EAA EXPERIMENTER
The Spirit of Homebuilt Aviation | www.eaa.org
Vol.2 No.8 | August 2013

# Just Aircraft SuperSTOL

## A Helio for the light-sport set

» **When the Kit** Doesn't Arrive

» **The ULPower** Six-Cylinder Engine

» **E-LSA**—Make It Your Way

» **More About** Sawtooth Climbs


# It's Time to Celebrate

By Jack Pelton

It's time for Oshkosh, the best week of the year. And, as always, we have many reasons to celebrate our love of all things that fly.

During the rest of the year it's easy for me, and I'm sure you, too, to become bogged down by the steady drumbeat of bad news and threats to personal aviation from all corners. And at EAA we are always on guard to protect our freedom to fly and to keep personal aviation accessible to as many people as possible. But at Oshkosh, during AirVenture, is the time to recognize just how successful we have been.

From the beginning EAA Founder Paul Poberezny recognized how important it is for us to get together, so the annual EAA fly-in and convention is as old as the association itself. Paul instinctively knew that people want to show off the results of their hard work and imagination.

Paul didn't need to invent a new concept to get the EAA fly-in started. It's as natural as a county fair where people gather at harvest time to see who produced the best steer, grew the largest pumpkin, or raised and trained the fastest horse.

It's the same at Oshkosh. I hesitate to call them amateur-built because the workmanship in most homebuilts that fly to Oshkosh is truly professional. I marvel at the craftsmanship and attention to detail most builders achieve. I know a thing or two about how difficult it is to build airplanes both big and small and am blown away by the achievements of members who fly their creations to Oshkosh.

It's the same for the antiques and classics in the Vintage area. Many airplanes on display are simply better than new because no factory assembly line could lavish the same level of attention aircraft restorers lovingly apply. And in the Warbirds area I'm constantly impressed that the number of flyable rare airplanes is actually growing instead of shrinking. People are so dedicated to preserving flying history that restoration projects once thought to be impossible are now almost routine.

Even the standard category airplanes nearly all look their best. No airplane owner wants to fly to Oshkosh without first washing and polishing his airplane and making it look as good as it possibly can. All pilots who fly to Oshkosh take immense pride in their airplane and their accomplishments as pilots no matter what they fly.

In 1975 Tom Poberezny was named chairman of the Oshkosh fly-in. Tom understood more than anyone that the prospects for growth in the event were enormous. He knew that people wanted to bring aircraft of every type to join the party. And after he convinced British Airways to bring a Concorde to Oshkosh in 1985, we all knew everything was possible.

Under Tom's leadership Oshkosh became the place to show the aviation world anything and everything that was new and noteworthy. The Voyager flew at Oshkosh before circling the globe, but then nearly all Apollo astronauts made the trip here, too. Fleets of warbirds fly in every summer, and so do gaggles of very light aircraft. And the aviation industry plans its new product introductions to make a splash here where the largest number of aviation enthusiasts can see the new stuff first.

Yes, there are many issues that personal aviation must contend with. And, yes, we need some luck with the weather and this year we truly lucked out!

Oshkosh is the envy of all other aviation events. Nothing matches its size and scope and ability to attract anything that flies. Oshkosh is aviation's greatest party, and I hope you enjoyed it to the fullest; I certainly did. If you weren't able to join us, you can relive the week online at www.AirVenture.org/live. EAA

*On the cover: Just Aircraft's SuperSTOL displays its talents (Photography courtesy of Just Aircraft)*

EAA EXPERIMENTER

Vol.2 No.8 / August 2013 | A publication of the Experimental Aircraft Association

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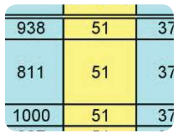

# Oshkosh…
# What a week!

By Charlie Becker

For me, EAA AirVenture Oshkosh is the best week of the year. Christmas in July! I hope you were here with us. If not, I urge you to come next year, July 28 to August 3, 2014. This past one was my 20th Oshkosh, and I will not miss the next.

Every year it recharges my aviation batteries. It inspires me to achieve more and dream bigger dreams. And if I've let my current build project gather dust, you can bet I get fired up about getting it restarted.

## Largest Gathering of Homebuilts

This year, at least 867 homebuilts flew in. That alone makes the week awesome. I got to see everything from an RV-1 to a Piel Beryl and everything in between. On top of that, you get to see all the kit companies and their aircraft. I love to see the ones only partially constructed such as the RANS S-20 Raven or the Javron Super Cub knockoff. This lets me see how they are solving construction challenges.

## Learning

One of the downsides of working for EAA during Oshkosh is I'm only able to make the forum presentations that I present. So this year I made sure to organize a forum for people building their own Super Cub–inspired aircraft (like me). If I'm a presenter, I have to be there, right? It also served as a meet-up of the online builders, so I had the chance to meet some of the people I only interact with online. The forums and workshops provide a wealth of knowledge on every aspect of building and flying.

## Faith

Oshkosh also restores my faith in humanity. You get to interact with and meet some absolutely brilliant, accomplished, and just all-around good people. The grounds are spotless because our members all subscribe to the high standards that Paul Poberezny set down when the organization was founded. And the entire event works because people volunteer. They give freely of their time to park aircraft, judge aircraft, teach workshops, present forums, and on and on.

## Family Reunion

And once you start coming regularly, you cannot help but form a new "Oshkosh family"—people you may only get a chance to see once a year but who enrich your life and with whom you become fast friends.

## 2014

During EAA AirVenture Oshkosh 2014, we will have a couple of special things to shine the light on the homebuilt movement. It will be the 50th anniversary of the Breezy design. No other design says EAA more than the Breezy. Also, Zenith aircraft will be building an aircraft in a week. Chris Heintz pulled this off in 1976 in eight days, back when Oshkosh was nine days long. (I think we only had a nine-day convention once.) I'm hopeful that this will get a lot of people interested in building.

Of course, I always run the risk of getting aviation fever and buying something crazy. I kept myself in check and limited my purchases to a nice, new pneumatic drill (4000 rpm, sweet!).

I encourage you to start planning your trip for 2014. You don't want to miss it!EAA


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## EAA's Certification Kit Is Great

Just got my RV-7 airworthiness certificate recently…in part due to EAA's certification kit that I bought several years ago. I followed it to the letter and did not get one thing sent back from the local FAA office. It was a breeze!

Thanks. I will highly recommend that kit to anyone getting ready for their FAA inspection.

**John Brunke**
EAA 482258

*Congratulations on getting your airworthiness certificate, John. Good luck with your flight testing. The EAA Amateur-Built Certification Kit can be ordered online here. – Ed.*

## Suggestions for Improvement

I've been reading *Experimenter* online since Pat Panzera produced it. It's a good production.

However, reading online requires a different effort compared to reading a paper copy. Here are a couple suggestions that I think would smooth out some issues:

1. Seems the text of articles is a gray color; contrast is not the best. I suggest making the text black.
1. The little "page-turner" icon pops up at the right or left side of the page, except when the page contains a full-page advertisement. Then, the hidden toolbar at the top of the page has to be found to turn the page. I have too often clicked on the ad, which takes me to places that I don't want to go. Can you put the page-turner icon on the edges of full-page ads, too?

Thanks for your consideration.

**Tom Hubbuch**
EAA 153061

*Thanks for your kind comments, Tom. We'll take a look at changing the text to black or a darker gray. As for the page-turner icon, we've fixed that problem for you, Tom. – Ed.*


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# AirVenture 2013 in the Record Books

On Sunday, August 4, EAA Chairman Jack Pelton wrapped a successful EAA AirVenture Oshkosh week, offering the following observations:

"First, it was a safe AirVenture, which is always our top priority, plus we were blessed with a week of nearly perfect weather. We also met a number of other objectives this year, including reconnecting with our volunteers and members on the grounds, upgrading the food concessions and options, and providing more value and activities throughout the day for attendees. We also had a tremendous amount of aviation innovation brought to Oshkosh."

Attendance: Very comparable to 2012 with more than 500,000 in total estimated attendance. Pelton said, "We overcame some big challenges this year, including a lack of current military aircraft participation, to produce an outstanding event. Attractions such as Jetman, the Terrafugia flying car, and the screening of Disney's *Planes*, which drew a record 15,000 people to the Fly-In Theater, were the most visible draws this year. But people come to Oshkosh for their own individual reasons, and there was a nearly unlimited supply of unique experiences throughout the grounds. We also received reports that many exhibitors had record sales, showing renewed optimism and enthusiasm in the aviation community."

Total aircraft: More than 10,000 aircraft arriving at Wittman Regional Airport in Oshkosh and other airports in east central Wisconsin.

Total showplanes: 2,341—including 867 homebuilt aircraft, 858 vintage airplanes, 343 warbirds, 130 ultralights, 92 seaplanes, 27 aerobatic aircraft, and 24 miscellaneous showplanes.

Commercial exhibitors: 821 (record total).

International visitors registered: 2,115 visitors registered from 64 nations, with Canada (562 visitors), Australia (257), and South Africa (187) the top three nations.

Media: 914 media representatives onsite from five continents.

Looking ahead to 2014, Pelton said, "There are some big aviation anniversaries next year, including the 100th anniversary of the start of World War I and the 75th anniversary of the jet engine. In addition, volunteers will build an airplane in seven days with the 'One-Week Wonder' project in which attendees can participate. And, of course, there will be plenty of additions for activities that can happen only at Oshkosh."

# Lowell Farrand Earns Tony Bingelis Award

Lowell Farrand, EAA 35370, of Ligonier, Indiana, was named the 2013 recipient of EAA's Tony Bingelis Award, recognizing his involvement in the homebuilt aviation community. He was honored on August 1 during the Homebuilders Dinner at EAA AirVenture Oshkosh.

Farrand was a part of the original EAA designee program in the 1960s, working alongside of EAA Founder Paul Poberezny and author Tony Bingelis. He specializes in homebuilt aircraft and is a safety advocate and innovator for aviation. In addition to helping others ensure safety in building and flying, he has achieved major accomplishments in the aviation community, including co-designing and piloting the first powered parachute in the United States and building and demonstrating some of the first gyroplanes in the country. And he has served as an FAA designated airworthiness representative since 2004.

Farrand is a founding chapter member and the Young Eagles coordinator of EAA Chapter 132 of Elkhart, Indiana, which since its inception has been known as "the builders unit." He previously received the "Man and Machine" prize from EAA in 1972 for his efforts at Oshkosh.

The Tony Bingelis Award was created in 2002 to recognize a member from the aviation community who has contributed to homebuilt projects and safety promotion while maintaining EAA values. The award honors the late Tony Bingelis, who was noted as a homebuilding authority and *EAA Sport Aviation columnist*.



Photography by Brady Lane

# Homebuilt, Ultralight, and Rotorcraft Aircraft Awards

The following aircraft and their owners earned awards at EAA AirVenture Oshkosh 2013.

*Best Aerobatic*
**Pitts Model 12**, N520CG, Christopher Getz, Center Valley, Pennsylvania

*Kit-Built Outstanding Workmanship*
**RV-7**, N362MB, Michael Brantseg, Sonoma, California
**Bearhawk**, N152GH, Georg Himmeroeder, Alamogordo, New Mexico
**Harmon Rocket II**, N77RM, Ryan Bendure, Brighton, Colorado
**Lancair 320**, C-GFAB, Patrick Hildebrand, Edmonton, Alberta, Canada
**RV-7**, N668MC, Michael Cooper, Manson, Iowa
**Bearhawk**, N962TD, Ted Callahan, Magnolia, Texas
**RV-12**, N330JA, Oren Heatwole, Dayton, Virginia

*Plans-Built Outstanding Workmanship*
**Long-EZ SP**, N400EZ, Dave Devere, Parker, Colorado
**Piel Beryl**, N42WX, Randall Weselmann, Bainbridge, Indiana
**Tailwind W-10C**, N499DC, David Conrad, Wausau, Wisconsin

*Kit-Built Champion – Bronze Lindy*
**American Legend Aircraft Co. AL3 Cub**, N755MG, Craig Gainza, Fairfield, California
**Lancair Legacy**, N88SX, Patrick Gonsoulin, Bend, Oregon
**Lancair Evolution**, N282CA, Neal Longwill, Austin, Texas
**RV-10, N104AL**, Al Dinardi, Jacksonville, Oregon
**RV-8**, N84JE, Jerry Esquenazi, Senoia, Georgia
**RV-8**, N188DW, Charles McCluggage, Sugar Land, Texas
**RV-8**, N214MK, Alex Margheritis, Santa Clarita, California
**Questair Venture**, N17FY, Gerald Mercer, Ventura, California
**RV-7A**, N567PK, Paul Kovalak, Comstock Park, Michigan
**SX300**, N42SX, John Wilson, Port Orange, Florida

*Plans-Built Champion – Bronze Lindy*
**Wittman Tailwind**, N169WH, Don Colchin, Willis, Texas
**Hatz CB-1**, NX1279, Mark Lightsey, Riverside, California
**Cozy Mark IV**, N333VM, John Dembs, Rocklin, California

*Reserve Grand Champion Kit-Built – Silver Lindy*
**Velocity TXL-5 RG**, N8XW, Richard John Cano, Galveston, Texas

*Reserve Grand Champion Plans-Built – Silver Lindy*
**Starduster SA-750**, N28KT, Thomas Shpakow, Littleton, Colorado

*Paul Poberezny Founder's Award for Best Classic Homebuilt*
**1963 Midget Mustang**, N955Z, Christopher Gardner, Dallas, Texas

*Grand Champion Kit-Built – Gold Lindy*
**Lancair Legacy**, N26XY, Jay Sabot, Cheshire, Connecticut

*Grand Champion Plans-Built – Gold Lindy*
**Hatz Classic**, N167Q, Jeffrey and John Hanson, Kasson, Minnesota

## Ultralight and Light-Sport Aircraft

*Honorable Mention Ultralight*
**Volmer Jenson VJ-24**, Tim Lohrey, Brookville, Indiana

*Honorable Mention Light-Sport Aircraft*
**Quad City Challenger**, N380TS, Tom Scully, New Lisbon, Wisconsin

*Reserve Grand Champion Light-Sport Aircraft – Silver Lindy*
**Quad City Challenger**, N138NA, Harold Goellner, Poplar Grove, Illinois

*Grand Champion Light-Sport Aircraft – Gold Lindy*
**Quad City Challenger**, N140TR, Mike Riley, Eau Claire, Wisconsin

## Rotorcraft

*Bronze Lindy*
**Mosquito**, Leo Faucher, Fond du Lac, Wisconsin

*Silver Lindy*
**RotorWay**, N162CT, Chris Tronaas, Alta Loma, California

*Gold Lindy*
**RotorWay**, C-FOME, Brent Lavallee, St. Clements, Ontario, Canada

# Sitka Spruce Available from Wicks

Wicks Aircraft recently completed a special purchase of Sitka spruce. Available immediately, this prime, aviation-grade Sitka spruce can be ordered in large sizes, with boards up to 1 inch (25 millimeters) thick and 10 inches (250 millimeters) wide.

