown more than 300 different types, and has published four books and more than 4,000 articles. He is editor-in-chief of *Flight Journal* magazine and a flight instructor primarily in Pitts/tailwheel aircraft. Visit him on *www.AirBum.com*.

Photography courtesy Steve Bensinger

The Groppo Trail

E-AB or E-LSA; have it your way

BY GRANT SMITH

WHAT IS A GROPPO TRAIL? Nando Groppo SRL is an Italian company active in aviation since 1982. Nando is the designer of the plane, and his company is named after him—Nando Groppo. The Trail has been available in Europe for several years and was first shown in the United States at the 2013 U.S. Sport Aviation Expo in Sebring, Florida.

In April 2014 the company shipped its 100th Trail, and the aircraft was presented at the Sun 'n Fun International Fly-In & Expo by Steve Bensinger of Lone Palm Aero LLC, which imports and assembles the aircraft. Groppo has completed one model as a special light-sport aircraft (S-LSA), so he's able to offer both experimental light-sport aircraft (E-LSA) and experimental amateur-built (E-AB) kits. Groppo's U.S. dealers are not currently offering an S-LSA model.

The Trail isn't just any LSA. It is an ideal aircraft for advanced students and pilots who would like to experience a basic, fun-to-fly aircraft and/or obtain the skills and endorsements necessary for taildragger operations.

If you think of the Trail as a modernized, 80-percent-scale, folding-wing, all-metal, Rotax 912–powered version of an Aeronca Champ, you will have a pretty good understanding of the aircraft and its capabilities. You might also think of it as a little Cessna L-19, if you chose to add larger, 8-by-6 tires. Don't take that to mean the aircraft is not suitable for larger pilots and passengers. There is ample cabin space.

The typical Trail is on a conventional (tail wheel) landing gear, but like the Champ it is also available with a nose wheel for those who need or want one. Several flat-four engine options are also available in the 80- to 100-hp range, including Rotax, Jabiru, and VW-derived engines. The well-designed (quick and easy), trailing-edge-up folding wing allows several aircraft to be stored in a relatively narrow space, or it can share a single-car garage with lawn mowers and other yard equipment.

The all-metal Trail is sturdy and more suitable for rough-field operations than the typical composite LSA. The Grove-type main landing gear and elastically supported and steerable tail wheel, coupled with differential hydraulic, toe-actuated disc brakes, make ground handling, crosswind landings, and tail wheel training standard operations. The 4130 chromoly steel tube cockpit area and strutted light alloy wing box and D-spar form a strong, light, and maintenance-friendly structure. All flight controls and flaps are aluminum alloy covered and well balanced and operate freely. The electrically operated flaps are effective and allow a 35-mph stall speed with a 100- to 115-mph max cruise speed, depending on engine and propeller choice.

A 13-gallon fuel tank is located in each wing, and the tank vent location allows fuel to be carried while the wing is folded. Fifty pounds of baggage can be held in the large baggage compartment behind the rear seat. With an empty weight of 720 pounds and a gross weight of 1,300 pounds, the Trail's useful load is 580 pounds.

Returning to the Champ analogy, visibility from the rear seat is as good as or better than from the Champ. Although the Champ did not have the option of flaps, the Trail has very effective electric flaps, and the rear-seat view of the front seat instrument panel is adequate.

A Trail panel with traditional round gauges.

The Trail kit on display.

The Trail is suitable for sport pilot or initial private pilot training or for advanced students who value learning stick and rudder skills, want a tail wheel endorsement, or just want to fly for fun in a reliable airframe with the traditional training aircraft configuration.

Prices vary depending on the kit and engine selected, but start at $24,900 for the E-AB kit and $74,900 for the ELSA model. It is fair to say that the Trail is one of the more affordable E-LSA or E-AB kits on the market. Learn more at www.GroppoTrail.com. EAA

Photography courtesy Steve Bensinger

A 'Wright' Tip

More help from the bicycle world

BY CY GALLEY

MOST OF US KNOW that the Wright brothers had a bicycle shop to support their aviation experiments. How many of us use common motor oil or one of the packaged aerosol lubricants for the pivot points on our plane—ailerons, flaps, elevators, etc.—even though those lubricants run off the application point, attract dirt and dust, and make a mess of things? But we need some sort of lube to keep things turning freely and easily and to prevent binding and corrosion.

