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December 2018 | Volume 35, Number 12

On the Cover: planes built and flown by some of our regular contributors. Clockwise from upper right: Dick and Sharon Starks, Airdrome Aeroplanes Morane-Saulnier Type L and Graham Lee Nieuport 11; Nigel Speedy, Van's RV-8; Sid Mayeux, Van's RV-7A; Tom Wilson, Stolp Starduster Too; Paul Dye and Louise Hose, Dream Tundra; Bob Hadley, Jabiru J250-SP; and Dave Forster, F-1 Rocket.

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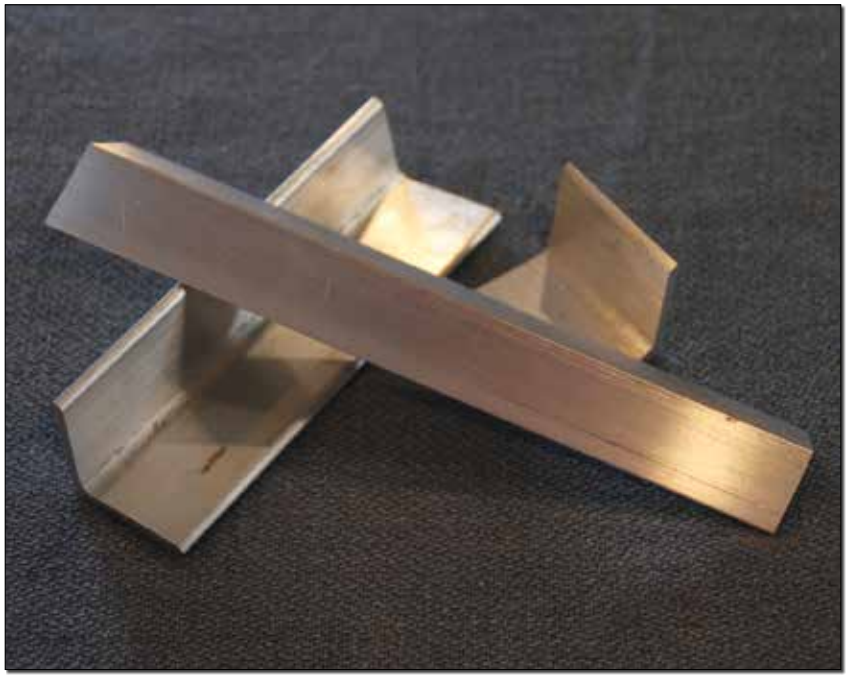
EDITOR'S LOG

Rites of Passage

Throughout human history, societal groupings of like-minded people have developed certain requirements for new members aspiring to join their fraternity. Whether it be a nation, a social club, a church, or a professional society, it is usually necessary for the aspirant to prove that they are worthy of joining those already members. Aviation is no different. We expect pilots to show a certain level of skill, designers to earn respect with excellent aircraft, and those involved in building those designs must show their readiness as well. The rite of passage may vary from locality to locality, or within certain subgroups, but we can generally agree that some things are necessary to prove that you are truly worthy of being called a builder of aircraft.

In the metal-building world, no one can be considered a true builder if they haven't drilled a hole in a finger—at least once. More than twice and we begin to wonder, not about your commitment to the task, but of your ability to learn from pain. (I know this because I am typing this with a Band-Aid on my finger where I got myself for the second time in my building career. Just a flesh wound…nothing serious.) Drilling one's finger is nevertheless a true indication that you are a metal airplane builder, and at some point, you got in a hurry to finish a line of holes before going in for dinner. Yes, you'll eventually do it, but we don't recommend grabbing a drill and getting it done with.

Building a part backwards is less common these days, with pre-fabricated parts so prevalent in modern kits. Yet it still happens to the best of us, especially when reading engineering drawings upside down because you didn't want to walk around the table to get a simple measurement. It especially happens when one drawing is provided for the "left" and "right" parts with the note, "Make the left the opposite of the right." What exactly does "opposite" mean when you're working in three dimensions?



"Now which one of these pieces was supposed to be for the longeron?"

Using the wrong piece of raw stock is another way true builders join the club, especially when that piece of raw stock is the longest piece of angle aluminum in the kit. Many have joined this club, which leads to the realization that you just cut the material intended for the longerons. Oh, the replacement material isn't very expensive—but shipping a 14-foot-long piece of aluminum sure can enrich the coffers of your favorite long-distance shipping company. Those who have participated in this particular rite will often have additional material shipped at the same time as the original piece, just to play it safe.

It is no longer considered mandatory to break your canopy blank to be considered a true builder, but there are still some companies that will happily sell you an extra one (when you buy the first) for a deep discount, especially

Paul Dye

Paul Dye, KITPLANES® Editor in Chief, retired as a Lead Flight Director for NASA's Human Space Flight program, with 40 years of aerospace experience on everything from Cubs to the Space Shuttle. An avid homebuilder, he began flying and working on airplanes as a teen, and has experience with a wide range of construction techniques and materials. He flies an RV-8 that he built, an RV-3 that he built with his pilot wife, as well as a Dream Tundra they completed. Currently, they are building a Xenos motorglider. A commercially licensed pilot, he has logged over 5000 hours in many different types of aircraft and is an A&P, EAA Tech Counselor and Flight Advisor, as well as a member of the Homebuilder's Council. He consults and collaborates in aerospace operations and flight-testing projects across the country.

when the shipping is expensive, and the two can nest together nicely in one box. Like buying extra long stock, it is often cheap insurance.

Another common way to prove that you are a true builder is to make a modification to the kit that looks great, but proves impossible to install or maintain later on. Lots of thought goes into airplane design, and the reasons some things are done certain ways, or in a certain order, is because the original builders boxed themselves into a corner the first time around, and they had to figure out how to prevent later builders from making the same mistake. Their cryptic instructions might have seemed like they were asking you to take a long way around—but usually, it's a good idea to follow their breadcrumbs.

Fabric builders know well the pain of stabbing themselves with a long rib stitching needle—or worse—stabbing their spouse with said needle after they have agreed to lie under a wing and pass the needle back and forth. Experienced builders who have done this deed often stab themselves quickly to take care of the potential for revenge to sneak up on them.

Composite builders who wish to enter the true guild know that they need to mix a paper cup of resin and hardener to make a slurry, but they discovered that they made too much and used a "fast" hardener to do it. The first clue they got was when the heat of the reaction started to smoke, followed by a rapid burning of the fingers, leading to a dropped cup and subsequent mess. Note that a multi-type builder might have both a burn scar and a drill bit scar on the same fingertip—true badges of homebuilder honor!

Oh—and whatever your building pleasure, no matter the materials, no matter how many times you have built, there is always one more rite of passage to go through, especially when you reach the point of flying your finished creation. For instance, will anyone who has *not* discovered that they forgot how to open the canopy (or door) from the inside please raise their hands? Yeah, I thought so… ∓

Photo: Paul Dye

LETTERS

EDITORIAL@KITPLANES.COM

Aircraft Build Times

I would love to see an article on aircraft build times. I am searching for a project that doesn't take too long to build. My mission is to go fast and far. However, I realize I am not willing to spend 3500 hours to build a plane that goes 250 mph. So, I have further defined the mission with a formula:

Speed of Plane ÷ Time to Build = Highest Number Wins

Here's an example:

Kit A's cruise speed is 198 mph
÷ 2700 hours to build = .073
Kit B's cruise speed is 138 mph
÷ 1000 hours to build = .138

In this example, Kit B wins. But it's very hard to know realistic build times. And, of course, build times vary wildly from builder to builder.

JEFF WESTON

Thanks for writing! Your idea is interesting, and I'll see if any of our contributors would like to look into it. The challenge, as you note, is collecting accurate information. Everyone builds at different rates, and everyone counts hours differently. Then consider that builder speed and experience varies widely enough as to double or triple the hours for many.

Another consideration is that some builders track time in the shop but don't include the many hours of "thinking time" that go into a build—researching accessories, avionics, etc., and pondering problems while away from the shop.

To address your own situation, I'd say that settling for a slow airplane that is fast to build doesn't really meet your requirements for a fast airplane, and therefore, you'll quickly regret that you didn't build what you wanted. Fortunately, there is an additional option: You can always buy a completed airplane and modify avionics, interior, etc. to your needs. This is the absolute fastest way to get in the air with an aircraft that does what you want it to do. Good luck with your choice!—Ed.