Length, too, is no problem. Wicks can supply wood in lengths up to 18 feet (nearly 5-½ meters) for gorgeous one-piece spars, and long wood pieces in smaller cross sections, as well.

Wicks' central U.S. location puts it at the optimum location for customers to save on shipping distances all across the lower 48 states. Even large and custom sizes usually ship in just one to two weeks. And that's for spruce, hemlock, and every wood in stock.

For more information, visit www.WicksAircraft.com.

# Electric eSpyder Earns German Certification

GreenWing International, a new company focused on bringing the electric eSpyder into production later in 2013, is pleased to announce that the aircraft was sanctioned by the German government and awarded its official certification on February 5, 2013.

"We believe this is the first time a national authority has certified an electric airplane," Company CEO Tian Yu said. Prior electric aircraft have been motorgliders, and some countries do not require certification for such aircraft.

Details on pricing and availability are to be announced in early August. The eSpyder will be available in the United States first as an experimental amateur-built kit and later as a light-sport aircraft when regulations permit electric power. In Germany and in other countries that recognize the DULV certification, the eSpyder will be offered as a completed airplane.

One-hour flight times have been achieved regularly during flight testing. The company reports that eSpyder offers pilots an unprecedented flight experience with the extremely smooth and quiet 51-decibel power system, enabling pilots to enjoy their flight without the powerplant intruding on the experience.

GreenWing said eSpyder was designed to enable quick, easy, reliable charging so that pilots can unplug the charger, roll out of the hangar, and take off silently and effortlessly for enjoyable flights of up to an hour. The fast charger can fully charge the batteries in about twice the flight time that has been used, for example: After a 45-minute flight, the plane can be fully charged again in 90 minutes. With a stall speed of just 28 mph (24 knots), a landing roll in the hundreds of feet, and a nearly silent powerplant, the eSpyder can be operated from a wide range of locations.

For more information, visit www.ElectricAviation.com.

# Rotax Revised Service Bulletin 912-063 R1

Rotax has released Revision 1, announcing a revised fuel pump replacement kit under a new part number to better assist customers in the replacement of their fuel pump. Owners should check with their Rotax service provider for pricing and availability. This service bulletin recommends the replacement of 912 series fuel pumps with a part number of 892 546 and 892 542. Fuel pumps that have pre-installed fuel lines and fire sleeve will need to have the fuel lines transferred from the original fuel pump to the replacement pump.

Rotax-Owner.com has released a new video to help clarify this requirement. The video explains in detail the steps required to comply. For UL (uncertified) engines, click here to view the UL service bulletin. For certified engines, click here to view the service bulletin. For more information on this bulletin, view Rotax-Owner's video.

# Lockwood Now Distributing the Rotax EMS Integra

Lockwood Aviation Supply is now the U.S. distributor of the Rotax EMS Integra for the new, fuel-injected Rotax 912iS engine.

The Rotax EMS (Part No. 886 859) features a 7-inch color LCD screen that integrates all primary engine instruments including engine tachometer, fuel flow, fuel pressure, exhaust gas temperature, cylinder head temperature, oil and water temperature, fuel level, voltmeter, ammeter, timer, throttle position, ambient air temperature, and more.

"With the Rotax brand, you can be assured that the unit has been fully tested and approved to work flawlessly with the new CAN bus interface included with the fuel-injected Rotax 912iS," said John Hurst, director of Sales and Technology for Lockwood Aviation Supply.

The unit is pre-configured to display all information that Rotax wants users to see for proper operation of the 912iS. The Integra EMS is delivered with mounting frame, backup battery, manuals, warranty card, and connectors set. Optional


sensors include fuel pressure (recommended for the 912iS), ammeter shunt, and fuel level sensors. Suggested retail price for the Rotax Integra is $3,348.

Learn more at www.Lockwood.aero.

# iStart Makes Starting Piston Aircraft Engines as Easy as Starting a Car!

iStart Partners is pleased to introduce the iStart system, an electronically controlled aircraft piston engine starting system that completely automates the delivery of fuel during engine startup.

iStart is simple to install by any person with reasonable mechanical skills in just a few hours. The system is comprised of only two components. There are no additional switches or pumps to install. The iStart control module is installed behind the instrument panel. A throttle body injector plate is installed between the fuel servo and intake manifold.

Operation is as simple as setting mixture to cutoff, throttle cracked to approximately 1000 rpm, turning on mags, and energizing the starter. iStart controls fuel delivery to ensure a perfect starting mixture regardless of whether the engine is hot or cold. (iStart monitors the engine temperature to determine the best mixture.) iStart will idle your engine and indicates to the pilot when it is time to transition the mixture control to rich. Once the pilot advances the mixture, iStart will automatically conclude its control of fuel delivery, and the aircraft will operate as normal by pilot control. iStart cannot interfere with normal operations of the engine until the next engine start.

iStart is currently available for Lycoming-powered experimental aircraft. FAA certification is in process. Development for Continental engines is nearly complete.

For more information, visit www.iStartair.com; or contact iStart General Manager Damon Berry by e-mail at sales@istartair.com or call 817-219-0007. iStart is based in Granbury, Texas.

# Engine Retro Kit for RANS S-6 Series

RANS is now offering an engine install retro kit. This kit features a sleek fiberglass or carbon-fiber cowling. With no more radiator louvers on the top cowl, the new design has a reverse scoop on the belly, and underslung radiator. The benefits: better cooling from a smaller, lighter radiator, less cooling drag, and easier engine maintenance. Without the large top-side-mounted radiator, the carbs are now easier to access. The underslung radiator naturally fills without air entrapment.

The cowling is offered in either fiberglass or carbon, which saves 4.4 pounds off the empty weight. Few planes lift more than their own weight, but RANS has a good record of creating planes that can; here are the models that do: S-4, S-6, early S-7, S-9, S-10, and S-12.

For more information, visit www.Rans.com.

# iLevil AW: Revolutionary ADS-B Receiver for Experimentals and LSA


The new iLevil AW from Levil Technology is a game changer when it comes to safety and avionics selection for noncertificated aircrafts. Similar to its portable version, the popular iLevil SW, this new rugged system integrates an AHRS, 978-megahertz ADS-B receiver, WAAS GPS, and iPad/Android compatibility using its integrated Wi-Fi technology. However, the iLevil AW introduces three key features that revolutionize the role of portable ADS-B receivers in the cockpit today:

1. An integrated 8- to 32-volt power adapter. This feature allows direct connection to the airframe's 12 to 24VDC system, leaving the cigarette lighter receptacle free for other portable systems. With a direct connection to the main bus, automatic on/off operations are now possible without the push of a button on each flight. In case of a power-failure emergency, the AW continues to function as a portable device by using its internal rechargeable battery, which can be operated by the integrated on/off switch, or a remote one, installed directly on the panel.
2. The iLevil AW easily connects directly to the aircraft's pitot-static system, without the need to recalibrate the existing instruments, and its internal pressure transducers are already calibrated, providing "right now" airspeed and pressure altitude information while still monitoring ground speed and GPS altitude.
3. Finally, the iLevil AW features two RS-232 ports, making it the only ADS-B receiver that facilitates connection between an iPad and the panel instruments. The AW outputs ADS-B and GPS information through one of its serial ports, enabling standard panel-mounted avionics to access free weather and traffic information while the tablet is used simultaneously for backup or complementary display. The additional serial port can be used to communicate data IN from external devices such as Zaon XRX traffic; when combined with an iLevil and WingX Pro7 software, the iPad facilitates all the traffic available to the pilot, even for those that haven't yet upgraded to ADS-B out.

Grand Rapid Technologies, manufacturer of the popular EIS 4000/6000 series, partnered with Levil to offer full engine instrumentation display on the iPad when combined with an iLevil SW or AW.

The new iLevil AW is available now, priced at $1,395. For more information, visit www.Aviation.Levil.com/iLevil.htm.

# Sonex Aircraft Offers Quick-Build Kits Featuring Pre-Built Major Assemblies

Sonex Aircraft LLC now offers quick-build options for the Sonex, Waiex, and Onex models, with the fuselage and wing of the aircraft assembled and riveted and the aircraft canopy installed. Sonex and Waiex wings are rigged and match-drilled to the fuselage, and Onex outboard wing panels are rigged and match-drilled to the wing center section. Quick-build upgrade pricing for all three aircraft models is $10,000.

The FAA National Kit Evaluation Team concluded an audit of Sonex Aircraft quick-build kits in early July. The new Sonex, Waiex, and Onex Quick Build 8000-38 checklists should be published on the FAA website soon.

Sonex Aircraft will be offering specialized transport services for quick-build kits to most regions of the lower 48 United States through Partain Transport Company, a reputable and experienced carrier specializing in the transport of quick-build kits for multiple homebuilt aircraft companies, including residential delivery at no additional charge and without the need for crating. Kits shipping internationally will be fully crated for a $500 crating fee. Sonex Aircraft Quick Build Kits are built to order, and customary lead times apply.

For more information, visit www.SonexAircraft.com.



Photography by Brady Lane

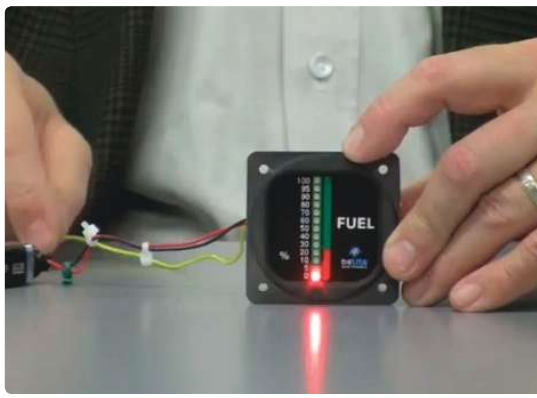
# Belite Electronics Introduces Digital Universal LED Fuel Gauge

Belite announces its new Universal LED Fuel Gauge. The new gauge is compatible with almost all fuel probes in existence.

An LED display shows the current amount of fuel in the fuel tank. Calibrated from 0 percent to 100 percent, it features unusually bright LEDs, which are completely readable in direct sunlight. It is available in a single or dual version for support of one or two fuel tanks. The input compatibility is selectable between traditional float-style fuel senders and newer-style capacitive fuel senders. It may be calibrated to match the full and empty point of any fuel sender/tank at the push of a button. The unit uses digital electronics to interpret, calibrate, and display the fuel tank level. Calibration of the fuel level is done via a single button for each tank.

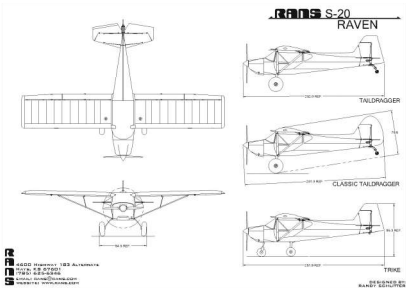
This instrument is available immediately and can be bought through Aircraft Spruce or Belite's online store. The price is $99.95 for the single fuel gauge (Part No. UFGA-021) and $124.95 for the dual fuel gauge (Part No. UFGA-022).

Watch a video of the gauge in operation at http://YouTube/Fr_4Roio7sY.




# RANS S-20 Raven Now in Development, Accepting Pre-Orders

RANS is proud to announce the S-20, the successor to the famous Coyote II S-6S. However, the S-6ES will remain in production. If you are looking for a side-by-side high-wing that can equal or exceed the performance of the S-6S, meet the Raven.




Features include an all-welded steel fuselage and tail; a flat aluminum landing gear made of 7075, CNC machined, heat treated, and shot peened for long life; a universal fuselage—the landing gear can be switched from tail wheel to trike; sliding seats; a large door opening to allow easy ingress and egress; welded steel door frames; and a large, easy-access baggage compartment. The wing and tail are directly from the S-7S, featuring one-piece fully CNC-machined stamped ribs, CNC-machined spars, aero servo ailerons, and a 26-gallon fuel system.

For more information, visit www.Rans.com.

# Aircraft Covering Conversion Kits for RANS Aircraft

RANS now has aircraft covering conversion kits for several of its models. The kits allow owners to convert their pre-sewn Dacron envelope-covered plane to the performance-enhancing Superflite fabric. The kits include all the parts needed to adapt the wings. Usually the fuselage and tails of any of their kits will accept standard aircraft fabric covering systems. If your plane is coming up for re-cover, consider a conversion kit. You can enjoy the benefit of increased performance and longer skin life. The performance increase comes from the wing ribs being more stable.

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# Just Aircraft's SuperSTOL

## A Helio for the light-sport set

By Dave Higdon



Photography courtesy of Just Aircraft

Watching Just Aircraft's new SuperSTOL descend onto the Sun 'n Fun International Fly-In and Expo's Paradise City Runway 9, I thought everything about the plane screamed rugged! Huge tundra tires complemented sturdy main-gear struts and high-lift devices extended from the leading edges. Barn door–size Fowler flaps and long-chord ailerons reinforced the aircraft's own dramatic statement of purpose.

For years Just Aircraft's resident designer, Troy Woodland, watched partner Gary Schmidt fly his Helio Courier from tiny patches of ground—often from Just's own tiny runway. The Helio Courier inspiration seems apparent in the execution of the SuperSTOL.