Enter a solution from the bike shop. Drive chains and cables on bikes work in a constant dirty environment as a bike rider forges through rain, dirt, and sand. Any lubrication has to penetrate down a cable and into the rollers of a chain. It won't remain liquid where it will be thrown off the chain nor hold dirt, water, and abrasives. It has to be dry after application and still repel moisture and prevent corrosion.

Bike shops have several synthetic lubrication products for chains; these products are thin during application but leave behind a high-strength lubricating film when they dry. This works great for chains and cables as the lubricants penetrate deep down into cable housings and into the interior of chain rollers. The product that I use is in a squeeze bottle with a nice spout for precise application. Just stay away from any products that are silicone-based as they can create painting problems later, just like silicone-based waxes.

Who knew that bike shops still support aviation? EAA

HINTS FOR HOMEBUILDERS VIDEOS

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

Replacing Control Cables
In this 400th EAA Hints for Homebuilders video, Earl Luce demonstrates a great way to attach an old cable that is being removed with a new replacement cable by fishing it through bulkheads and around pulleys.

How to Make a Hot-Wire Bow
EAA Technical Counselor Mike Busch shows how to assemble a homebuilt hot-wire bow to cut foam for composite layups.

Cutting Plywood
Achieving a clean cut line without splintering can be a challenge when using a jigsaw. Timm Bogenhagen from the EAA staff gives a couple tips that can minimize wood splintering on your cut line.

Air/Oil Separator
Dick Koehler discusses the design and use for an air/oil separator. Dick is a Technical Counselor for EAA Chapter 186, A&P aircraft mechanic with Inspection Authorization (IA), and SportAir Workshop instructor.

Stefano Gamberini temporarily mounted his forced-induction tuning kit on a Rotax 912 engine for demonstration purposes. Note the different oil tank manufactured to customer specification.

Flygas Power Tuning for Rotax 912 Engines

Forced-induction tuning for Rotax 912 four-stroke engines

BY MARINO BORIC

WE HAVE RECENTLY written several times about the possibilities to increase the power output of four-stroke Rotax engines. Most tuning kits increase the engine power by adding a turbocharger to the original "atmospheric" engine. There are other ways to boost engine performance that are currently used less in aviation applications but that are similarly effective. Mechanical supercharging or forced induction are the magic words when compressors are not driven by engine exhaust gases but rather by the engine mechanically.

Flygas Engineering is located just outside of Bologna, Italy. The young and dynamic company owner, Stefano Gamberini, is a well-known engine tuner in Italy; his specialty is performance tuning of aircraft engines. He tunes existing stock Rotax engines but also is building his own high-output powerplants. Stefano was very active in the car racing field where he worked closely with car engine developers and since 1992 has offered forced-induction tuning kits for cars, boats, and now lastly, for airplanes. In addition to supercharging the Rotax 912 ULS engine, Flygas is supercharging an ancient two-cylinder, air-cooled, flat Citroen engine and is adding a fuel-injection system to it. Flygas is offering a similar fuel-injection system for all four-stroke Rotax aviation engines. For those engines, Stefano also is offering tuned induction manifold solutions, a second alternator, and a Fly-Safe electronic injection system, which is operated parallel to the original carburetors. This system allows switching from original carburetors to the Fly-Safe injection system in flight only by pulling a single lever in the cockpit.

Flygas is currently fine-tuning its own liquid-cooled, flat-four engine with a patented two-stage mechanical supercharging system that is capable of delivering almost 300 hp even at high altitudes. This engine will be used in unmanned reconnaissance aircraft for military purposes. Although this engine has great similarities with the Subaru four-cylinder automotive engines from which it is derived somewhat, Flygas is manufacturing most of the parts. Actually the original Subaru engine is incredibly similar to a Lancia automotive engine. For Subaru EA81 automotive engines,

Photography by Marino Boric

Flygas offers self-designed high-performance cylinder heads that Stefano developed for the UAV engine described above. Two spark plugs per cylinder and improved airflow allow better cylinder filling so that the performance increases by 20 percent.