Educating the FAA

In the September 2018 issue, you published a letter titled "Bureaucratic Insanity" from a reader who was required by the FAA inspector to add eight pounds of ballast so the airplane would be within CG with no pilot!

I want to remind readers that one of the many services EAA provides to our members is educating the FAA on amateur-built matters. Many FAA personnel spend very little to no time working on special airworthiness certificate issues, so when they are faced with an issue, they will often (wrongly) assume that the answer for a standard category factory-built aircraft applies to our homebuilts. One call from EAA to the FAA staff member would have fixed this problem with the added benefit of it not coming up again in the future.

So if you get an answer from the FAA that seems to go against your understanding of what amateur-builts are allowed to do, feel free to give EAA a call to double-check.

CHARLIE BECKER
EAA DIRECTOR OF CHAPTERS
AND HOMEBUILT
COMMUNITY MANAGER

Davis DA-2 Correction

In "NextGen Heirloom" [October 2018], we incorrectly identified the original builder of Dennis Hutchinson's Davis DA-2. The original builder is Charles V. Jahn. We apologize for the error.—Ed. ✢

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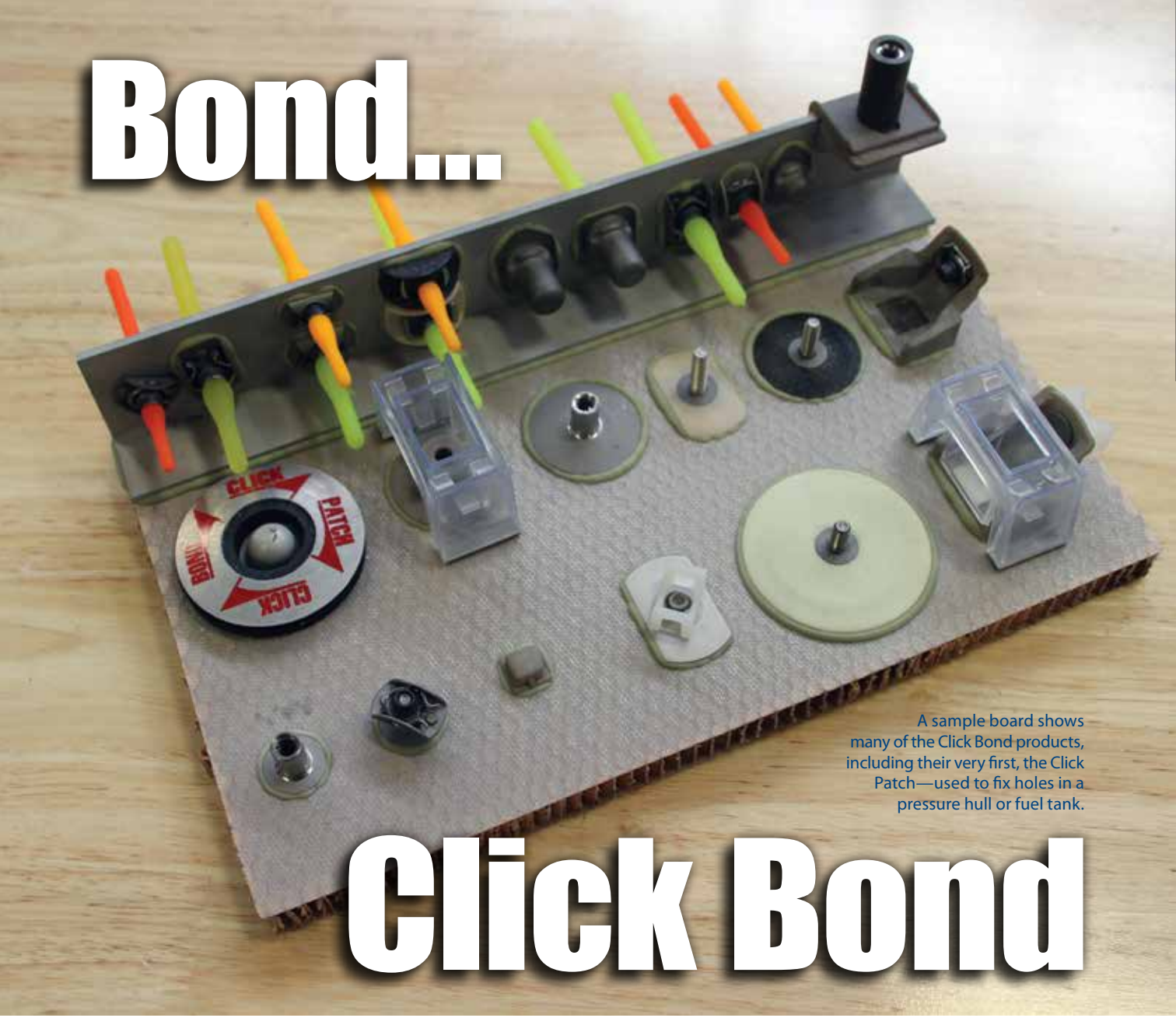


A sample board shows many of the Click Bond products, including their very first, the Click Patch—used to fix holes in a pressure hull or fuel tank.

Click Bond

Building a better nut plate.

BY PAUL DYE

What do you do if you're an established aerospace company that no one in a growing part of the industry knows about? You build an airplane using your components in order to show them off! That's what Click Bond, Inc., headquartered in Carson City, Nevada, did this summer.

But they didn't just buy an airplane kit and install their line of fasteners, stand-offs, and nut plates in it as they went. They did build an airplane—a Glasair Sportsman—and they used their products in every nook and cranny of the machine. But they did so by involving many of their employees who had never worked on aircraft, and they partnered with GAMA's Aviation Design Challenge to involve student builders from the Harkness Career & Technical Center, near Buffalo, New York. They achieved multiple goals by creating their airplane, teaching their employees more about aviation, and providing the next generation of aviators with a valuable learning experience. It was a win for everyone, and we had a chance to watch as the airplane came together.

Click Bond has been in the aerospace fastener business since 1987. I first heard of them while working in the space program, training on how to bond their standoffs and use their products as a leak repair kit for the International Space Station. Their adhesive-attached products made for an excellent patch in the case of a micrometeoroid hit that created a cabin leak—quick, fast, and permanent. Click Bond nut plates, studs, and standoffs are used extensively in high-end military and space equipment, allowing attachments with fewer

Click Bond nut plates were used everywhere in their Sportsman. Here they serve to hold the instrument panel to the structure.

Click Bond has sold a wing tip attachment kit for several years for RVs. Here they did the same thing on their Sportsman.

drilled holes in structures and making for much quicker installation times than traditional drilled nut plates.

Click Bond began marketing to the homebuilder world with wing tip attachment kits for the RV designs, their easily installed nut plates making for a quick, clean installation. While these have proven successful, they have not had a lot of market penetration for their line of nut plates up to this point, and part of this is simply a lack of familiarity on the part of homebuilders. They decided to remedy this by building an aircraft and including as many of their products as possible. The easiest and quickest way to do this was to go with an existing factory assist construction program. This would mean that they could concentrate on how to apply their products instead of figuring out how to build the airplane.

The heart of any Click Bond fastener is really the adhesive used to attach it to the aircraft. This is the common bond (excuse the pun) of all the products—an attachment that doesn't require drilling and stays put no matter the environmental condition. As anyone who has used hardware store zip-tie attachments with peel-and-stick foam tapes knows, heat, oil, and vibration can quickly leave your "secured" cabling dangling about in the bottom of your fuselage. Many builders use those same attachment points and substitute Shoe-Goo adhesive, but I have also seen that type of fastener pop loose under some conditions.

Click Bond's process involves a two-part adhesive that is mixed on the spot using small packets or a gun dispenser and mixing nozzle. If you're using just a few fasteners, the little packets of adhesive work just fine. If you are attaching a bunch of nut plates all at once, then the dispenser is a worthwhile investment, for convenience and the lack of mess. It is common to find epoxy adhesive now in double syringe packaging, and this is the same idea—but in the Click Bond system, the mixing tip is sacrificial (and relatively inexpensive), so you can keep on using the cartridges until all of the product is gone, simply by clipping on a new nozzle.

Where Click Bond shines, however, is not just adhesive—it is in creativity. They are constantly thinking up new shapes and types of fasteners, standoffs, and supports for use in the aerospace industry. Their online catalog at *www.clickbond.com* is a great place to go and look for ideas—and to see the variety of ideas that have already been developed. Most homebuilders will probably focus in on nut plates, cable tie fasteners, and

A Family Business—Crazy About Airplanes

Click Bond was founded in 1987 by Charles Hutter, a former Air Force officer who previously created an industrial design firm that worked in many technical fields. Always crazy about aviation, he has owned a string of aircraft and has an ATP to go along with them. He passed on his love of aviation to his son Karl (now CEO of the corporation), who also flies the many aircraft in the Click Bond fleet and also holds an ATP rating. And let's not forget Co-Founder Collie Hutter, wife of Charles and mother of Karl. Also active in aviation, she has served on airport and type club boards.