When the Helio Courier showed up in the aviation marketplace, it deepened the meaning of "short" in the short takeoff and landing acronym "STOL." Woodland's latest design for Just Aircraft raises the bar even further by shortening the runway needed to a level rare in real-world operations. Watching it land and take off left little to be surprised at in the runway-performance arena when it came time to fly. In fact, the most surprising aspect of the SuperSTOL emerged in flight,

sandwiched between my bookend moments of abbreviated runway occupancy.

The SuperSTOL needed at most a slight, two-toes-only touch on each rudder pedal, a light two-fingers hand on the stick, and smooth throttle use in exchange for the reward of a fun flyer with excellent manners.

On the ground, a long neck, a thick seat-bottom cushion, and constant S-turning help keep the runway ahead in view off the high, steeply angled cowl. Aloft, however, no such vision limitations exist, thanks to ample glass and broad skylights. No one should tire from flying this plane; it was no work at all.

## Hangar Kin—the Highlander and SuperSTOL

On appearance alone the SuperSTOL stops people in their tracks. Little wonder, given its distinct features. But beyond the differences, the SuperSTOL is all Just Aircraft, employing simple, proven technologies: welded steel fuselage, metal wing substructure, and cloth covering.

Just's Escapade and Highlander share a fuselage with different wings and gear; the SuperSTOL shares *some* of the Highlander's fuselage structure and construction philosophy. But it's still its own plane, differing in many distinctive ways. For example, that distinctive main landing gear delivers more than 20 inches of stroke available from the long shock absorber, wholly different than the more conventional tail-wheel mains of the Highlander.

But where the SuperSTOL varies from the Highlander most is its wing. Each leading edge sports a self-adjusting slat—a cuff conforming with the leading edge shape that pivots forward to form lift-enhancing slats. The slats deploy automatically at about 55 knots indicated and stow, also automatically, at about 57 knots. Stowed, they impose next to zero penalty on airspeed performance. Deployed, they allow approaches at a steep angle indicating 40 knots—probably a high number because of the steep angle of attack the combination of 40 knots and idle engine power produces. Stall is so low and at such a high pitch angle that it made me question the airspeed indicator's accuracy. Silky smooth in operation, the pivot mechanisms move on ball bearings with rubber bumpers cushioning deployment and retraction.

Those slats get help flying slow-speed exercises from the huge, half-span Fowler flaps while wide-chord, half-span ailerons give the pilot significant roll authority, even at the highest angles of attack the plane can fly; and it can fly at ridiculously high angles of attack with just a modicum of power.

Working together, the aggressive flaps and automatic slats enhance the slow-speed numbers of the SuperSTOL while the long-chord ailerons contribute significantly to two-fingers-is-enough roll authority available right down through stall.

## SuperSTOL: A Name and a Design Philosophy

Designer, engineer, pilot, and Just Aircraft partner Troy Woodland wears a lot of hats, as does his partner Gary Schmidt. During Sun 'n Fun 2013, Woodland took on the role of showing off the SuperSTOL. "My design approach tries to continually make runways unnecessary," Woodland explained as we prepared N272SS for my flight in it.

STOL performance is nothing new to the pair of Schmidt and Woodland. Their planes all adhere to a philosophy that follows that slower and shorter are often more attractive than faster and longer. But the SuperSTOL performance review revealed it to be not only short-field exceptional but approach-error tolerant, as we'll see from our flight. "Getting into a field too short to depart from is its own safety element," Woodland said. For that very plausible possibility, the SuperSTOL retains two traits present in its predecessor designs: folding wings and the ability to tow the folded, secured aircraft.

## Born of Highlander, Kin of Helio, With a Bit of Porter for Good Measure

Schmidt and Woodland's previous creations—the basic-trainer Escapade and the robust bigger brother, the Highlander—number nearly 400. As with the Highlander, prospective SuperSTOL aviators enjoy two approaches to flying their own model.

First, there's the experimental kit approach, with two options: Build it as a sport pilot–eligible experimental light-sport aircraft (E-LSA) by listing its legal gross weight at 1,320 pounds, or build it as an experimental amateur-built (E-AB) with a 180 pounds greater weight of 1,500 pounds.

With the factory number for an empty SuperSTOL at 720 pounds, the E-LSA option leaves the operator with a useful load of 600 pounds, and yes, it will make the power-based formula for fuel. Use the option to build

to a 1,500-pound gross weight, and useful load rises to 780 pounds.

The owner-built E-AB example flown at Sun 'n Fun for this article tipped the scales at 790 pounds empty and was certificated to the 1,320-pound limit. Topped to its 30-gallon fuel limit, the Sun 'n Fun airplane still could carry 355 pounds in the cabin, but make that 635 pounds for the plane with a 1,500 gross-weight number on its paperwork.

Just Aircraft offers quick-build options for the wings and fuselage; those options are in addition to the $36,500 complete airframe kit for the SuperSTOL with 21-inch tires.

Highlander owners or builders can rework their aircraft to fit the SuperSTOL's wing onto their airframes, but the fuselage would require more rework to fit the landing gear, which would round out the previous design to the SuperSTOL's standout runway numbers. This option may appeal to Highlander builders or owners interested in flying an airplane with arguably the shortest runway-performance flying.

And it flies great between visits to the runway.

## The Flight—Super Short at Each End, Super Fun in Between

The SuperSTOL departs Earth after a breathtakingly short takeoff roll, transitioning to an impossible-looking climb angle at an even more acute deck angle than the heavier, more powerful Helio, better than the Pilatus Porter and nearly even with the champ of all STOL machines—the Fieseler Storch.

Launching from Paradise City's Runway 9 against a blustery crosswind, Woodland showed how to do it: full power, aft stick, and wait—briefly. In something around 75, maybe 85 feet, the SuperSTOL was quickly approaching the 400-foot AGL pattern ceiling, ending in about a 20-second, steep, sky-view-only climb.

Approaches require minimal work on final; to make the runway, resist starting final until you can make the runway deadstick…yes, deadstick. You see, if you pull power prematurely, significant drag forces go to work while gravity drags you down. At idle power it's possible to see 700 to 800 feet per minute in a descent at 40 knots, the stick full aft.

The flip side is if you're flying into any kind of wind the SuperSTOL almost feels as if forward progress just

*Just Aircraft's SuperSTOL pairs a huge Fowler flap on each wing with an equally large slotted aileron to assure positive control at below-belief angles of attack and below-scale airspeeds.*


*Just Aircraft's SuperSTOL offers builders plenty of panel with which to work.*

*Just Aircraft's SuperSTOL employs a pair of automatic slats on each wing, hinged to retract and extend as airspeed warrants, with slower-than-usual speeds the result.*

Photography by Dave Higdon

*With one fully deployed (on left) and one shown halfway, these automatic slats on each wing help the SuperSTOL fly slowly and land shorter than normally possible.*

*Shown fully stowed.*


*Slotted ailerons and Fowler flaps contribute to slower speeds with full control.*

stopped while the steep descent angle barely leaves the pilot a view of the runway ahead. The SuperSTOL does slip nicely, albeit unnecessarily; just pulling power takes care of descent planning.

On its shortest landings, the SuperSTOL effortlessly absorbs the impact of touching down at more than 700 fpm. The impact of touchdown transfers practically no feeling to the cockpit seats; instead, the arrivals all feel impact-free, soft, with a short roll dissipating any residual energy.

With a little coaching, Woodland had me able to touch down and stop in less than 75 feet at South Lakeland Airpark. No amount of coaching could, however, bring me to Woodland's level of control: touching down in a headwind with nearly zero forward momentum, holding the tail off the runway, turning and taxiing off to the side, before letting the tail wheel ease down to the grass.

And in between? Of course, planes like the Helio *can* cruise nicely in the 140-knot range; the Porter manages a respectable 115 knots, on several hundred horsepower; the Storch about 95 knots. That's not bad company for the SuperSTOL, which manages about 90 knots with the 29-inch tundra tires, about 95 with the smaller 21-inch versions.

But few SuperSTOL operators are likely to feel shorted with its ability to shine from runways shorter than a tennis court while carrying two with ample gear for some bush flying at less than half the price of a good, used Helio. Best of all, it benefits from the company's past award-winning design work. Both the Escapade and Highlander won Best Light Plane Awards previously at the Lakeland event—in 2004 and 2005, respectively.

The SuperSTOL demonstrator flown for this story received the Reserve Grand Champion LSA award for its builders and owners, Tony and Janet Shuler of Franklin, North Carolina. The success of N272SS in the awards venue follows the tradition of its older siblings; all were customer-built examples entered into the judging at Sun 'n Fun. And that's a testament to the kit as well as to the design itself.

## Postflight Analysis

Despite the look of its giant tundra tires, the massive telescoping main landing gear, and its supports, and aside from the huge flaps and lift-enhancing slats, the SuperSTOL pulls off one healthy imitation of a Helio



Photography by Dave Higdon

Courier, an airplane known for its prowess negotiating its way in and out of near postage stamp–size clearings.

While imitation serves some as the finest form of flattery, the design delivered by Schmidt and Woodland goes beyond imitation into outright emulation. For the builder looking for the ultimate in backcountry performance, the SuperSTOL deserves a review. For pilots interested less in building and more in flying, Just Aircraft's principals are well along in earning special light-sport aircraft approval to sell a fly-away SuperSTOL.

For the pilot interested in a solid-performing, all-around excellent flying machine, maybe the SuperSTOL's hangarmates could suffice. The Highlander, in particular, is no slouch in hauling, cruising, handling, and negotiating shorter-than-average strips. But if the ultimate in STOL performance appeals more than anything else, consider this: SuperSTOL doesn't *imitate* or *emulate* a STOL airplane; it redefines the field by showing how much less "ample" can be where "short" is the operative adjective. Fact is, Just's SuperSTOL challenges its inspiration in STOL performance, and of course, economy, top to bottom.

Just's SuperSTOL performance gives up little to the sturdy Helio; for example, in seating, the LSA is limited to two. But it's solid on total useful load. Aside from the greater seating capacity of the Helio Courier, the SuperSTOL does it all at a cost to purchase and fly assured to make most Helio Courier owners envious. In particular, the SuperSTOL's fuel burn, flying on 100 hp, could make a few Helio fliers a little green with envy. That reflects the difference between feeding gulps of gas to the Helio's various 540-inch Lycoming six cylinders and the comparative fuel sipping of the four-cylinder Rotax 912 powering the Just design.

And this is just the briefest introduction to Just Aircraft's new SuperSTOL. Come along and fly; that's where this little bird makes its STOL genes abundantly clear. EAA

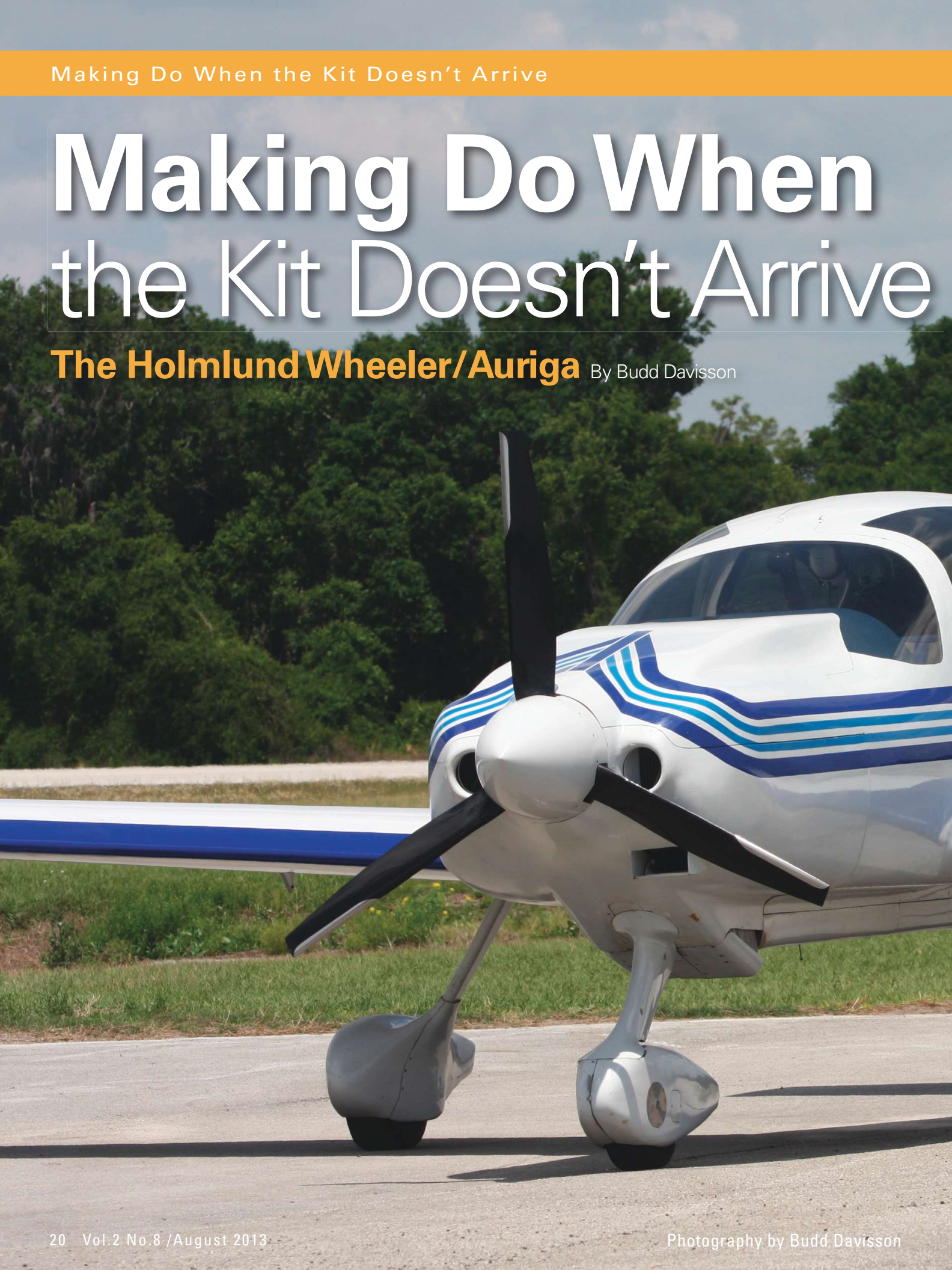
Dave Higdon, EAA 465009, is a Wichita, Kansas-based aviation writer/photographer and 5,000-hour pilot who started his career flying hang gliders and ultralights.