About 12 years ago, Stefano began with the production of mechanically driven centrifugal compressors for the four-stroke Rotax 912 engines. Over time, this has become the main activity of the small company. Stefano first tuned 80-hp Rotax 912 engines for about 10 years and only recently adapted that kit to the 100-hp engines.

Flygas tuning kits enhance the performance of Rotax 912 engines by 25 to 45 hp; the power boost depends on the boost (over)pressure. This overboost is limited to a maximum of 7.25 pounds per square inch (0.5 bar) above the environment atmospheric pressure so that the manifold air pressure (MAP) increases to 40 to 43 inches Hg. After installation of the mechanical supercharging, the 80-hp engines deliver 115 to 125 hp; the 100-hp engines increase to 132 to 145 hp.

A Flygas-tuned 912 ULS engine delivers the following performance on the dyno:

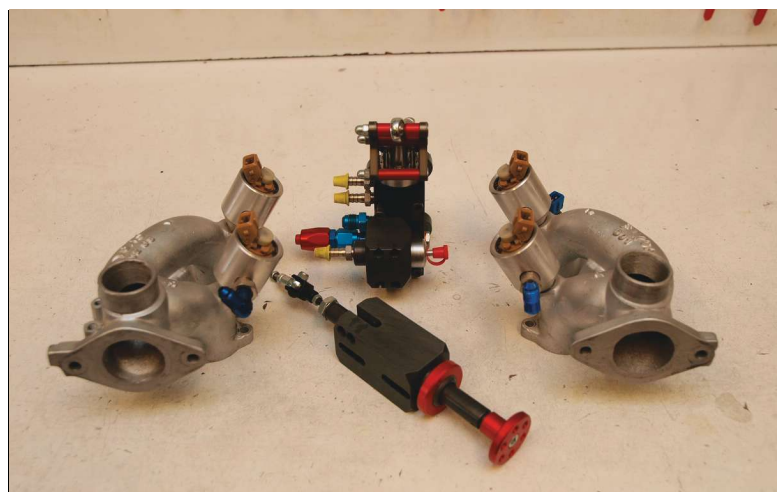
- 4800 rpm, 38 MAP, 110 hp
- 5000 rpm, 39 MAP, 115 hp
- 5500 rpm, 41 MAP, 129 hp
- 5800 rpm, 43 MAP, 141 hp

Stefano is especially proud of his construction because of the "advanced safety margins" of his tuning system. If the connecting belt that connects the supercharger to the engine fails, the stock 100-hp Rotax engine will deliver 81 hp. This power loss occurs mainly because of the engine's lower compression; lower compression means less developed power plus greater intake air resistance. The fresh air cannot be sucked directly through the carburetor as with the stock engines, but rather must take the longer path through the non-spinning centrifugal wheel and longer intake manifolds.

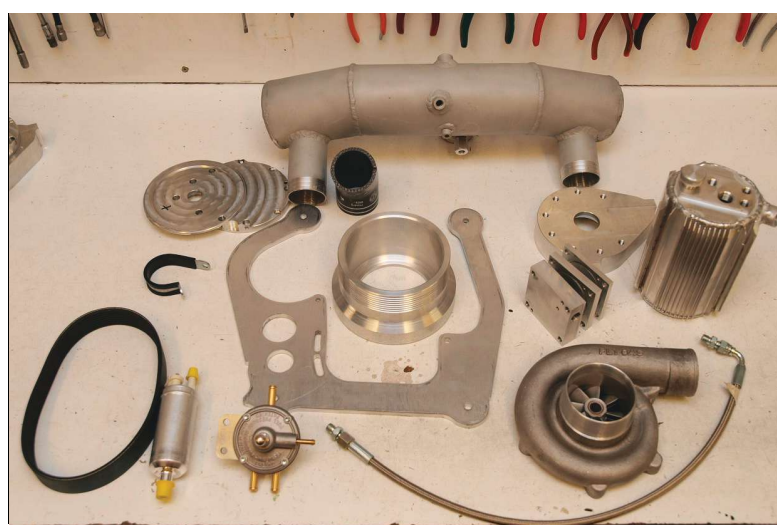
The Flygas mechanical supercharging unit basically consists of an axial compressor driven by a toothed belt. The mechanical energy of the engine is used to drive the compressor, not the energy of the exhaust gases as in a conventional turbocharger application. Imagine the normal turbocharger in which the "hot section," the turbo wheel, has been replaced by a pulley that spins the centrifugal compressor wheel—the "cold section" of a turbo assembly. According to Stefano, his system has some significant advantages over the turbocharger. First, the exhaust gas temperature is around 400°F lower (1,300°F instead of 1,650°F) because the engine breathes more freely (no turbo wheel in the stream of exhaust gases). The lubrication of the compressor is independent from the engine oil because a separate oil circuit with an additional oil pump is installed. No electrical or electronic control for proper system function is needed.