The Click Bond fleet consists of several Aerostars and a couple of different models of Citations…but recently added a Glasair Sportsman built by Click Bond employees and the student winners of the GAMA Aviation Design Challenge. The Hutters clearly emphasize the importance of aviation in the company's core mission and want to make sure that they share that with their employees. We found that the excitement was definitely catching as workers from all levels of the company got to get their hands on the Sportsman as it was constructed.

Click Bond is a growing business that wants to remember its roots and keep its close ties to aviation—and now, experimental aviation.

—P.D.

Click Bond President and CEO Karl Hutter poses after finishing with the job of safety wiring the prop. He was rightfully proud of his team and the work they had done as the build reached its successful conclusion.

Photos: Paul Dye

Nut plates come in standard sizes—here is a compact #6 and a standard #8. The different color fixtures tell you the size.

Here, the hollow Click Bond screws are used with nut plates to hold spark plug baffle grommets in place.

standoffs—and the variety even in these product lines is extensive.

Nut Plates

All Click Bond nut plates are essentially floating—you bond the baseplate, and it carries the threaded portion of the fastener. They come in standard aviation sizes (#6, #8, #10/AN3, etc.) and in locking and non-locking varieties. On the smallest, simplest, and lightest designs, the threaded element is captured with a rolled edge and is essentially permanent. In the most popular style, however, the threaded element is retained in the baseplate with a clip—meaning that you can actually replace the element if it becomes damaged or a screw breaks off in the element. The elements are also interchangeable, so that locking or non-locking elements can be traded out. We watched during the Sportsman build as they changed several dozen nut plates from locking to non-locking for the cowl in just a few minutes' work.

Nut plate mounts come in a variety of sizes and shapes, from direct replacements for two-rivet plates to mounts that are clipped shorter to fit in tight, small places. Additionally, many of the standoff products have integrated nut plates that can be used like the parts of an Erector Set to position items wherever they are needed.

Studs

Oftentimes, you need to fasten something to a specific point in an aircraft, but you'd rather not drill through the structure and have a bolt head on the other side of whatever skin or bulkhead you are fastening to. In this case, what you want is a stud—a threaded screw coming straight out of the structure. Click Bond provides these, either in metal or composite bases. You simply use their adhesive to bond the stud directly onto a flat surface, let the adhesive cure, and now you can mount anything you want using a nut to fasten it in place. If you are locating an item that requires multiple mounting points, you can attach the studs to the item, prep the mating surfaces, apply adhesive, and plunk the entire assembly in place at once. This puts the studs in exactly the right spots, so when the adhesive is cured, you remove the nuts, and the item can be removed as required.

Standoffs

In many cases of aircraft construction, wire bundles need to be carried through an aircraft, but you don't want them rubbing on the interior skin. In this instance, a standoff is what you are looking for—something to support the bundle on a sidewall, overhead, or deck. Click Bond standoffs come with either

A stud can be attached anywhere with adhesive and used to mount clamps for wiring or plumbing.

A standoff holds wiring bundles off of a floor or bulkhead to prevent chafing.

Installing a Click Bond Nut Plate

Installing a standard nut plate involves drilling three holes (of different sizes), countersinking the rivet holes, then riveting the nut plate into position using solid rivets if you can reach the backside or tiny pop rivets if the backside is blind. It is a process that an experienced builder has done hundreds of times on a particular airplane, and getting them all done correctly (and neatly) is something that makes many wonder if they really want to tackle another project.

Click Bond nut plates are attached with adhesive, and the only hole involved is the one that the fastener goes through. No jigs are required, no drill changes, no countersinking. Once you have located the fastener hole, you choose the appropriate nut plate and clean both the mounting surface of the nut plate and the surface to which it will attach with a special solvent wipe provided by Click Bond. You then thread the little rubber installation fixture through the structure.

Next, you mix up a little adhesive. You can do this from a tiny pouch with the correct proportions or using a cartridge gun and a mixing nozzle. Because the adhesive has a limited working time and the nozzle fills with mixed adhesive, you want to have a number of fasteners to install before you mix a batch to make the most use of the nozzle and adhesive. With the adhesive mixed, installing the nut plate is simple: Apply a bead of adhesive around the fixture, then pull the fixture through the hole where you are going to mount the nut plate, pulling on the fixture until it pops through to snap the nut plate into position. Let it sit for 30 to 45 minutes (depending on temperature), and it is ready to use!

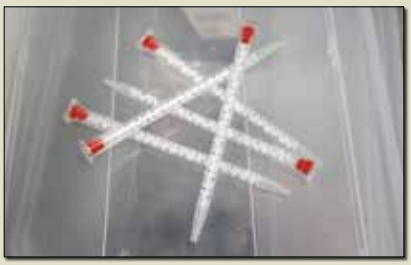
Using the adhesive gun is quick and clean—but do you waste a lot of adhesive that way, using only a little bit of the full cartridge? Well, no, because the only place the adhesive parts mix is in the nozzle, and the nozzle can be separated from the adhesive cartridge and thrown away. Then you pop on a new nozzle and mix away! The amount of adhesive lost is what was in the nozzle.

—P.D.

Start with the special Click Bond wipes to clean the area you will be working on.

Use the Click Bond cleaning wipes to clean both the nut plate and the surface to which it will be applied.

If you're going to install a lot of fasteners, the gun and cartridges work very well.



The disposable tips for the gun have spiral mixing inserts so that the adhesive is ready to cure when it exits the tip.

If you have let the gun sit with adhesive in the tip for a few minutes, clean it out by squirting the semi-cured adhesive into a waste plastic bag until you get the nice white color.

Apply the adhesive to the nut plate all around the fixture.

Thread the fixture through the hole to pull the nut plate up to the surface.

Pull the fixture until you hear a little pop, and the nut plate is seated fully.

You'll see a nice even bead of adhesive all around the nut plate if you have done it properly. After the adhesive cures, the fixture pops right out.

The Students

Harkness Career & Technical Center, Cheektowaga, New York

GAMA's annual Aerospace Design Competition is a growing event, with more participating schools each year. The 2018 competition involved 130 different schools, all working to design an aircraft that would perform better than those designed by other schools, given specific criteria specified by the contest. With a single four-person team representing the winning school, it would be easy to think that the other 1600 participants were losers—but this is far from the truth. The fact is that GAMA encouraged 1600 students to get involved in aviation, and that is a win not only for them but also for the future of aviation.

In effect, the four students who spent two weeks in Arlington helping to build the Click Bond Sportsman were representing all of the students who participated from across the country. The winners were from the Buffalo, New York, area, representing the Harkness Career & Technical Center. The vocationally oriented high school has an aerospace program that is broad and well rounded, giving students exposure to both aviation and space, from the aspects of design, construction, maintenance, and flight.

The design challenge this year involved starting with an RV-10 design and improving it in terms of speed, range, and efficiency. The students worked with an X-Plane simulator to implement their changes, then flew specific missions to prove that their design would meet the design goal. After they achieved an optimum flight, it was submitted to the judges, and the Harkness students were the winners.

The students (and two teachers) spent the full two weeks of the build in Arlington, Washington, meeting GAMA member company representatives who supported the project, learning construction techniques, working alongside Glasair and Click Bond employees, and getting mini-lectures on aerodynamics and other aviation-related topics. At the end of the week, they got to see the aircraft that they helped assemble have its first engine start—and then got to ride along on the first taxi tests on the ramp.

This program is one of a number in today's aviation environment designed to expose students to aviation at a young age. All of the students in this year's program expressed keen desires to find careers in aviation, a sure sign that these programs are working to foster a future generation of aviators and aircraft builders.

—P.D.

Students, teachers, and Click Bond employees posing for one of the many photographs taken with industry reps and other builders during the week.

Students help to a fold the wing on the Sportsman in preparation for installing fuel lines.

Rolling it out, ready for engine start!

The students got a chance to ride along on the first taxi tests of the airplane they built.