Photography courtesy of Just Aircraft

# Making Do When the Kit Doesn't Arrive

## The Holmlund Wheeler/Auriga

By Budd Davisson





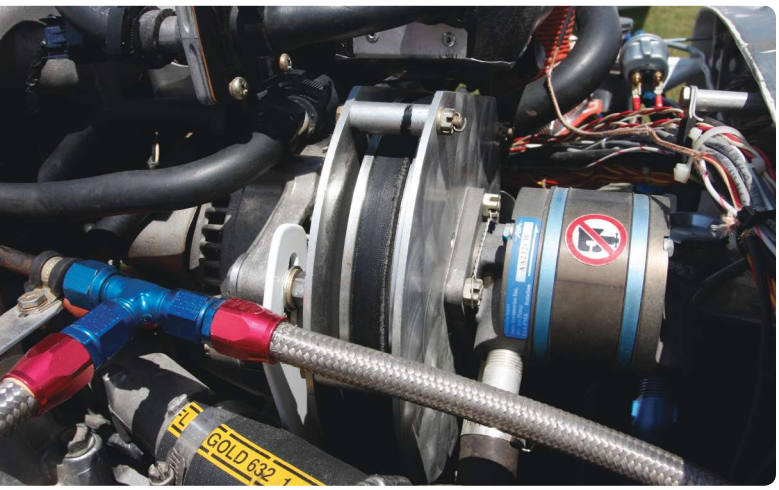
Photography by Budd Davisson

What follows might well be considered a case study in solving the kind of problems most builders hope they never encounter. In fact, these are the kinds of problems that generally spell the end to an aircraft-building project. However, the story of Victor Holmlund, the Auriga, and the tenacious group of builders behind it shows that it's hard to keep a homebuilder down.

Victor, a native of New Jersey, was born and raised in Newark, but now home is Hillsborough Township in the central part of the Garden State home. After graduating from high school, Victor found work as a mechanic in the chemical industry. Gradually that led into electrical work that culminated in his forming his own electrical contracting company, which he has been running now for nearly


*Victor Holmlund thought he was going to build a Wheeler Express. But the wings were all he received before the company disbanded. The bottom half of the fuselage came from a less-determined kit builder. From that point on Victor was on his own.*

*The Subaru 3.3 liter SVX puts out 240 hp at 6000 rpm and is lighter than most V-8s. The induction system, however, forced Holmlund to build a fairing over it.*




*Victor fabricated a pulley and bracket to mount the automotive alternator and vacuum pump while also reducing the rpm of both to proper levels.*

*Equal -length headers feed into 6-inch augmenter tubes that help suck air through the radiators and out the cowling and under the fuselage.*

43 years. As much as he was always into getting his hands dirty, he also always had a taste for excitement.

"In my twenties I was racing motorcycles," he said. "Mostly I was running flathead KR Harleys. My favorite was flat tracking. I ran at Laconia [New Hampshire] and finished third in the amateur national race. I raced on the beach at Daytona, before they moved to the speedway, and usually did well. However, when big money started filtering into the races, I found that without a sponsor, I couldn't continue to be competitive. Besides, I had gotten old enough that I didn't heal as fast as I used to, so I got out of it.

"Adrenaline is almost a narcotic. So, you always crave some sort of excitement, and that's what got me into flying. I needed some excitement, and learning to fly looked like it might provide that. Neither my brother nor I were pilots, but that didn't stop us from buying a $2,000 1947 Cessna 140. At that point, I'd never even been up in a light plane and couldn't stay up for more than 10 minutes before getting airsick. But I looked at the payment book and realized I had no choice. I couldn't give up.

"I soloed in 10 hours and flew the wings off that little airplane. I covered most of the East Coast, including Florida and as far inland as Oshkosh. I loved that 140 and still had it when Superstorm Sandy came on shore last year. Unfortunately, when Sandy left, our little 140 was a ball of twisted aluminum. It was completely totaled."

Every airplane is a compromise of sorts, and with the C-140, that was its size and its speed.

Victor said, "As much as I loved the 140, I was tired of slow. I desperately wanted a faster airplane that had more room. But I couldn't afford to buy what I wanted. However, by that time I was well into the EAA, and I reasoned that I could always build it. So, I started looking around at what was available in kits."

Victor began his search in the mid-'80s and was first attracted to the White Lightning. That had the speed but was limited in load and cabin size. The Wheeler Express came out shortly after that, and it looked ideal for his purposes. It had a large cabin, could carry a healthy load, and according to all of the sales literature, could provide the speed he was looking for. So, he mailed in his deposit and was on the way to building his first airplane.

"The first Wheeler had a couple of problems, and one of the first builders to complete the airplane had tail flutter,



Photography by Budd Davisson

which he attributed to the narrow cross section of the rear of the fuselage. However, by far the biggest problem was that the company went out of business after delivering between 40 to 50 partial kits. Mine was one of those."

At the time the company went under, Victor had taken delivery of both wings, but he didn't have a fuselage, which considering everything was formed in molds, was a major problem: Even if plans had existed, he couldn't have easily scratchbuilt it.

"I looked around and found a builder in Washington state who had a bottom fuselage half. That was sort of like having the keel of a boat because it attached to the wings and formed most of the load-carrying structure. But I still needed a top fuselage half as that's what formed the cabin: It had the door and windows in it. The tail was also part of the top half."

By this time, some of the Wheeler builders had begun communicating with each other as most of them were in the same boat; they had no upper fuselage and were missing dozens of other components. So, 26 of them formed a group that would manufacture the parts for themselves. This was made much easier because two of the 26 builders in the group were engineers as well as aerodynamicists and had both design and manufacturing experience. Equally important, one of the builders was a commercial fiberglass boat builder.

Each of the builders in the group agreed to purchase parts from any member who could manufacture them, and they were off and running. However, this was no small project because it meant designing and having complete fuselage molds built, then having the parts molded. This amounted to developing complete aircraft production capability, even though some of the production was farmed out. In the end, the group completed 26 sets of parts to get everyone in the air.

"Part of the goal was to redesign the fuselage to eliminate the tail flutter and add a pilot's side door. Since we were redesigning from scratch, we thought we should make it more convenient to fly.

"When we decided to move ahead, we realized that all we had were wings from the Wheeler. So, in effect, we were building a nearly new design. That being the case, we decided to rename it the 'Auriga,' which is a star. Also, going to a new name eliminated any possible legal issues with the original company."

At the time Victor started building, composite construction was well accepted, but the techniques


*The removable step is another Holmlund innovation. A small, notched blade fits in the top of the wing...*


*...and, when inserted, locks into place.*

*The fuselage is much wider than most aircraft. The builder's group had to build its own top fuselage half, adding right and left doors.*

weren't well known. So there was a learning curve to be managed.

Victor said, "I bought the $45 Wheeler test kit that included three pieces of fiberglass, two cores, some fabric, and the vinyl resin used in the layup. I built the test pieces and brought the pieces to my local EAA chapter to evaluate my workmanship. Composite construction was pretty new, and most of the members didn't know if what I did was good or bad. What I learned from the test kit was that I didn't know enough to build a composite airplane. So, I went to a SportAir Composite Workshop that was running near me. It was a good move and gave me a lot of knowledge and confidence in what I was about to do.

"When I started building, the only manual available was for the wings, and from that point on it was every builder for himself. We had to figure it out for ourselves. Fortunately, the Auriga group worked together and helped each other in many areas. Plus, we did a few things you don't expect of homebuilders. For instance, the lower fuselage has the wing carry-through in the lower half, so we had the entire wing structure load-tested to confirm that it was as strong as it was supposed to be."

Although the aircraft started as a Wheeler, the Auriga group made a lot of changes. Among other things, the rear fuselage lines were changed slightly to allow it to be stiffer, and the empennage was modified considerably.

"The Wheeler had all torque tubes in nylon bushings, which caused aileron binding in flight," Victor said, "but in the Auriga they are all ball bearings. The rudder still uses cables, but the elevator, which had been cables, is now push-pull tubes."

It takes only a casual examination of the airplane to see that Victor definitely had his own ideas of what he thought an airplane should include. Some of those features are rooted in his knowledge of electricity and his willingness to not only come up with his own solutions for problems but also to design his own subsystems.

One of the first things noticed when glancing in the cockpit is an unusual flat console in the lower center of the instrument panel. It's hard to describe it, but basically it is an outline of the airplane with warning lights and strip indicators for various functions. He can, for instance, just glance at the panel and see how much fuel is in each of his four fuel tanks (92 gallons total!) and which tank he is feeding from at any moment. Trim and flap settings have similar indicator lights. And there are warning lights for every lock in the airplane, including the seat and door locks. There are even parking brake and cowling lock warning lights. It's a masterpiece of homebuilt engineering and far in excess of what is normally seen on general aviation airplanes. But then, that's what homebuilding is all about.

Victor's airplane is a *tour de force* of tiny, innovative details. Even the removable boarding step shows a lot of clever imagination in its simplicity and function.

Victor said that from the beginning he had intended on using an auto engine because of cost and because he wanted newer technology. Among those he considered were several V-8s including the Cadillac Northstar. His final choice, however, was the Subaru 3.3-liter SVX. He said, "The Subaru SVX puts out 240 hp at 6,000 rpm and was lighter than the V-8s. Plus, its flat, aircraft-like layout meant that it fit the Auriga's nose profile much better, although the intake does protrude above the cowl line; so I had to fair that in.

*It takes only a casual examination of the airplane to see that Victor definitely had his own ideas of what he thought an airplane should include.*

"I started out with an available planetary, inline reduction unit but lost a bearing in it almost immediately. Now I have a Gear Drives Inc. direct gear unit that worked, but a defective gear surfaced. So, I found matching gears that are readily available from the guys who run monster trucks. It has worked flawlessly for well more than 100 hours now."

One feature about his prop drive unit that is unique and raises eyebrows on start-up is that the prop is not connected directly to the engine. It is connected to the reduction unit by a centrifugal clutch that hooks up to the propeller at 600 rpm. So, as the engine is initially cranking, the propeller doesn't turn until the engine is already beginning to run. It looks a lot like a turbine in that respect.

"I decided to use an in-flight adjustable prop from Ivo but was not happy with the thought of brushes (which change the pitch) riding on slip rings all the time. So, I devised a way to retract them from the slip rings and only engage when I change pitch. This saves on brush wear.

"When first running the engine, I tried using the computer system from [a Subaru] car, but there were

so many wires and sensors, more than a hundred in the system, that I needed a better method. Searching through hot rod and racing magazines, I finally found a simple digital system. This computer system controls both the ignition timing and fuel injection system. It also has an onboard computer that lets you adjust timing and fuel flow at will. This makes it easy to adjust the fuel/air ratio when at altitude.

"I maintained the original fuel injectors and installed six fuel pumps. Since the airplane has four fuel tanks, I use two low-pressure pumps to transfer fuel from auxiliary tanks to main tanks, two to supply a small header tank, and two high-pressure pumps to supply the injectors. This is all done for redundancy."

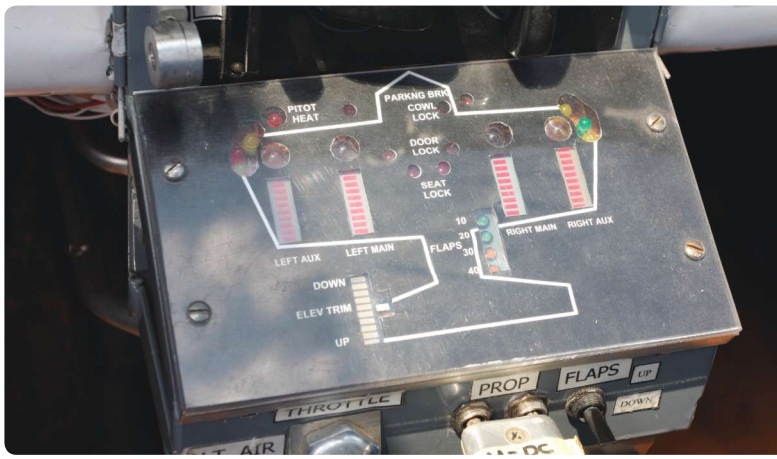
There are lots of ideas worth borrowing from Victor's airplane, but one that many may find useful is the way in which he balanced his headers for power. To determine the exact length of each tube and keep them equal, he filled one with peas and then kept trimming the rest until they held the same number of peas. This could well be a trick left over from his motorcycle racing days.

The 2-¼-inch primary tubes flow into collectors that dump into distinctive 6-inch-diameter augmenter tubes that, besides guiding the exhaust well back under the fuselage, help suck cooling air through the cowling and radiators. They also sound really cool!

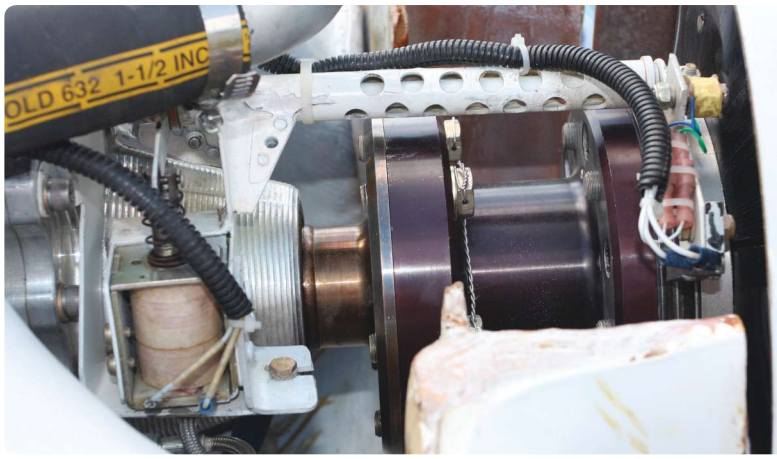
Victor said that one of the hardest things when doing something no one has done before is designing to ensure that everything is accessible and is easily removed so it can be checked. He said, "It took three months just to design the engine mount. That was done by lying on my back and looking up at every possible obstacle I could imagine."