Like all power augmentation systems, the Flygas system also has some disadvantages. The mechanical drive of the compressor absorbs 3 hp because the energy required is taken from the flywheel of the engine. The engine weight goes up because the kit weighs 15.4 pounds. And the tuned engine loses the manufacturer warranty, if it still had one.

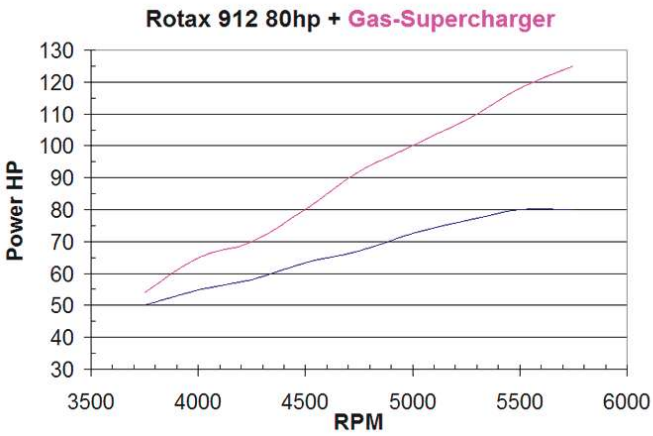
This is the heart of the Flygas tuning kit—the belt-driven centrifugal supercharger. It is the same turbocharger used in most automotive applications but without the "hot section."

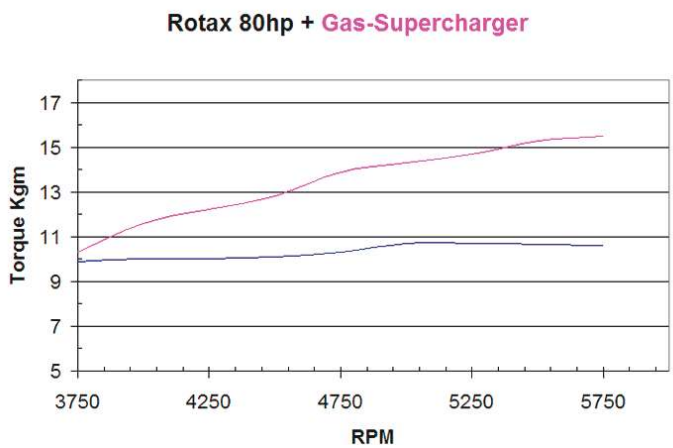


Flygas also is selling a fuel-injection system called Fly-Safe for the Rotax 912 engines; this setup still retains the original carburetors. The choice between fuel-injection and the original carburetors is made by pulling a red knob.



These are the parts you get with the purchase of the Flygas tuning system.