The "spoon" standoffs can be used to fasten wire bundles or, in this case, to serve as attachment points for a wiring tunnel cover.

an integrated nut plate, so you can use an Adel clamp with a screw directly to the top, or with provisions to thread cable ties through the top and secure the bundle that way. In either case, the standoffs come in different heights and sizes to give you just what you need.

Some standoffs create a surface 90 degrees to the original mounting surface; these are useful for mounting rigid tunnels or simply attaching bundles directly to the standoff using an Adel clamp. Click Bond has a carbon fiber 90-degree standoff they colloquially refer to as a "spoon" because it was inspired by a soupspoon one of the founders was using in a Chinese restaurant when he was trying to develop a particular product. Such innovation is common with Click Bond as they devise products to fill particular roles.

Inserts

A significant product line for Click Bond is their array of inserts used to protect composite structures that are penetrated by bolts. Since these structures are subject to wear when bolts are inserted and removed, they have devised a very thin metal insert with a countersunk flare at the top that can be bonded into holes (with different lengths for different thicknesses of composite) so that the fasteners are running through metal instead of the composite. This can be great for thick structural components in the aerospace industry, but it can also be useful in lighter, thinner homebuilt structures

A spoon standoff used to mount cable connectors to the floor of the cabin.

such as composite cowls. It is great for large bolts holding structural components such as spars to fuselages, of course.

LoMas Screws

One of Click Bond's latest products has nothing to do with adhesives, but is a close relative to their inserts. Their recent line of hollow screws (in #8 and AN3 sizes) is there for creative homebuilders to use. They can save quite a bit of weight if used throughout an aircraft where ultimate strength is not required—such as fastening Adel clamps and holding floor and wall panels to structures. These screws are drawn with special machines, have standard thread sizes and grip lengths, and an integrated washer in the head that spins separately from the screw, so a separate anti-gall washer is not required.

When we first saw the hollow screws a year and a half ago, they were available in AN3 sizes and larger. During the Sportsman build, we were introduced to the smaller #8s, which are perfect for builders who want to shave every gram off their build. There are lots and lots of #8 screws on most homebuilts. Not a lot of weight for sure—but pounds are made up of ounces, and many builders save a lot of weight a little at a time.

Creative Ideas

One of the interesting things about Click Bond is the creativity they bring to aviation fastening. The common thread in all of their products is adhesive bonding; almost everything they make is bonded to structure in some way. Beyond that, the sky is the limit! Click

Click Bond makes hollow screws in standard AN sizes. They may not save enough weight to make them necessary on light aircraft, but they are still amazing!

Bond engineers are constantly looking at new shapes for standoffs, new ways to accommodate tight places with nut plates, and ways to protect composites from wear and tear.

When fastening the cowling on their Sportsman project, the factory personnel weren't satisfied with the standard use of countersunk screws and Tinnerman washers going through countersunk holes in the fiberglass upper cowl, then into nut plates on the flange of the lower cowl. The countersunk holes just seemed ragged, and the Tinnermans are visually large on a small cowling. The solution? Click Bond makes a countersunk sleeve designed to protect holes in thick composite structures. But the cowling is thin! No problem—they used a countersunk sleeve with no cylindrical depth, bonded it in place, and then had a perfect hole for the screws...forever. You could do this with epoxy and a Tinnerman, but epoxy is brittle; the Click Bond adhesive is not, so it doesn't pop off.

Summary

No matter what you are building, you can probably save time and weight by using Click Bond fasteners. You will, of course, spend more money over the use of standard hardware, but if you value your time as part of the build expense, then you might find that the added expense is reduced quite a bit. The real advantage to using Click Bond parts such as nut plates comes from reduced hole drilling and countersinking, and the fact that fewer rivets need to be set—some of those in very hard to reach places. For builders of composite aircraft who have limited riveting skills and tools, these types of fasteners may be even more attractive as they don't need to add a new skill set to their repertoire.

The Employees

It has been a long-time dream of Click Bond President and CEO Karl Hutter to build an airplane. As a life-long aviation enthusiast and ATP-rated pilot (who routinely flies the company's Citations and Aerostars), Karl not only wanted to build a plane, he wanted to share the experience with the Click Bond employees. This was not only a way to show them how their products are used in the real world, but a genuine desire to see more folks have the chance to experience aviation and maybe start down the road to flight for themselves.

The GAMA Design Competition provided a perfect opportunity for him to make this happen. Partnering with the industry organization, Click Bond gathered support from industry participants such as Hartzell and Garmin—both of which contributed major components to the build—as well as Glasair to provide a learning environment for everyone involved.

Click Bond management accepted applications for over 30 employees who wanted to be a part of the project. They winnowed this down to 12, chosen from across the company, to spend several days at a time at the Glasair facility in Arlington. Click Bond Flight Department Manager Jere Marble and Hutter shuttled the employees up and back in the company's aircraft, providing them not only with a good building experience, but exposing them to the flexibility of general aviation flying as well. Who doesn't want to skip the lines at the airport and go point to point in a Citation?

We rode along on the final trip up and back, spending two days at the end of the project observing—and occasionally turning a wrench or two. On this trip, we accompanied three typical Click Bond employees: a young lady who threads and locks nut plate nuts, a young man who helps maintain all of the industrial machines used to manufacture Click Bond products, and a company chemist (and current student pilot) who provides expertise on the adhesives and other materials used in Click Bond products. None of them had worked on an airplane before, but all were excited to learn the techniques and put parts on the airplane that will become a part of the Click Bond fleet—hopefully as an anchor of an employee flying club.

All of the employees who participated seemed to enjoy the experience, and talked of little else on the trip home. It was hard to tell who appreciated the opportunity more—the adult employees or the student winners of the design competition. The truth is that everyone benefited, no matter their age or current occupation. And that is a significant benefit to aviation in general, and experimental aviation in particular.

—P.D.

Everyone who worked on the Click Bond Sportsman was given a pen and asked to sign the backside of the rear cabin bulkhead. The collection of names included employee builders as well as industry supporters—and maybe even a journalist.

Click Bond Flight Department Manager Jere Marble and CEO Karl Hutter inspect wiring under the seats of the Sportsman.

Click Bond employees join the student builders and Glasair employees for a briefing before work started on the final day of the build. The team worked very well together to achieve the common goal of finishing the airplane on time.

The Click Bond adhesive gun, cartridge, and nozzle.

Click Bond is intent on gaining visibility in the homebuilt market, and their intent is to use their new Sportsman to show off the many creative uses of their line of fasteners at airshows and fly-ins across the country. Look for their plane at the major shows and some of the minor ones. Get up close and personal, and see what ideas it might spur in your mind for your own build, or for those already flying, in maintenance situations. Sometimes, it pays to spend a little more to make fabrication and maintenance easier, and Click Bond has some creative ideas to help. ✢

Where to Buy Them

Click Bond has, up until recently, sold their products in large part to the high-dollar aerospace industry. They are used to selling nut plates in quantities listed in the thousands—not the few that a typical builder might need. However, the founders are simply crazy about general aviation and want to make their product more available to the average airplane owner and builder. As of the time of this writing, you can buy Click Bond products through their authorized distributor, The Flight Shop *(www.theflightshop.com)*, based in Brigham City, Utah. The Flight Shop carries a full line of Click Bond products, such as nut plates and stand-offs, that a builder might need, and they do that with no minimum quantities. A few of their products are also available through Aircraft Spruce.

—P.D.

So You Want to Buy a Used Homebuilt?

It's not always as easy as it seems.

BY LANCE HOOLEY

You found the perfect Long-EZ. But the owner has it for sale at 52,000 bucks. Hmm...

We'll use the Long-EZ as our example in this article. Canard airplanes are what we deal with at Jet Guys, and we see the following scenario regularly. It can also happen with other types of experimental aircraft, so here you go.

The perfect Long-EZ you found has an IO-360...kinda high time, but it's not using oil, has really good compressions, dual electronic ignition, and fuel injection. It's IFR with an IFR GPS WASS nav/com unit, second com, EFIS, autopilot, standby attitude indicator, engine monitor that does everything, really good paint and interior, has less than 150 hours total time, and was built and maintained by an A&P. Not to mention it goes like stink—192 knots true, burning nine gallons per hour. It needs nothing and comes with a spare prop.

So, you give us a call, and our conversation goes something like this:

"I found this Long-EZ (the one just described), but I've seen some others listed for less than $35,000, and I'm thinking of buying one of them instead."

"Really. Tell me about your second choice."