When it was time to fly the airplane, Victor elected to do his own first hop, which while it went fairly smoothly, wasn't without incident. "I found out quickly that the plane was wing heavy and the aileron trim wasn't strong enough to keep the wing up if one auxiliary tank was full and the other empty. Also, on the first landing, the fiberglass gear legs weren't strong enough and one started to collapse. It caused minor damage, but it was obvious that the legs needed modifying; so I had Robbie Grove [of Grove Tailwheels] make up some aluminum ones, which work perfectly."

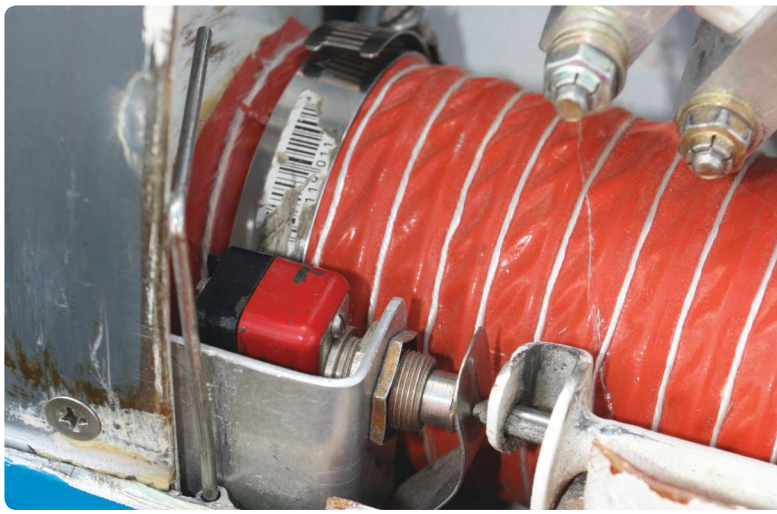
Victor is the first to admit that when you build something as complex as an airplane, especially when you're pretty




*Victor believes in keeping track of things, and the console between the seats displays factors from fuel level in each of four tanks to whether the cowling is latched and everything in between.*




*Not liking the idea of the bushings in the electric IVO prop mechanism always being in contact, Victor devised a way to allow them to contact only when changing prop pitch.*



*One of many micro switches feeding the display in Victor's cockpit; this one monitors the cowling latches.*

Photography by Budd Davisson

much on your own with no factory support, there are bound to be things that need changing once you think you're finished. He said, "Experimental airplanes are called 'experimental' because in some cases, like with the Auriga, you're truly experimenting and will do a lot of tinkering to get things the way you want them. That's just part of the game.

"Initially, I had cooling problems; so I changed and redesigned the radiators, and then the temps were too low. And there was the propeller reduction unit change and the heavy wing. Also, I was disappointed in the speed. I was hoping for 172 knots but got only 150 at about 13 gallons per hour. That's one area I'm working on right now.

"The good news, however, is that it handles loads really well and has a big CG range, so it's not critical in that area. Fully loaded, it'll use about 2,300 feet of runway to get off and likes to have just a little flap out on takeoff. When I'm landing, I come over the threshold at 75 knots and full flaps. Even then, it likes to float in ground effect. In the air, it's just a little pitch sensitive, which I think I can tame. The ailerons, however, are fine. Not too light, not too heavy."

Victor calls his creation *Odin's Wind*. The tail number N234VV is in remembrance of his father, who whenever Victor did something wrong would shake his head and say, "Victor, Victor."

Like we said at the onset, Victor's Auriga project suffered some of the most crippling setbacks a kit aircraft can suffer, e.g. a major part of the kit not being available. Still, in true homebuilder fashion, he once again proved that determination is the single most important ingredient in completing such a project. However, when obstacles that big have to be overcome, project progress slows significantly. Victor summed it up when he said, "If I'd had a child born when I started on the project, the child would have graduated college and made me a grandpa by now."

As with grandchildren, which are also worth the wait, Victor seems more than satisfied with what he has created. Of course, with grandchildren, there is a minimum of tinkering, but that's what builders such as Victor like most about their mechanical creations: They are never truly done creating. EAA

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


*From the fuselage stripe up, everything in and on the fuselage was designed and molded by the builder's group that formed when it was obvious they weren't going to be receiving their kit parts from the former company.*



Photography by Budd Davisson

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*EAA Members (determined as of September 20, 2013) will be entered automatically as follows: New Members – 50 entries; Renewing Members – 50 entries; Rejoining Members – 50 entries; Automatic Renewal ("AutoPilot") Members – 100 entries; Lifetime Members – 250 entries. Trial Members do not receive automatic entries. ****A purchase or contribution will not improve your chances of winning.** EAA encourages you to make a donation with your entry. All donations support EAA's mission to grow the next generation of aviators. For complete Official Rules by which all entrants are bound see http://www.eaa.org/sweepstakes/official_rules.asp.

# A Tail Wheel Shimmy

## No, it's not a dance

By Cy Galley

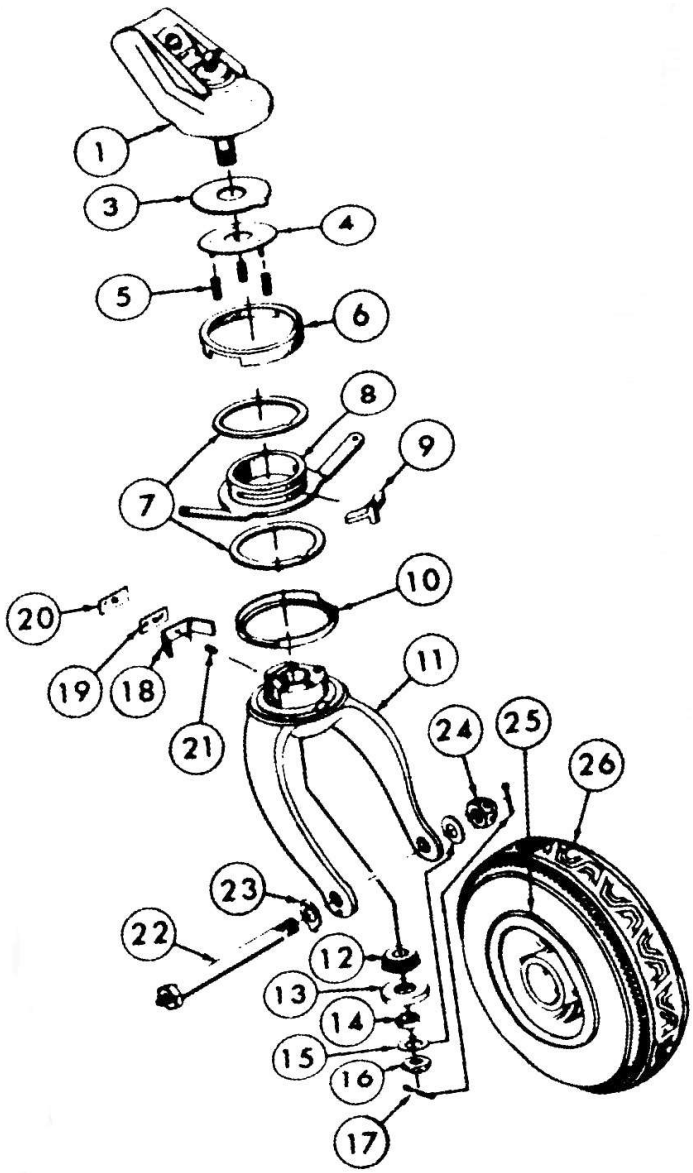
Do you fly a taildragger? Does your tail wheel shimmy, shake, or bang from stop to stop? Most tail wheels will shimmy quite easily if the design geometry is wrong (and most are), if the friction device (Scott No. 3234, thrust plate No. 4 of diagram) is misadjusted or gets grease on it, if there is looseness in the various parts, or if the mount or spring is not secure.

The first item, geometry, is easy to check. The pivot should be vertical under load. The top should never be slanted to the front of the aircraft. If the pivot top is slanted under load a little toward the back of the plane, that's okay.

As your tail spring weakens with age and less than spectacular landings, the pivot will slant toward the front of the plane. You can replace the spring or have it re-arched. The re-arching has to be done cold. No heat! Some spring companies will do it, but our local truck spring company will not have anything to do with aircraft springs due to the company's worry of liability.

So if you have a large hydraulic arbor press at your disposal, press away. I have also seen it done with a large sledgehammer and a piece of channel iron. This gets a little noisy but works very well. While you are at it, make sure someone hasn't removed a leaf in the misguided attempt to make the plane "ride" better.

Also included in the geometry check is the lean of the wheel. It should stand vertical from side to side. If it leans, then the spring or mount is twisted, or the axle has been bent. Check your hard rubber tire for "coning." A hard rubber wheel can be re-trued on a lathe by grinding or sanding. The pneumatic tire should not have flats or cups, and the pressure should be around 45 to 50 pounds per square inch.



We replace several tail wheel tires at Emergency Repair every year during EAA AirVenture Oshkosh when the sidewalls are destroyed during the long taxis at the event. That happens because the pressure in the tires is too low.

Also, make sure that the rudder and the tail wheel are lined up. One can force any tail wheel to shimmy by touching down with the tail wheel cocked to one side. So check the springs so that the wheel and rudder are aligned.

Next, there should not be any side play of the wheel on the axle. The axle nut tightness adjusts the wheel bearings as well. If there is a lot of play, you might have to put an additional washer on the axle. If there is way too much play, check the wheel halves for damage or missing grease seals. Don't forget the cotter key after adjusting.

One of my pet peeves is the grease zerk on the wheel axle. I never ever used mine and you shouldn't, either. When you use a grease gun to lubricate your wheel bearings you first have to fill the big wheel cavity before any grease reaches the bearings. This takes a lot of grease, adds weight, and generally makes a big greasy dirty mess. How so? Between heat and centrifugal force, the grease has nowhere to go but out of the hub to be slung all over the tail wheel assembly, rudder, and tail of your clean airplane.

The amount of grease necessary to lubricate your bearings is minimal. Pack your bearings by hand with a good-quality automotive bearing grease designed for disk brakes. Just fill the spaces between the balls or rollers. That is enough. More will just get thrown out to ruin the friction of the shimmy dampener. This is the last thing you want greased on a tail wheel assembly.

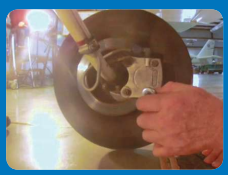
Last, the friction of the pivot is the shimmy dampener. On a Scott 3200 tail wheel, friction cannot be increased by tightening the main pivot bolt. The assembly must be disassembled and degreased carefully, and the condition of the thrust plate checked. The thrust plate is held under pressure (against Scott No. 3207, washer—No. 3) by three small springs (Scott No. 3233, spring compression—No. 5). If there is not enough friction, either install a new thrust plate or install stronger springs; or sometimes there are six spaces for springs and you can add three more.

Remember, the newest and best tail wheel will shimmy if it isn't positioned on the airplane correctly or if the tail wheel isn't centered when it touches down.EAA

# Watch These Online Hints for Homebuilders Videos!

Here's four new videos that were released recently.

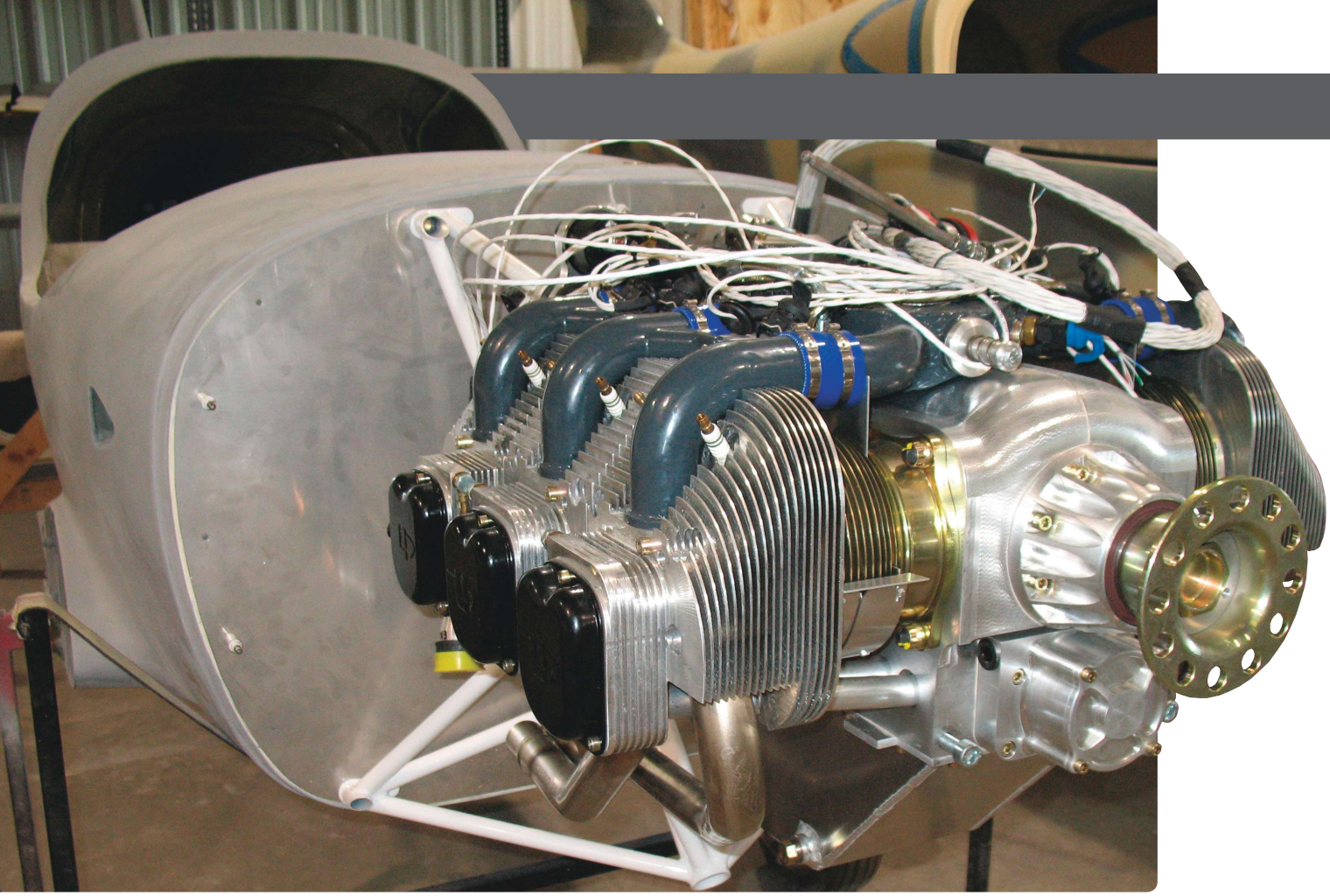
**Servicing Your Brake Reservoir**
Dick and Bob Koehler show how to add brake fluid to brake systems with remote- and pedal-mounted reservoirs. Dick and Bob are both A&P mechanics with IA authorization and EAA SportAir workshop instructors.