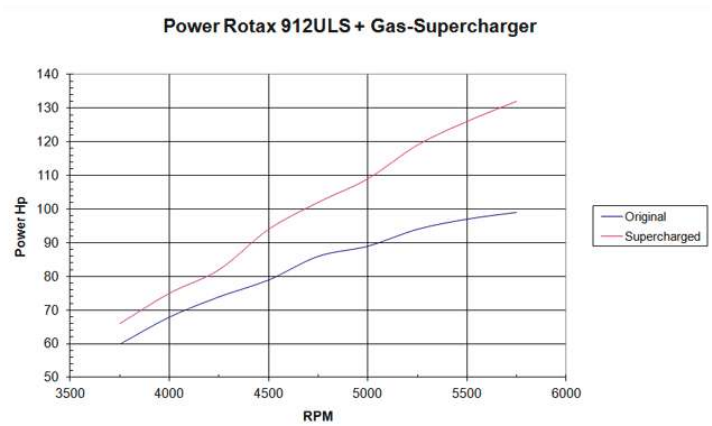
To drive the compressor, an aluminum pulley is flanged to the original Rotax alternator. A 1.2-inch (30 mm)-wide toothed Poly-V belt drives the compressor, which is located below the rear part of the engine. Because of this mechanical coupling, the compressor wheel always rotates at a fixed rotation ratio to the engine. The atmospheric air is sucked in, compressed, and then sent through the proprietary (aluminum) air-box, which serves the two original Bing carburetors. The Flygas air-box looks similar to the original Rotax one; only the warm-air intake is missing. The warm-air port is not necessary because the air warms up when passing through the fast rotating compressor wheel. The original carburetors get new fuel jets, and different spark plugs are used. For the lubrication of the compressor, Flygas developed an autonomous oil system that consists of an additional oil pump (bolted on top of the stock engine oil pump), aluminum 1-quart oil tank, filter, and low oil pressure switch. The centrifugal supercharger is held in position by two sturdy aluminum brackets. Two different bracket sets are available for the round or conventional engine mount. The Flygas kit also includes: an oil pressure regulator, electric fuel pump, and fuel pressure regulator. Along with the aforementioned parts, the customer also gets all the necessary tubes, clamps, and fixing materials.

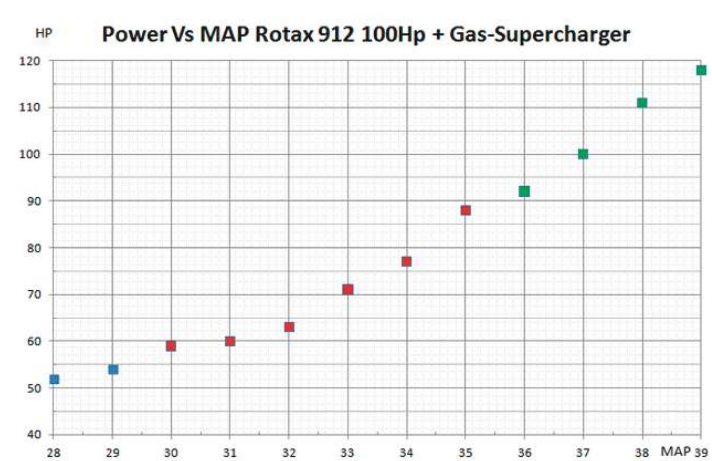
The tuning kit for stock 80-hp Rotax engines is somewhat simpler because these engines come with a lower compression ratio than the 100-hp engines. The compression ratio on 912 ULS engines is lowered by means of gaskets that are placed under the cylinder base; the compression ratio decreases from 10-to-1 to 9-to-1. The performance increase of the Flygas kit also depends on the diameter of the pulleys used on the alternator and on the supercharger. For aircraft constantly operating at high altitudes, a faster spinning supercharger can be used.

For those who require less power increase at sea level but want to keep the sea-level power output in climb or simply don't want to constantly overstress the engine, Stefano offers an optional proprietary mechanical blow-off valve that limits the intake (over)pressure and consequently the engine power to a desired preset level. In this case, the customer gets almost a "turbonormalized" engine.

The tuning kit costs 4,580 euros for the 80-hp Rotax engines and 4,950 euros for engines with 100 hp. (All prices are plus applicable tax and shipping; please consult current exchange rates.) Currently Flygas ships 2.5 sets per month. Nearly 60 of these tuning kits are already in use worldwide, mostly in mountainous regions of the United States, Colombia, Brazil, Canada, New Zealand, and most recently France.

For more information, visit www.Flygas.info. EAA





Illustrations courtesy of Flygas Engineering