"Well, it's in California, has 800 hours on it, and hasn't flown in seven years. The engine, an O-235, was overhauled when the airplane was built 15 years ago. It has

The owner of this VariEze "just wanted to overhaul the engine."

electronics that were available back in 1984: 360-channel radios, no transponder, and Stewart Warner gauges. The widow only wants $30,000 for it, and it has new paint. The owner succumbed to cancer four years ago."

"OK."

"So, can you guys get it back up to speed and flying? Can't be hard; it's a flying airplane. And after you get it in your shop, would you put an EFIS in it and a new radio and transponder?"

"Sounds easy, huh? Let's break this down...we have to drive from Tennessee to California and back with a trailer both ways; there's a week's time. So you're looking at two grand to *recover* the airplane. Yeah, it's a recovery. It will be covered in dirt, hopefully dissembled, with flat tires, and have to be dug out of the back of a garage."

Fast forward a week or so, and it's time for another phone call:

"Your project...yep, it's a project... is now in our shop in Tennessee. First thing you said you want is new radios—a nav/com and a transponder. You don't want a GPS nav since you're going to use your iPad."

"Uh-huh..."

"OK, you also want one of those snarky small EFIS units. And you want us to move that row of switches...oh, and put in a replacement instrument panel—you know, one of those carbon-covered aluminum panels we do."

"Yeah...and you do know where to get instrument panel placards made up to the correct size, right? And can you install an autopilot, too?"

"Sure, right after we pull the current boat anchors out of the panel—yep, they're trash—and by the way, we found the wiring is code-compliant house wire throughout the airplane, complete with a copper tube down the side of the fuselage for a ground strip.

"Really? Are you sure?"

"So let me guess...you want us to use the existing wiring and plug in eight grand of new radios?"

"If you can..."

"Ain't gonna do it. And to be honest, it's faster, cheaper, lighter, and safer to rewire the whole airplane. By the time we figure out how it's wired, it's easier to start over. So just to wire the new radios together is close to 10 days of radio-guy work...and he's paid by the minute...like a buck a minute. But he is really good."

Now, I know what you're thinking—it doesn't really happen like this. Well,

(Left) The original cowling on the "just overhaul the engine" VariEze was ridiculously heavy. To build the bottom cowling, we flipped the airplane upside down. (Right) Sometimes to work on the inside, it's easier to put the fuselage on its side.

Photos: Lance Hooley

(Left) What's an engine overhaul without new baffling? A really good job on baffles is a 10-day process. (Right) The red and silver are House of Kolor paints that require a clear coat.

sorta...usually it's even worse. The next call often goes like this:

"By the way, you're going to need new tires and tubes. And we need to bleed the brake system after the brakes are rebuilt."

"You do?"

"Of course. What, you expect O-rings to last forever?"

"Uh..."

"And remember those 1984 Stewart Warner gauges you have? Well, half don't work...which is cool because you want an EIS engine monitor system installed...but it's going to require new sensors and wiring, too."

A few weeks later, we finally get to run the engine. Now I have to ask a couple of very serious questions:

"The carburetor hasn't seen fuel in seven years—what are the odds it will work? What are the odds that anybody would want to fly in front of it? Probably about 0%. But we'll try anyway. Who knows..."

"Uh-oh. Please let me know how it goes."

So, we pull the plane out of the hangar, dump in 10 gallons of fresh fuel, and poof—the fuel selector in the front seat leaks...just a minor O-ring, so we start it. Yeah, we already replaced the dead battery.

Bang, cough, and a couple of backfires later, it kinda runs. Oh man, it's sick. Forget a mag check—can't get that high in rpm. Pull the mixture to shut it down and nothing happens. Turn the mags off...yeah, it dies.

The compression check shows one cylinder at 65 and the other three between 42 and 55. I'm not making this up, y'all. It actually happened.

We borescope the cylinders and yep, all kinds of pitting and corrosion. No surprise there. Time for an engine overhaul—and another phone call:

"While the crank was out being checked, it was found to have a crack. Cylinder and pistons are shot, too. Let's say it goes well...for an O-235, you might get out for about five grand."

"Ugh...doesn't sound good."

"Oh, the carburetor...Send it out and get it overhauled, too—800 bucks and about two months to accomplish."

"Can you put in an O-320?"

"Yeah, but..."

A few weeks later, an O-320 shows up that is half run out, but reliable. Cool!

But wait—the prop is bent the wrong way. It's for a tractor type...880 bucks for a Sterba wood prop and two

A Long-EZ that hasn't flown in four years gets transported to the Jet Guys shop.

(Left) Even though snarky green tape with Sharpie ink is legal, you want appropriate placards on the panel. (Right) New mini EFIS and audio panel installed in a Long-EZ.

more months. But there's a whole lot more to discuss:

"You do realize the O-320 will not fit under your O-235 cowling or on an O-235 engine mount, right?"

"Uh-oh..."

"So we'll build a new engine mount, dump the fuel—only 10 gallons—and take the wings and canard back off. Then we'll flip the fuselage over and make the lower cowl. Then it's back upright to make the upper cowl. Next, we sand and fill, then paint...You do have the exact paint numbers for a match with your fresh paint job, right?"

"Well, um...Hey, since you have to make a new engine mount and all, can you put dual electronic ignition in it?"

"Yeah, sure. Oh, by the way, the O-235 exhaust pipes won't work either..."

Finally, the plane is put back together and ready to tweak. The EFIS has to be calibrated, engine sensors brought up, plus a couple dozen other tasks that must be completed before it's ready for flight. Guess what, it's out of rig...common.

After two days of test flying at 500 bucks a day for the test pilot, you now have a 155-knot cruiser. No gear leg fairings or wheel pants, which takes off about 13 knots. Oh, you want those, too...

So here's your airplane a year after you bought it for $30,000. You only paid $73,000 for it in the end.

The reality is, you have a choice: fly now or fly later and pay more money. The $52,000 bird may have seemed expensive, but was it really? Please understand, doing all the upgrades is one of the things we do. We'll do whatever you want because we want our customers happy. But which way really makes you happy?

This scenario plays out regularly at the shop. None of it is made up. It applies to Velocitys, Cozys, Longs, VariEzes, and probably any airplane that has been sitting unused for years. The way we proceed is really up to you. ✚

As this issue was going to press, we were saddened to learn that Lance Hooley died in a crash in his one-of-a-kind Jet Eze near the Covington (Tennessee) Municipal Airport. We extend our deepest condolences to Lance's family and his many friends in the canard segment of experimental aviation.

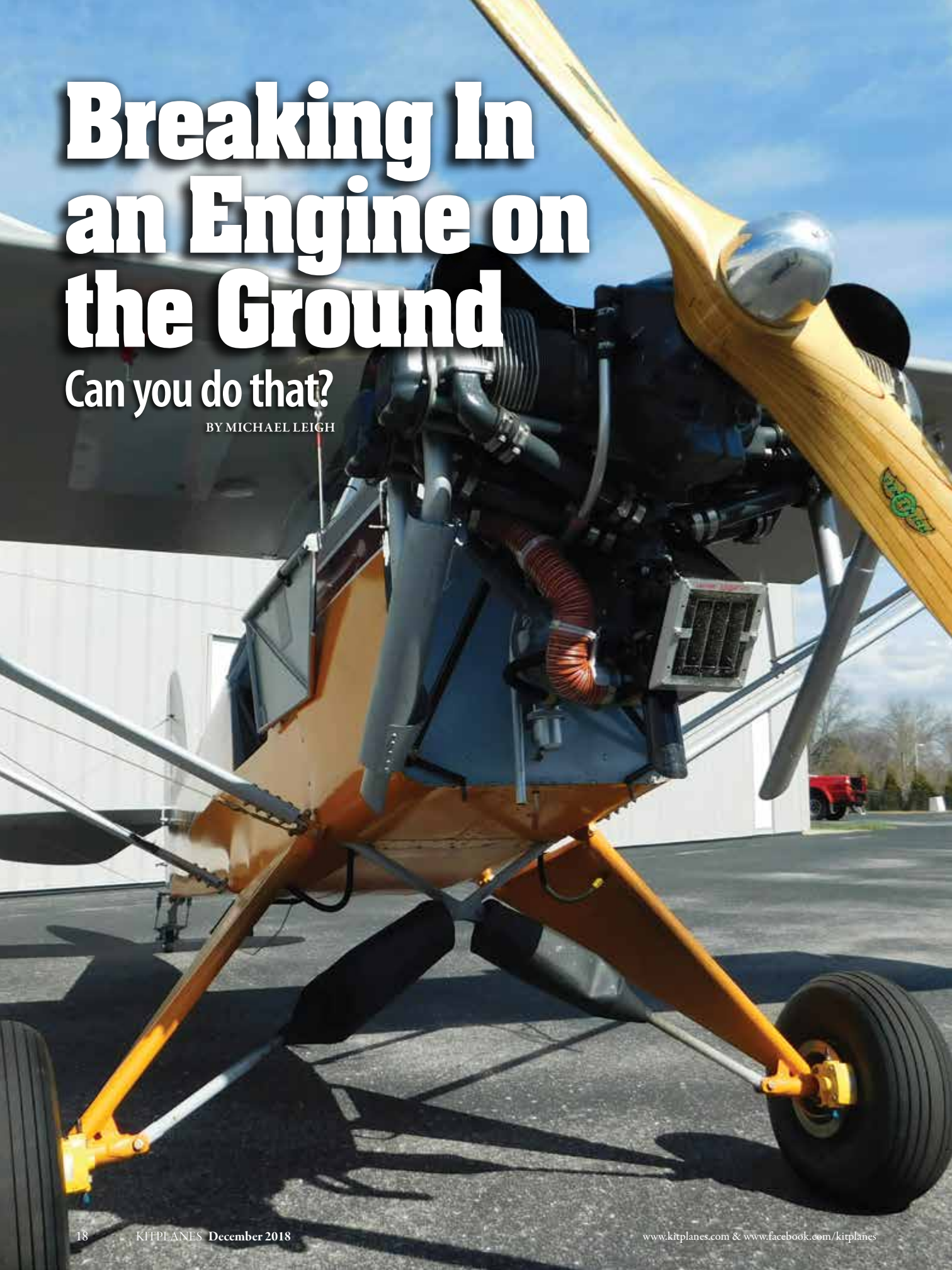
—Ed.