**Remove and Replace Landing Gear Wheel**
A procedure for removing and replacing main landing gear wheels is demonstrated by Dick and Bob.

**Bleeding Hydraulic Brakes**
Dick and Bob demonstrate the bleed up and bleed down methods to ensure all air is out of the brake system.

**Servicing a Gascolator**
Bob Koehler demonstrates the sometimes difficult job of how to remove, service, and install the gascolator.



*The ULPower 390iS mounted on the nose of an Arion Lightning.*

# An Engine in Search of an Airplane
## The ULPower Six

By Tim Kern

When ULPower brought its 86-hp UL260i to the U.S. Sport Aviation Expo at Sebring, Florida, in 2007, it caused a stir. (It is now rated at 97 hp.) Here was a conventionally laid-out, four-stroke, four-cylinder, air-cooled, direct-drive engine that incorporated the virtues of tradition but with modern engineering, metallurgy, electronics, and fuel systems. It took a while to gain acceptance, but now with thousands of fleet hours, the ULPower four-cylinder engines (now up to the UL350iS, rated at 130 hp) are popular and gaining both original equipment manufacturer (OEM) and experimental builder acceptance.

At AERO Friedrichshafen in 2012, ULPower displayed a six-cylinder 390i (145 hp) and iS (160 hp), and announced its big-six 520i and iS. And so, at the Sun 'n Fun International Fly-In and Expo in April of 2013 came the 170- to 180-hp UL-Power 520i six-cylinder family, the promised enlargements of the 145/160 hp 390. But where do these sixes fit? The 520 family is way more powerful than engines of comparable size and weight. That sounds like a good thing, except… what design is looking for this engine?

The 520 is a 5254-cc flat six. Like all ULPower engines, it's air cooled and direct drive, with fuel injection and dual electronic ignition.

Good practice is evident in the overall design, and most parts are manufactured from billet, on a 150-tool CNC machining center. Some notable features: The wet sump is deeply finned and incorporates a windage tray, and long studs couple opposing unlined SAE 4140 finned steel billet cylinders, straight through the aluminum alloy case. The



Photography by Tim Kern

noncounterbalanced, plain-bearing crankshaft is supported in seven main bearings and is fed high-pressure oil from a single, large mechanical pump. The heads and rocker boxes are machined in one piece, and fins carry all the way out to the covers. Traditional overhead valve actuation is mechanical, with screw adjusters. Four mounting points are located on the rear plate.

For now, overhaul is done at the factory in Belgium, but U.S. importer Robert Helms said, "So far, in my territory, every owner has done his own maintenance or used a local A&P. My plan is to have at least one overhaul facility in the U.S. and conduct training for owners and others. I also want a mobile repair/overhaul vehicle I can take to shows, OEMs, and maybe to do some field work."

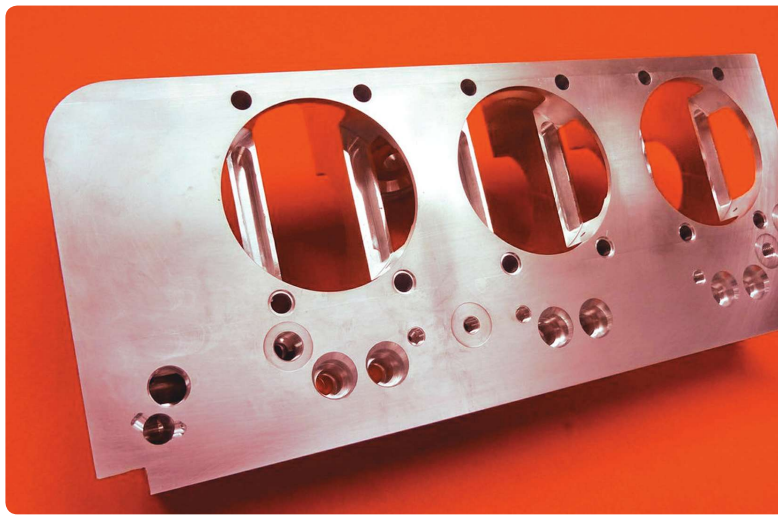
There are two engines in the 520 family: the base UL520i has 8-to-1 compression and delivers 170 hp at 2800 rpm (and 180 hp at 3300 rpm). The higher-compression (8.7-to-1) UL520iS makes 180 hp at 2800 rpm and has tested to 225 hp. An aerobatic version is planned—the 520iSA—which has an inverted oil system and weighs 3.8 kilograms more than the other two engines' 182-kilogram (242-pound) weight; and that's *with* the starter and 50-amp alternator. Dual ignition through a single electronic control unit (ECU) is standard, as is the full authority digital engine control (FADEC); there is a dual ECU option, though the factory advises to run just one ECU at a time. The second ECU is just there for the ride in the very unlikely event that the identical main unit conks out.

The entire engine management system is a ULPower design, using proprietary and dedicated hardware (all the way to the wire looms), ECU, and software but employing mass-produced automotive spark plugs, sensors, coils, and injectors.

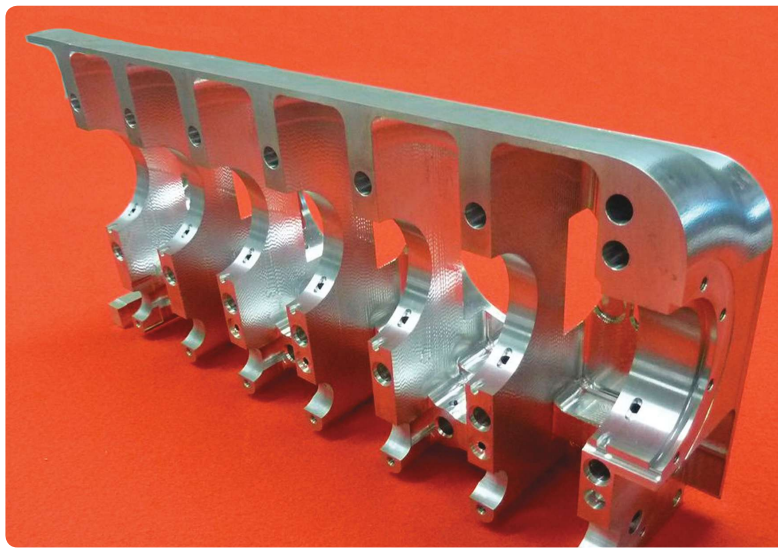
All the engines use four liters of AeroShell 15-40 internally (more may be needed, if additional oil lines and coolers are added), and they run on high-octane auto fuel (the "i" uses 91 octane; the "iS" uses 93 octane) or 100LL avgas. The engines turn the props in the clockwise direction as viewed from the cockpit; the same, for example, as Lycoming and Continental, and opposite Rotax and VW. Prop weight is limited to 15 kilograms (33 pounds).

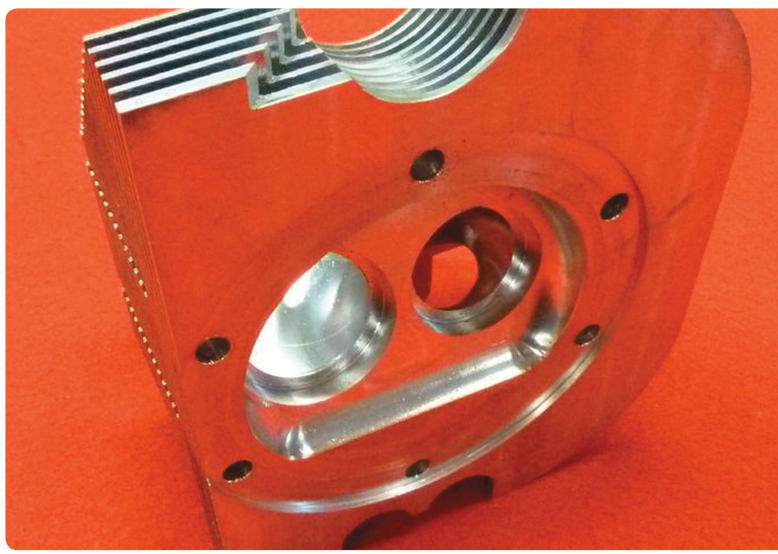
## On the Test Stand

Some independent dynamometer work has yielded interesting comments. Scott Ehni is a private Zenith builder, and he and a friend are putting ULPower 350iS units into their next two Zeniths. (Scott already has built a CH 701 with a JFS 100 turbine. "It can't carry enough fuel for long distances," he said. His story was featured in the April



*The engine case is machined from billet aluminum.*





*Nearly finished head shows generous finning.*

Photography courtesy of ULPower

*The 7-main crankshaft is well-supported.*

*Billet 4140 steel cylinders are stable and tough.*

*The piston has cutaway for combustion and valve clearance.*

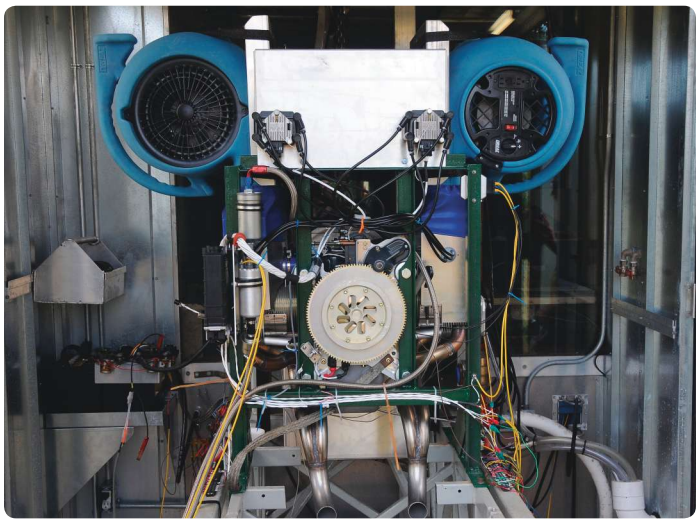
2013 issue of *Experimenter*.) He also does contract work for many others on his dynamometer so he was happy to hook his new engines up and run them. He said, "We weren't hired to test these engines; we bought them for our own airplanes. Our tests didn't depend on their being nice to us." Still, he noted that ULPower's responsiveness was great: "Whenever we needed anything, they've just sent it right away."

As for performance, Scott noted that his four-cylinder 350iS ran closer to its rated power than most, at 118 hp. One would expect even closer performance-to-rating from the sixes, because many of the components that use horsepower—the alternator and oil pump, for example—are the same across models and thus represent lower proportionate horsepower drains.

He also noted, "When you get to 3300 rpm, you hit the [automatic electronic] rev limiter, so we didn't test beyond that. Best torque is around 2500," which is great for takeoff since fixed-pitch props don't reach full rpm until there's some airspeed.

It's important to understand the difference between manufacturers' ratings and real-world performance. Scott said, "Pretty much no matter how you arrange cooling blowers in a dyno room, you won't get cooling that's as good as what you see in the air, at speed. So, temperatures ramp up pretty fast, and sometimes because of that, dyno runs are not representative of the maximum achievable horsepower. Offsetting this, a lot of (especially manufacturers') dyno runs are on 'optimized' engines, where all adjustments are perfect, where the spark plugs may have been indexed, where there's (nonrecommended) lightweight oil, and only the minimum quantity of oil may be in the crankcase, or where accessories may be disconnected. Some shops are known to alter the ignition timing from specification, or to run the valve tolerances a bit tight—all in the name of 'enhancing' the horsepower rating." Scott preferred to run "real-world" tests, with the engines as-is, with the right oil, and with the alternators producing 15 amps. (The two coils each use about 5 amps at cruise and 6 amps at full speed.)

Also, it's worth noting that instrument readings may be imperfect. "At 3300 rpm, a single foot-pound of torque gives a big boost to horsepower," Scott said. That, too, is telling. Exactly how accurate and repeatable do you think anybody's dyno stand is, day after day? "Don't put too much stock in variations of under a percent," he added.
Scott just took the engines from their crates, hooked everything up, poured in the oil, checked everything, and ran them. His summary (as a customer, not a hired gun): "Of all the engines I've tested, I'd say it's one of the nicer pack-



*Scott Ehni's dyno is the real deal ... on which he tested the 390iS.*

ages. They are pretty close to rated horsepower. No leaks; starts right up."

## All Pumped Up and Nowhere to Go?

So, why do the UL520i and its iS brother not have a home? It's a breakthrough in horsepower packaging. Not much heavier than an O-235 and with 65 to 80 percent more horsepower, it's more an equivalent to a 320 or 360, except it's measurably smaller. Maybe there simply isn't a tiny airplane (where it would fit and balance correctly) that needs the power, and a larger airplane has plenty of space for the legacy four-cylinder engines.

But time does not stand still, and builders always want more power. It won't be long before the UL520i series starts showing up in a classic or light-sport aircraft design; it seems logical that a Pitts builder or a speed-crazed RV builder will see the inherent beauty in a compact, smooth-running six.

So, again, where are the airplanes? They will come, as designers see the possibilities.

The first OEM application is in an Arion Lightning (with a Mark II tail) that's getting a 390iS, and a private builder is mounting one to a Long-Ez. The first known installation of a 520 is coming in a Just Aircraft Highlander.