When all is said and done, perhaps it would have been cheaper to buy a more expensive plane that's already flying with the equipment you want.

Breaking In an Engine on the Ground

Can you do that?

BY MICHAEL LEIGH



Engine break-in is intended to seat the piston rings to the cylinder walls by a controlled wearing of both surfaces. After the procedure is completed, oil consumption and operating temperatures will decrease, and compression will increase. Aircraft engine manufacturers give guidelines for break-in, warning to avoid prolonged ground running. The reason is that light cylinder pressures and insufficient cooling will cause oil residues to bake onto the cylinder walls. The reduced metal-to-metal contact will prevent the rings from seating properly. To avoid this, the airplane should be taxied to the active runway without delay, taken off, and flown at continuous power without exceeding any critical operating parameters.

If you have built your own airplane with a newly overhauled engine as I have, you basically have an unproven airplane with an unproven engine. The homebuilt testing guidelines indicate that a series of taxi tests will be needed to prove the ground handling characteristics before committing to flight. However, this contradicts the advice of the engine manufacturer. This is a perfect example of a procedural impasse.

Feeling a bit confident in my problem-solving skills, I decided that I would break-in my engine on the ground. Yes, on the ground! Soon I was told that I was about to do the worst possible thing to my engine. Specifically, I just needed to (shape up) and get in the airplane and fly it. OK then, what can happen once airborne high above the ground. Let's see.

- Sudden engine stoppage
- Misfire and rough running
- Smoke coming out of exhaust
- Heavy vibration
- High operating temperatures
- Low or no oil pressure
- Loose parts suddenly discovered

Each one of these challenges must be evaluated separately, and the appropriate action taken to prevent serious harm to the pilot and airplane. On the other hand, ground running requires only one solution to every problem—shut the engine down!

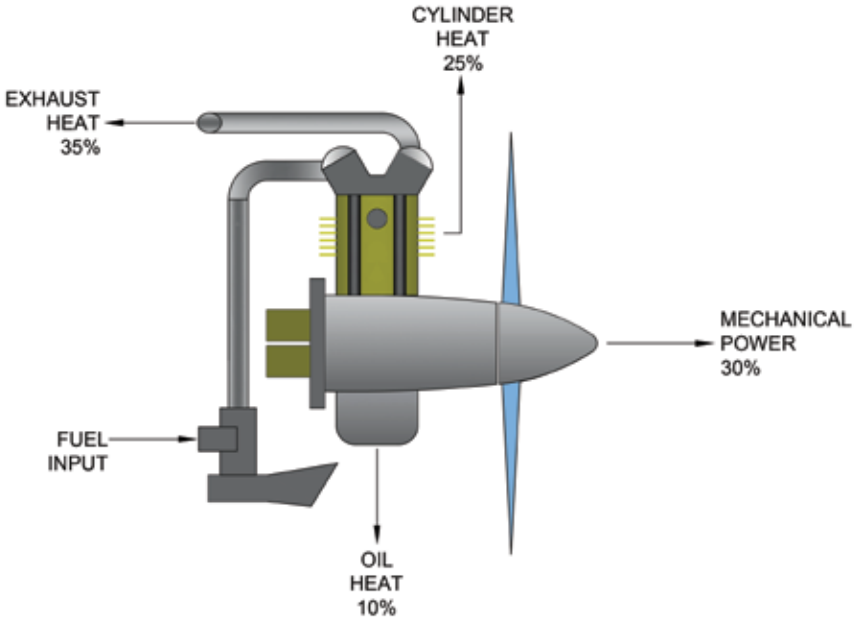


Figure 1: Waste heat represents a major portion of the energy available in gasoline.

Stay Cool

The bottom line in breaking in an engine is controlling the heat while still carrying substantial power. A gasoline engine is about 30% efficient. In other words, only 30% of the energy involved in burning gasoline appears as power at the propeller, and the other 70% is converted to heat. Figure 1 illustrates the major heat flows for a hypothetical single-cylinder job. As you can see, most of the heat goes safely out the exhaust pipe. Unfortunately, some stays in the engine with potentially dangerous effect.

The objective during break-in is to produce sufficient cooling to maintain the temperatures under control. If you decide to go with the procedure I am about to suggest, you will need to refer to your engine manual to determine the temperature limits. For my Continental A-75, the maximum cylinder head temperature (CHT) that I would permit is 400° F. The maximum oil temperature is limited to 220° F. EGT readings were taken but found useful only for leaning the engine. At the break-in power settings, the mixture control (if available) is pushed to full rich.

A method was needed to simulate the cooling conditions that occur in flight. Figure 2 shows a proposed solution. A blower supplied high velocity air through the flexible duct into the plenum chamber. The forced air created pressure above the cylinders, which was measured by the water manometer. Baffling around the cylinders caused the airflow to hug the fins and thereby transfer heat to the air, which was then exhausted below. Tight baffling maximized the cooling effect from the available air volume.

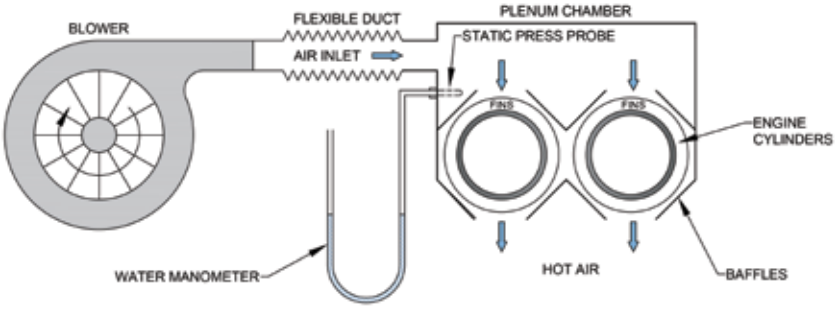


Figure 2: An alternative way to provide cooling air on the ground.

Photos and illustrations: Michael Leigh

Two leaf blowers were obtained from the local hardware store to provide the forced air. These were adequate for my size of engine, but may not be appropriate for anything larger. Figure 3 shows the resulting implementation. As you can see, Clecoes were used on the front covers to allow inspection of the CHT thermocouples that were installed on the top spark plugs. The water manometer is shown positioned at the side of the assembly in view of the pilot.

The manometer consists of a U-tube of clear plastic tubing half filled with water. Air pressure connected to one arm of the tube causes an imbalance of water level, which can be regarded as a pressure indication. Although only an inch or two of pressure was required, anything that caused that pressure to drop was a cause for immediate concern. A blower that has tripped a circuit breaker cannot be heard over the noise of the engine, but the cylinder temperatures will rise quickly.

Why not just use a test club and get it over with? That might be a good idea for a larger engine. After all, the full power of the engine would be available to provide cooling air. Just like with clean, abundant nuclear energy, the power must be controlled carefully. If you decide to make or buy a club, it must be able to absorb the full power of the engine, be properly balanced for the maximum rpm, and be able to withstand the bending forces on the blades (without resonance). In addition, an oversized scoop would be required over the engine to direct the prop wash through the cylinders. Considering the dynamic pressure and area of the scoop, the forces can be substantial. The scoop should not go flying before the airplane is ready!

Figure 3: Aero engine with addition of forced air cooling for ground running.

The Procedure

My break-in operation began by filling a five-gallon gas can from the airport's 100LL pump and transferring it to the airplane's fuel tank. This amount of fuel should provide for at least one hour of running time. I measured and recorded the height of the fuel float rod extending out of the gas cap. I also noted the starting oil level. Next, the airplane's tail was tied down to a stationary object, as shown in Figure 4.

After the usual preliminaries, the prop was pulled through, the engine was brought to life, and then the blowers were started shortly thereafter. After climbing into the cockpit, the data collection began. Shown in Table 1 is the data from the first run. Measurements included clock time in hours and minutes, tach time in decimal hours, oil pressure in psi, engine rpm, cylinder head

Continental Run In A-75 Date: 26 Feb 2016			Ambient Temp = 48˚F											
Time	Tach	Oil Press	Oil Temp	RPM	Cyl #1 Sw #1	Cyl #2 Sw #2	Cyl #3 Sw #3	Cyl #4 Sw #4	EGT #1 Sw #5	EGT #2 Sw #6	EGT #3 Sw #7	EGT #4 Sw #8	Start Oil Level	Fuel Used
12:49	0.40	37	<100˚F	700	68	75	69	69	776	608	778	783	4.5	4 5/8" on rod
12:56	0.45	38	<100˚F	1500	82	82	83	83	1007	1060	1031	1041		
1:01	0.50	40	<100˚F	1700	91	91	96	93	1040	1081	1132	1149		
1:09	0.61	39	<100˚F	2000	104	100	112	108	1124	1134	1226	1259		
1:16	0.72	37	<100˚F	2150	109	104	121	116	1134	1153	1296	1332		
1:23	0.83	36	<100˚F	2150	110	105	124	120	1129	1159	1304	1318		
1:30	0.94	36	<100˚F	2150	107	101	120	114	1122	1148	1312	1329		
1:42	1.13	37	<100˚F	2150	104	102	118	114	1122	1143	1296	1326		
1:47	1.21	37	<100˚F	2300	111	106	125	120	1235	1307	1276	1258		
1:52	1.29				******** Engine Quit **********								4.0	7/8" on rod
____	____													
63 min.	0.89 hr.													

Table 1: Engine Run-in Log Sheet.

Figure 4: Front plenum covers off for pre-run check. Remember to set brakes on pickup truck.

Figure 5: Thermocouple wires come in from the left and the 12-position switch determines which temperature point is indicated on the readout.

temperatures in degrees F, and exhaust gas temperatures in degrees F. A rotary switch was used to select the CHT and EGT points of interest. Figure 5 shows the view of the instrument panel that provided this information. Ambient temperature was measured by taking the EGT temperature before starting the engine. The throttle was advanced in steps to ease the engine up to the cruise power setting of 2300 rpm.

I soon faced my first crisis of confidence. The test was terminated rather suddenly with an abrupt stoppage of the engine as noted by the last entry in the log sheet. This event either represented clear justification for doing the ground run, or proof that I just did the worst possible thing to my engine. The problem was eventually traced to the fuel tank float rod being 7/8 inch too long. The engine simply ran out of gas.

Further investigation of the log shows the oil temperature readings

Figure 6: Vapor pressure bulb removed from oil strainer and replaced by a thermocouple.

Figure 7: Exposed junction type-K thermocouple (inset) and hand-held thermocouple readout used to accurately read oil temperature.

ridiculously low. The bottom of the temperature range was 100° F, yet the needle never moved off the peg. A new temperature gauge was ordered and installed, giving slightly better readings but still too low. Both gauges (with vapor pressure bulb type) indicated approximately 212° F when submerged in boiling water. An old mechanic's adage came to mind, "If the heat's not going where it's supposed to, then it's going someplace else." That was the answer. The heat was short circuiting the sensing element and going through the fittings. The bulb and mountings are shown in Figure 6. An exposed junction thermocouple, shown in Figure 7, was substituted and inserted deeper into the oil strainer to get better readings. Oil temperatures thereafter registered about 195° F (220° F redline) on the thermocouple meter.

More data problems exposed their deceitful indications. The low cylinder head temperatures were questionable, but I wanted to believe them because, to my mind, the whole ground-based engine break-in idea was just too good. As it turned out, the washer thermocouples installed under the spark plugs were of the *isolated* junction type. In this type, the thermal path is blocked by an electrical insulator to permit compatibility with some readout devices (but not mine). By cutting off the original spark plug washers and silver soldering the Type-K wires directly to standard copper spark plug washers, the problem was solved. After this, CHT readings were around 389° F (400° F redline, still good!). Figure 8 shows the original thermocouple, and Figure 9 shows the reworked version.

CYLINDER	COMPRESSION
1	77/80
2	78/80
3	79/80
4	79/80

Table 2: Compression readings after 10 hours of ground run.

During the first oil change, a considerable amount of debris was found in the oil screen. The second oil change was better, and the third oil change was very reassuring. Frequent oil changes tell an important story during the first few hours. As you can see from the log sheet (Table 1), oil consumption was about a half quart in the first hour. Now? Significantly lower. The compression readings are shown in Table 2.

Success!

After successfully completing the 10-hour run, I didn't expect any high fives or body slams. You see, I didn't follow accepted procedure. Who ever heard of breaking in an aero engine on the ground? Now you have!

In conclusion, I highly recommend this approach. For one thing, you come to know your engine because of the repetitive starting and stopping, refueling, adjusting idle mixture, checking for leaks, climbing in and out, buckling up, expecting certain readings, the

Figure 8: Purchased isolated junction thermocouple had poor thermal transfer characteristics.

Figure 9: Homemade washer thermocouple (resting on terry cloth towel) gave accurate readings.

Michael Leigh and Beate Ellis check the A-75 engine for leaks and loose components, which often try to ruin a sunny day.

feel of the throttle, the sound of the exhaust. Since most of the problems that I encountered were instrumentation related, I could have flown and survived the first experience. Building and installing the required baffling was certainly an extra effort. However, the ground runs described above unlocked the procedural impasse. It would now be safe to proceed with taxi testing without concern for improper piston ring seating. After 10 hours, most of the ring seating is done. Lastly, flight testing should always be approached incrementally, and that means one step at a time. ✚

MICHAEL LEIGH

Michael Leigh is based at the Tullahoma Airport in Tennessee, which once served as a WW-II bomber training base. In this partly historical setting, Michael enjoys his involvement as an officer in the local EAA chapter 458 and has built a Baby Ace airplane that is currently undergoing its test phases. Michael is also a satisfactory electrical engineer with a master's degree in aviation systems and an airframe mechanic's license. He has worked for Boeing Helicopters in flight testing and the University of Tennessee Space Institute as a research engineer. He currently works part time in the field of electronic flight control augmentation.

So Many Airplanes, So Little Time...

Choosing a new set of plans, a new kit, or a finished airplane that is new to you is an important decision—one that is full of excitement as well as a big financial and lifestyle commitment. At KITPLANES®, we maintain a directory that is as broad as we can make it, listing airplane designs that are new and those that are old so that you have the big picture of experimental craft. Giving you this broad perspective is important; we want you to know as much about your choices as possible so that once you have settled into the cockpit of your new aircraft, the excitement never goes away.

This year, we decided to show you our own choices. We have many regular contributors to KITPLANES®, all of whom have gone through the process of choosing an aircraft to build and fly. You read their work here every month—but what did they go through to get here? What choices did they make, what requirements were they trying to fill? Our authors fly a variety of airplanes, which reflects the variety of needs, opinions, and desires of a diverse group of people. What do they have in common? A love of flying and all things aviation!

As you peruse this year's guide, we hope that you dog-ear the pages looking for your own dream project and plane, just as our authors have found theirs. Enjoy their stories and use the guide to inspire yourself. Aviation is a personal journey, and building an aircraft is something that will change your life. Follow the process others have taken to get to their perfect airplane—and we look forward to seeing what you got when we see you at the airport!