Is there room for additional development? There's a rumor from the dyno room that a special exhaust system was helping a 520iS into big numbers: 225 hp was reported, but the exact circumstances, rpm, etc. are not going to be disclosed until they are reliably repeated and until the exhaust system can be built to fit in a cowling.

All ULPower engines ship with a 50-amp alternator, dual ignition (dual ECUs are an option), and comprehensive manuals. Four different prop flanges are available, up to 100 millimeters (4 inches) long; extensions are not recommended, as they have not yet been tested.

Prices of these Belgian-made sixes fluctuate with the dollar/euro spread, with the most expensive 520iS currently fetching about $35,000, and the 140-hp 390 near $28,000. Because the currency rates are volatile, Helms advises locking in a given price with a deposit over the phone.

The ULPower engine lineup was displayed at EAA AirVenture Oshkosh 2013, housed with Zenith Aircraft; and the company participated in Zenith's engine day (Thursday) at the same location. EAA

More information: www.ULPower.com
Assembly animation: www.YouTube.com/watch?feature=endscreen&v=ySz7TTLkwGY&NR=1
Manufacturing footage: www.YouTube.com/watch?v=JzIaRgP1wzE

Tim Kern is a private pilot and has written for more than 50 different aviation magazines. He was a key builder on two aircraft projects and has earned the title of Certified Aviation Manager status from the NBAA.

## Comparisons by the Numbers

| | UL520i/iS | O, IO-320 | O, IO-360 |
|---|---|---|---|
| **Horsepower** | 170/180 at 2800 rpm | 150/160 at 2700 rpm | 168-200 at 2700 rpm |
| **Weight** | 242 pounds | 271–299 pounds | 280–335 pounds |
| **Length OA** | 29.5 inches | 29–32.2 inches | 29–33.8 inches |
| **Width OA** | 30 inches | 32.2–32.7 inches | 33.4–34.3 inches |

*Ray Anderson's M-Squared Breese STOL is ready for action at the Sun 'n Fun International Fly-In and Expo. Anderson built this model from a kit, but made many modifications to get the airplane he wanted.*

# Have It Your Way With an E-LSA…Mostly

## The changes you can make

By Dan Grunloh

An option sometimes overlooked in the world of light-sport aircraft is the ability to change a special light-sport aircraft (S-LSA)—the aircraft sold ready-to-fly—into an experimental light-sport aircraft (E-LSA). According to the regulations, the E-LSA must be identical to the S-LSA when the airworthiness certificate is issued. Everything including the engine, tires, and instruments down to the last nut and bolt on the E-LSA must be identical to the S-LSA.

The very next day, however, anything can be changed—truly anything! There is understandably much well-deserved emphasis on the S-LSA category. About 130 models of new factory-built, ASTM standard-compliant aircraft have come into service in less than a decade. It's something that never could have been accomplished in the world of FAA-certificated aircraft.

The S-LSA is special because it can be used for rental or instruction, but it is the E-LSA that could change sport aviation. It gives us an amazing freedom we never had before. Aviation enthusiasts can begin their "experiment" with a fully completed, safe, and well-proven aircraft instead of having to assemble hundreds or thousands of parts before the first flight.

Early in the implementation of the LSA rules, there was the notion that it would enable kit manufacturers to market airplanes that were perhaps 80- to 90-percent complete, saving a lot of time for builders and also saving on the cost. Instead, some manufacturers are learning that a 90-percent completed aircraft costs as much or more to deliver than a 100-percent completed airplane. Many find it easier to produce one completed airplane that can be certificated either way.

The ability to do your own annual condition inspection after taking a 16-hour course and the desire to make changes to the airplane are the primary reasons owners opt for the experimental classification. The manufacturers of the Carbon Cub, the best-selling U.S.-made LSA in 2012, have stated that almost all their aircraft go out the door as S-LSA, but they are quickly changed to E-LSA with the addition of oversize tundra tires. Those owners can continue to make modifications, provided the changes are entered into the airframe log and that the airplane is tested solo and endorsed by the pilot before taking passengers.

The S-LSA entering service now will be around for a long time. I think it quite likely that all will eventually become experimental, and we will see them in service for a long time in highly modified versions. I'm serious; you can cut the wings off an E-LSA, modify or swap wings, change the landing gear, and do anything you could do to an amateur-built airplane, *provided it stays within the LSA definition*. Anyone can do the work, provided the aircraft is flight-tested and signed off by a pilot. The owner, even the next owner, can do the annual inspection by taking the three-day inspection course for that category. Most modifications don't require any new official documentation other than a new weight and balance sheet.

There have been a few times in the history of aviation when we get a good break. The establishment of the experimental amateur-built category was one of them, and the freedom to fly ultralights under FAR Part 103 with no pilot certificate or vehicle certification was certainly another of them. We still have both those freedoms, and now we add a new one—the ability to buy a completed airplane and then customize it to your heart's content while doing your own maintenance and inspections.

It's almost too good to be true. Soon we will see more used LSA that have been modified by the second or third owner. That expensive LSA you can only dream about will eventually be available as a used experimental airframe suitable for alternative engines and application of whatever flat panel display device or other human interface you can devise. Don't think it's only for the metal, tube, and cloth airplanes. The world's best-selling all-composite airplanes such as the Flight Designs CT line are also being converted. Follow this discussion thread on the CT Flier website.


*The outboard end of Ray's full-span flaperon.*

Photography by Dan Grunloh

Changing an LSA from an S-LSA to an E-LSA involves applying for a new airworthiness certificate. The procedure varies depending on the status of the aircraft. Contact the factory, your dealer, or an established designated airworthiness representative (DAR) for help. However, be advised that not every official fully understands the privileges, so plan to be patient. If the aircraft is a legal S-LSA that is up to date with all requirements, the change is purely a paperwork change. If it already has been modified or otherwise not in compliance, a new inspection by a DAR will be needed, and a Phase I test period may be required.

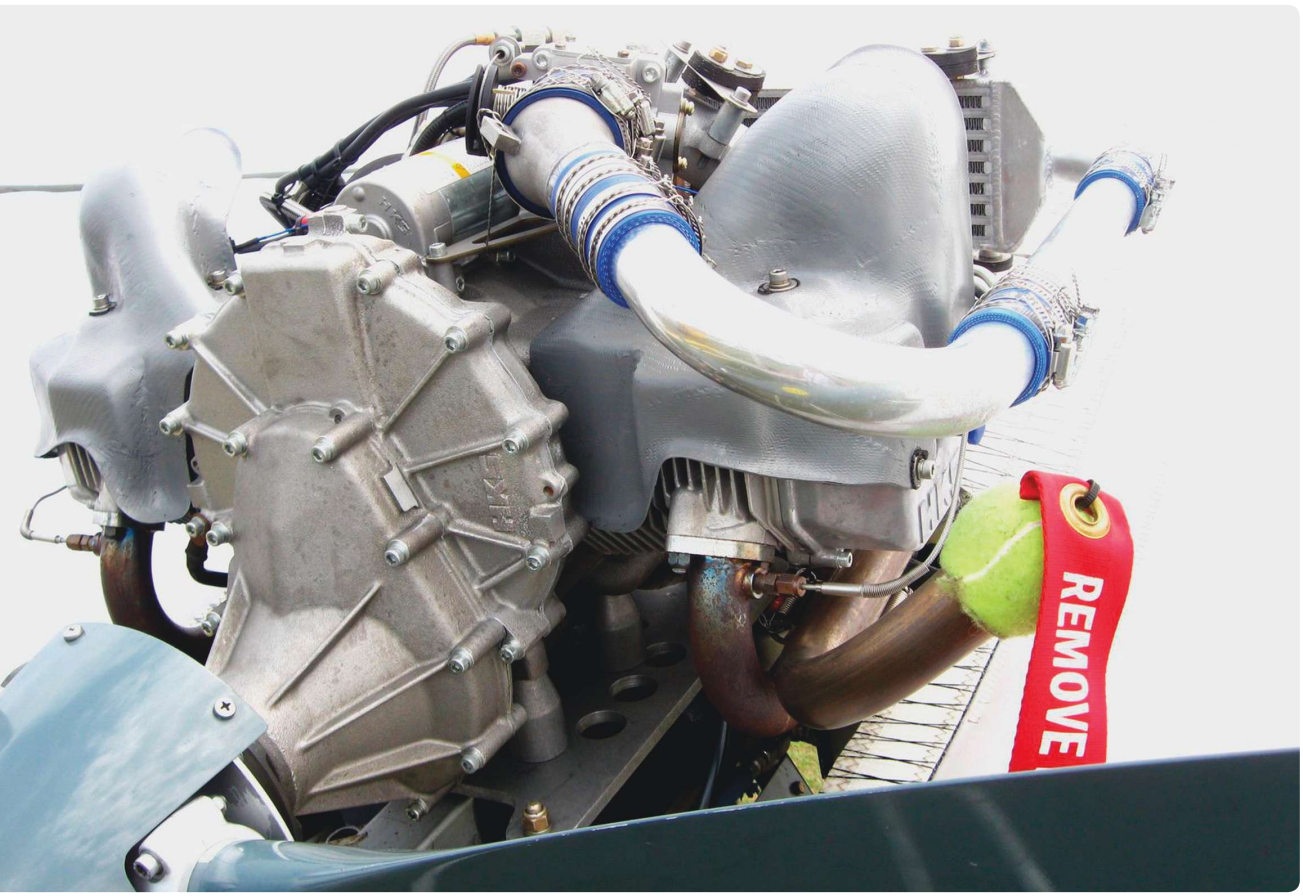
## A Slow Flight Award Winner

The M-Squared Breese, N8TU, built by Captain Raymond V. Anderson, U.S. Navy (retired), is an example of what you can do with an E-LSA. It also shows how our airplanes can be a form of personal expression and not just transportation to the pancake breakfast or a way to avoid buying a Cessna. This airplane is much more than that.

Ray earned his pilot certificate 44 years ago in a Cessna 140 at a cost of $705. It was a lot of money back then, but it got him into the Navy where he got to fly the Douglas A-4 Skyhawk and Vought A-7 Corsair fighters. When he left the Navy, he found that general aviation had priced itself out of existence, and he started flying the M-Squared Breese because of the low cost. In 2009 he began a project to demonstrate that a rugged, proven Breese airframe could be adapted with the latest innovations in LSA technology without losing its fun way of flying.

Ray took an already robust airframe for its type and added the kind of things you would expect for a pilot accustomed to landing a 12-ton, 600-mph jet on a moving carrier deck. The nose art on the modified Eipper GT-400 nose pod helps set the tone. It has a stronger landing gear and a wider, more comfortable seat. The original 52-hp Rotax engine was replaced with an 80-hp HKS 700T turbo for more power, greater reliability, fuel economy, and quieter operation. The original intercooler was replaced with a more efficient design. All fuel lines are metalized, and there is a backup fuel pump. Every detail on the airplane is very robust. It's built like a piece of military equipment.

Ray decided to modify the Breese for maximum slow flight. Over the last couple of years, he has added almost




*The HKS Turbo 700T engine provides 150-percent increase in horsepower over the standard 52-hp Rotax engine.*


*Nose art is appropriate for a veteran fighter pilot.*

every aeronautical "trick" known to aviation in a fun attempt to "go where no man has gone before." Talking to spectators at the 2013 Sun 'n Fun International Fly-In and Expo, Ray said anyone can make an airplane streamlined, put in a big motor, and go fast. His niche was going to be slow flight. He began with large wingtip endplates to reduce induced drag and to provide a mounting point for various wing enhancements. Vortex generators were added to the leading edge of the wing and the underside of the tail. A full-span leading edge slot was added. It entailed mounting an aluminum tube just ahead of the existing leading edge to carry the curved metal strip that forms the slot. Control surface gap seals were adapted from high-end rubber door sweeps for kitchen doors. They are in keeping with the extra robust construction throughout the airplane. Ray calculated that the total combined control surface gap in a tail of this type is almost one square foot. It's like having a one-square-foot hole in your tail, so it is no surprise the gap seals add to the control authority in slow flight.

Next up was full-span flaperons capable of deflecting downward as much as 40 degrees. The installation is extremely simple with no complicated linkages. Electric actuators were fitted in placed of the standard aileron pushrods. Special rod ends had to be machined so the actuators could mate with the existing aileron hardware. By now his combined modifications had lowered the stall speed from 29 knots to about 20 knots. He didn't stop there. At Sun 'n Fun he revealed full-span leading edge flaps (Krueger flaps). Like the flaperons, they are driven by electric actuators. Both sets of flaps are controlled by marine switches mounted in a waterproof box. Ray said he has flown as slow as 13.4 knots with everything deployed; but he cannot land at that speed because his landing gear is not tall enough.

The instrument panel sports a pair of 10-inch Dynon D10 displays, a panel-mounted Icom radio, and a Garmin GPS. The GPS has been linked to the Dynon displays, which provides an HSI display. Furthermore, if Ray de-clutters the screen and uses the VNav function, he can get a glide slope for landing just about anywhere. The judges at Sun 'n Fun were so impressed that they gave the Super-Breese STOL a special award for technological innovation.

Have fun with your E-LSA, and please send your comments and suggestions to dgrunloh@illicom.net. 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.

Photography by Dan Grunloh

# Sawtooth Climbs $V_Y$ Determination

## Creating your plots

By Ed Kolano

Last month we described the sawtooth climb test technique along with some hints and gotchas and provided a sample data grid. This month we'll show how to take the numbers you recorded during the flight test and turn them into plots that will show your airplane's best rate of climb speed, $V_Y$.

The data presented in this article came from sawtooth climbs performed during three flights. Each climb was timed over a 500-foot altitude change, and the middle of those pressure altitudes were 3,500, 6,500, and 9,500 feet. Average airplane weight during each climb was 1,442 pounds, or 208 pounds below the maximum allowed. Our center of gravity was right in the middle of the allowable range.

Flight test data were recorded on kneeboard cards during the flights and transcribed to a worksheet for the data reduction. We created the worksheet—last month's data grid—to have a single matrix of flight test data that will be easier to work with than a bunch of test cards and separate worksheets. The worksheet in Figure 1 contains the raw test data (yellow columns) and the numbers we calculated (blue columns) as part of the data reduction for the 3,500-foot test. We'll use the 80-mph data in the first row of our worksheet in the examples during our data reduction explanation.

### First, the Numbers

The first calculated column is the test altitude block height, which is merely the top-of-block altitude minus the bottom-of-block altitude. We'll use this height and the elapsed time to calculate the average rate of climb through the test block. Using the terminology in Figure 1,

$$\text{Press Alt Block} = \text{End Press Alt} - \text{Start Press Alt}$$
$$500 = 3750 - 3250$$

The next calculated column is the midpoint of the test block for each run. Determine the midpoint by adding the bottom, or start, altitude to the top, or finish, altitude, then divide by 2.

$$\text{Mid Press Alt} = \frac{\text{Start Press Alt} + \text{End Press Alt}}{2}$$

Calculate the average rate of climb (ROC) for each run by dividing the block height by the elapsed time it took to climb through the block. Our block height is in feet, and our elapsed time is in seconds; so we multiply by 60 to make the climb rate come out in feet per minute.

$$\text{Avg ROC} = \frac{\text{Press Alt Block}}{\text{Elapsed Time}}$$

$$938 = \frac{500}{32} \times 60$$

As we said last month, having your airplane's climb performance charts based on density altitude will allow you to use them anytime you know the density altitude you'll be climbing through. If we make the plots based on pressure altitude, they would only be valid at those pressure

altitudes when the outside air temperature (OAT) matched the OAT during the test. We used the midpoint pressure altitude and the OAT (measured at the midpoint of the test block during each run) and an intimidating equation to calculate the 3,794-foot density altitude for the example test run in our worksheet. You can use a similar equation, a flight computer, or a density altitude chart to determine the density altitude for each of your test runs.

The last column in our worksheet is the "Remarks" column. Some of this information came from the notes made in flight after each test run. We added other remarks during our analysis. Notice there are several runs with vertical speed indicator (VSI) readings. We did this as a "sanity check," and you can see that the VSI readings were close to the calculated ROCs but not close enough to use instead of the calculated values.

## Now, the Plots

Figure 2 is a plot of climb rate versus observed airspeed. The numbers came from the "Avg ROC" and "Observed Airspeed" columns of the worksheet in Figure 1. Notice that because the OAT varied by one degree Fahrenheit during the testing, there are two different density altitudes, 3,794 and 3,859 feet. Because they're only 65 feet apart, we averaged them to get 3,822 feet. We labeled the plot in Figure 2 as 3,800 feet, but it's really 3,822 feet. We did the same thing for the 6,500-foot (6,700 feet density altitude) and 9,500-foot (9,600 feet density altitude) test blocks.

Test Run Number 2 was annotated immediately after the climb as a low-confidence data point. That's why we repeated the test at the same 70 mph on Test Run Number 8. We plotted this data point (blue square in Figure 2) anyway, but we didn't use it when fairing a curve through the other points.

We also labeled the 95-mph test at a 3/5 confidence level. We decided to keep this point because the elapsed times recorded for speeds slower and faster than this one indicated our timing for this point was probably reasonable.

We performed the same data reduction for the other two sawtooth climb altitude blocks, which averaged 6,700 feet and 9,600 feet density altitude. After plotting the data for each altitude, we faired a curve through each set of data and removed the individual data points for clarity. Figure 3 shows our composite plot of climb performance curves. The peaks of the curves show the maximum climb rate and the maximum climb rate airspeed ($V_Y$) for each tested density altitude.

Having the unique $V_Y$ speed for just three altitudes isn't very useful, so we created a plot that filled in the gaps between the tested altitudes to show what $V_Y$ is for any altitude. Plotting the density altitude versus each density altitude's $V_Y$ (the airspeed corresponding to the peak of each density altitude curve in Figure 3) gave us Figure 4. Drawing a line through the three points in Figure 4 gave us a curve that shows $V_Y$ for any altitude between 3,800 feet and 9,600 feet density altitude.

We extrapolated the line to zero density altitude for illustration, but this is a bit of an assumption stretch. Another sawtooth climb series that centered around 1,500 feet density altitude would have provided an additional data point through which we could have drawn the line, making the extrapolation more reasonable. The same argument applies above 9,600 feet. If you like, you can add a climb rate scale to the right side of Figure 4 to give you a single plot that will show both $V_Y$ and the associated climb rate for any density altitude.

| Test Order | Observed Airspeed | Start Press Alt | End Press Alt | Press Alt Block | Mid Press Alt | Elapsed Time | Avg ROC | OAT (deg F) | Density Alt | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 80 | 3250 | 3750 | 500 | 3500 | 32 | 938 | 51 | 3794 | |
| 2 | 70 | 3250 | 3750 | 500 | 3500 | 37 | 811 | 51 | 3794 | Low confidence. Wandered fast; explains faster ROC. Don't use. |
| 3 | 90 | 3250 | 3750 | 500 | 3500 | 30 | 1000 | 51 | 3794 | |
| 4 | 65 | 3250 | 3750 | 500 | 3500 | 45 | 667 | 51 | 3794 | VSI 650 |
| 5 | 100 | 3250 | 3750 | 500 | 3500 | 29 | 1034 | 52 | 3859 | |
| 6 | 75 | 3250 | 3750 | 500 | 3500 | 37 | 811 | 52 | 3859 | VSI 750 |
| 7 | 85 | 3250 | 3750 | 500 | 3500 | 31 | 968 | 52 | 3859 | VSI 1000 |
| 8 | 70 | 3250 | 3750 | 500 | 3500 | 40 | 750 | 51 | 3794 | |
| 9 | 95 | 3250 | 3750 | 500 | 3500 | 29 | 1034 | 52 | 3859 | 3/5 confidence |
| 10 | 120 | 3250 | 3750 | 500 | 3500 | 30 | 1000 | 52 | 3859 | VSI 1050 |
| 11 | 140 | 3250 | 3750 | 500 | 3500 | 39 | 769 | 52 | 3859 | |

*Figure 1*

There's one more test to complete before you laminate your $V_Y$ plot; namely, a flight to check your results. You can fly three climbs through a selected density altitude, one at $V_Y$ (according to Figure 4), $V_Y + 5$, and $V_Y - 5$. The highest climb rate should occur at the $V_Y$ indicated in Figure 4. If it doesn't, you'll have to check your data reduction for errors. If no errors can be found, and if the difference is large enough to concern you, another sawtooth climb test should resolve the discrepancy. Perhaps your airspeed wandered a bit too much, or the air was a little choppy, or setting the climb power was not performed as consistently as it should have been. Here's where those quality notes can come in handy. Considering the confidence levels we assigned during our testing, the engineering judgment we applied during the data reduction, and how well the curves overlay the data points (we didn't show you this), we expect our new tool to be accurate.

That's it for $V_Y$. Next time, we'll take that same sawtooth climb data and create a similar plot for the best climb angle airspeeds ($V_X$). EAA

Ed Kolano, EAA 336809, is a former Marine who's been flying since 1975 and testing airplanes since 1985. He considers himself extremely fortunate to have performed flight tests in a variety of airplanes ranging from ultralights to 787s.

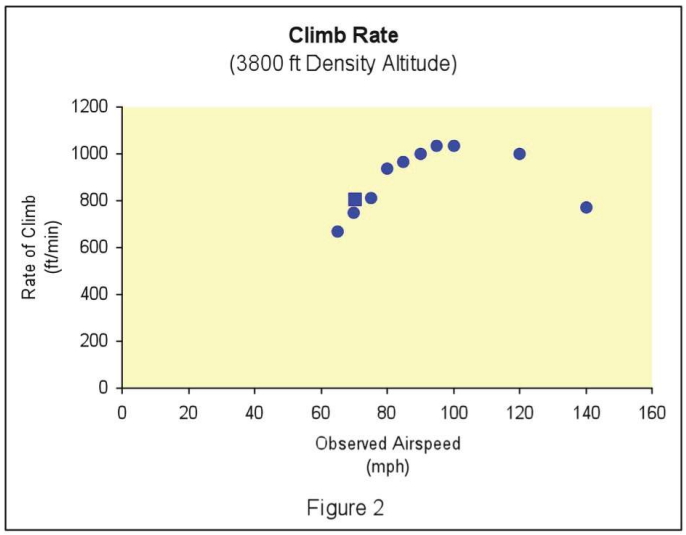


Figure 2

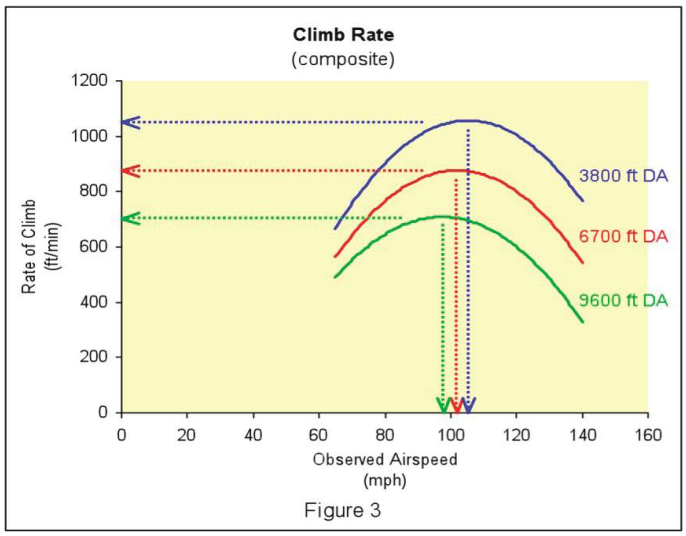


Figure 3

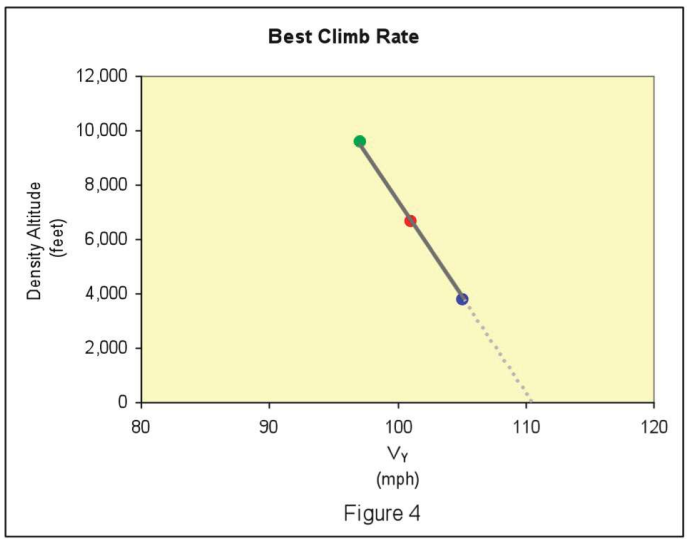


Figure 4

**Correction to 'Angle of Attack and Maximum Range'**
*Experimenter*, March 2013

I goofed. In the March *Experimenter* article "Angle of Attack and Maximum Range," Figure 3 included a plot of lift coefficient and drag coefficient versus angle of attack and stated that the greatest vertical distance between the curves represents the maximum lift-to-drag ratio. That's wrong. It represents the maximum *difference* between the curves—not the same thing, and not relevant to the maximum range discussion. Rather than enumerate the reasons for this error, I might just pen them as lyrics to a woe-is-me, country-and-western song.

The bottom line is maximum range glide occurs at the unique angle of attack where drag is at its minimum and the ratio of lift to drag is at its maximum. My apologies for any confusion, and please disregard Figure 3 in my March column. – Ed Kolano

# Help! I Need Somebody

## This Beatles hit is my theme song sometimes

By Rick Weiss

"Help!"

*Help! I need somebody*
*Help! Not just anybody*
*Help! You know I need someone*
*Help!*

*When I was younger, so much younger than today*
*I never needed anybody's help in any way*
*But now these days are gone, I'm not so self-assured*
*Now I find I've changed my mind, and opened up the doors…*

If you like music, you probably have sung these opening lines sometime in your life. If you don't know the song, Google the Beatles song *Help!*, read the lyrics, and listen to the song. After all, it was number one for a long time.

Now you're probably asking yourself, why am I reading this and what does it have to do with building an airplane? I repeat: Read the lyrics. Now picture yourself hanging over your project trying to figure out where all the wires are coming from and going to. Help, I need somebody…

I'm sure many aircraft builders can relate to this. I have about a dozen wires that I can't figure out what to do with, so rather than do what I would have done "When I was younger, so much younger than today," I spent some quality time on the phone with experts from three or four rather well-known companies in the homebuilt community. I'm sure my experience is not an uncommon one. "Help me if you can, I'm feeling down, And I do appreciate you being 'round." And sure enough every one of the people I talked with were not only technically competent, but also they were patient as I asked a dozen dumb questions about this or that…and then asked them to repeat everything as I tried to write their answers down.

Help from wherever it's needed—be it the manufacturers, fellow builders, online forums, *Experimenter*, EAA Member Services, or EAA chapters—is the true spirit of the homebuilt community: people helping people—fellow builders who have been down that road or experts supporting their company's products—each one passing on information and making sure that not only are the questions answered but also that they are the right questions and answers.

Of course, if I built the kit exactly as the designer intended, I probably wouldn't have any questions. Just "read the book" would have been the answer. However, let's be serious; we all want to put our "X" in experimental—a little modification here, a better idea there, all so that you can make the aircraft your own.

For those who were fortunate enough to make it to EAA AirVenture Oshkosh 2013, I hope you looked really hard at each builder's project to see if you could find two alike. Unless the plan was to build two identical experimental amateur-built aircraft (E-AB), I doubt you found any. If you look at any two production aircraft, they should be nearly identical. They're supposed to be. Not so with E-AB aircraft; that's what separates us from the others. We can experiment, tinker, change, add, subtract, and in fact, do nearly anything we like within the rules of the game.

I also hope while you were at Oshkosh 2013 that you visited the vendors who not only supply the products but also provide product support, with a smile on your face. These people care; they're out there to do their best and produce products that add value and safety to our planes and our lives. They do their best to get us in the air and "Help me get my feet back on the ground."

Go ahead, sing it—you know you want to! What a great E-AB community we have. EAA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