—Paul Dye
Editor in Chief

Paul's latest completion was the Dream Tundra (below), a bush plane used for exploring the wilds of Nevada. Although it and his collection of RVs are metal, he has also restored tube and fabric aircraft and dabbled in both wood and composite. His latest projects are a Xenos motorglider and a soon-to-be-started SubSonex personal jet.

N207KS was the 207th RV-6 kit sold out of more than 6000. It first flew on December 26, 1993, and Ken still owns it.

Ken Scott: Once Is Not Enough

Back in about 1987, I was 36 years old, with very little money and a logbook with about 180 hours in it. The preceding three years had contained one wrenching experience after another, and I was ready to do something, anything, positive. I decided to build an airplane.

I had no idea what I was getting myself into.

I ordered info packs for three different airplanes ($5.00 to $8.00 each...I really had to think about that) and tore them open eagerly when they arrived. My choices? The Beachner Special, the Durand biplane and the Polliwagen. I think a total of seven or eight of those airplanes—combined—were ever finished. I grew up building surfboards and had helped a friend rebuild a few VW engines, so when the Q2 came along, I was all over that. Foam, fiberglass, and a VW motor? Perfect. Until I stood next to one and realized I'd never fit in an airplane I could step over.

I live near Portland, Oregon, and one Dick VanGrunsven was building a small but successful business nearby. I thought his airplanes, with expensive Lycoming engines, were out of my financial reach. Besides, I knew nothing about rivets or sheet metal. Then Carl Battjes took me out in his Chard 6, and suddenly I understood what all the RV zealots were raving about. I wanted something that flew like *that*, and if I had to learn the skills to build it, so be it. I rode my bike out to Van's Aircraft and placed my order for their newest design, the RV-6. I received builder number 20207.

I finished that airplane and made the first flight on December 26, 1993. I have it still. Over the next couple of decades, I partnered with Ken Krueger to build an airplane he designed, a small VW-powered single-seater we called the KK-1. It was a five-year project, but the result flew very well. In 2008, Van's came out with the RV-12. I enjoyed flying the company airplane and needed some way to occupy my hands and mind, so I spent 18 months building one. It lives in Georgia now.

Knowing that I'd be retiring in a couple years, I consulted my wife, The Violinist, about ways that I could avoid becoming a living room vegetable when I no longer had to go to work every weekday. Naturally, I suggested another airplane. I took the resulting eye-roll as permission. What to build? I already had an RV, and after three sheet metal airplanes, I was ready for something different.

Ken Scott works on the tail feathers of the scratch-built Bearhawk LSA. Now known as the ForeverHawk, it is expected to fly in 2019.

I'd spent a lot of time at Oshkosh watching airplanes go by. Some looked OK, some looked...well, not so OK, most were just blah...and a few caught my eye as just looking right. One guy who seemed to get it right was Bob Barrows, designer of the four-seat Bearhawk. I liked his tandem Patrol even better, and when he came out with the LSA version, I liked it best of all. The Violinist surprised me with a set of plans for Christmas. I convinced a couple of airpark neighbors to join me, and in 2013 we formed the Pudding River Bearhawk LLC. The resulting airplane, now known as the ForeverHawk, should fly in 2019.

As a way to stay busy, learn new skills, and enjoy working with a couple of good friends, it's been a great project. As a way to obtain an airplane, it's just dumb. I now know why so few scratch-built airplanes are finished by the original builder—it's a ridiculous amount of work. There's no doubt that the Bearhawk LSA flies and performs well. I recently had a chance to fly one, and now I'm really looking forward to getting ours done. If it does what you want to do, it's a good choice.

But after spending the majority of my adult life building and flying experimental airplanes, my advice is that if you want to build an airplane, buy a kit. There's a world of satisfaction and pleasure in building a kit aircraft, without the grinding grunt work. There are a *lot* of choices out there. Figure out what you're *really* going to do with an airplane, find one that does it, and get to work.

—Ken Scott

Photos: Courtesy of our contributors and the manufacturers

Aircraft Buyer's Guide Online Access

This year the online Aircraft Buyer's Guide follows the format we established a few years ago and provides many useful features for users. Among them is the ability to do side-by-side comparisons of more than one aircraft using various selection criteria. Unlimited access to the online Buyer's Guide is free for subscribers, but for a limited time only, we are offering non-subscribers a chance to sample the site, too.

Here's how it works: Newsstand buyers should visit *www.kitplanes.com* and click on the "Buyer's Guide" button. This will take you to the Buyer's Guide access page. Click on the "Create Newsstand Buyers' Account" button, and that will take you to a signup page. The access code is kitguide19. This will give you 30 days' access (from signup date) to the online Aircraft Buyer's Guide and will also allow you to explore the entire KITPLANES® website. So go log in and have a look around.

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
AC Millenium Corp.	Griffin IV	2	1730	160	150	45	K		
	Griffin Mk III	2	1730	170	150	45	K		
ACD	SQ-2000	4	2250	250	215		K		$85-125k
	SUA-7	7	5600	160	160	70	K		
Ace Aircraft, Inc. *www.aceaircraft.com*	Baby Ace	1	950	110	100	35	K/P	✓	$35-75k
 *Junior Ace*	Junior Ace	2	1320	115	109	38	K/P	✓	$37-78k
Aceair SA	Aeriks 200	2	1433	178	161				
Acro Sport, Inc.	Acro Sport	1	1350	152	130	50	P		$40-55k
 *Acro Sport*	Acro Sport II	2	1520	152	123	53	P		$40-55k
 *Pober Pixie*	Nesmith Courgar 1	2	1250	195	135	53	P		$38-40k
	Pober Junior Ace	2	1313	130	85	40	P	✓	$32-42k
 *Pober Super Ace*	Pober Pixie	1	900		83	30	P	✓	$25-35k
	Pober Super Ace	1	1030	160	110	44	P		$21-26k
Acrolite Aircraft *www.acrolite.org*	Acrolite 1B	1	800	130	110	45	P	✓	$10-25k
 *Acrolite 2M*	Acrolite 1T	1	720	110	90	44	P	✓	$8-20k
	Acrolite 2M	2	1200	125	105	43	P	✓	$12-30k
Adams Aeronautics Company, Inc. *www.adamsaero.com*	CA-2 (formerly Hummel)	1	520	80	63	26	P	✓	$4-8k
 *CA-2*	T-100D Mariah	1	504	80	63	27	P	✓	$4-8k
Aeriane SA *www.aeriane.com*	P-Swift	1	520	93	72	25	K	✓	
Aero Adventure Aviation *www.sea-plane.com*	Aventura HP	1	750	90	75	32	K	✓	$24-32k
 *Aventura UL*	Aventura UL	1	650	60	55	24	K	✓	$20-24k

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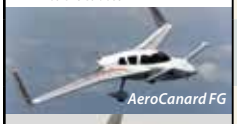
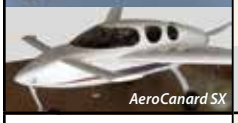
Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Aero Adventure Aviation *(Continued)* *www.sea-plane.com*	Aventura II	2	1430	105	85	30	K	✓	$23-29k
 *Toucan*	Barracuda	2	1430	105	85	41	K	✓	$21-27k
	Toucan	2	1050	85	62	28	K	✓	$20-27k
Aero Concepts, LLC  *Discovery*	Discovery	2	1620	240	225	58	K		$60-150k
Aero-Systems  *Cadet Model STF*	Cadet Model STF	2	1350	145	130	50	P		$35-48k
AeroCad, Inc. *www.aerocad.com*	AeroCanard FG	4	2150	225	205	71	K/P		$75-150k
 *AeroCanard FG*	AeroCanard RG	4	2150	225	210	78	K/P		$75-160k
 *AeroCanard SX*	AeroCanard SB	4	2050	220	200	78	K/P		$70-140k
	AeroCanard SX	4	2150	225	205	71	K/P		$75-150k
Aerochia *www.aerochia-lt1.com*	LT-1	1	793	161	138	55	K	✓	
AeroLites, Inc.	AeroMaster	1	1000	90	75	32	K	✓	$26-40k
	AeroSkiff	2	1125	90	65	38	K	✓	$27-35k
	Bearcat	1	700	70	65	27	K	✓	$16-23k
Aeromarine-LSA *www.aeromarine-lsa.com*	Electrolite (formerly Zigolo MG12)	1	485	58	42	22	K	✓	$15-20k
 *Merlin PSA*	Merlin PSA	1	715	125	115	38	K	✓	$30-50k
Aeromarine Marketing	Harrier	3	1200	120	100	40	K		
Aeroplane Manufactory *(was A.S.A.P.)* *www.amplanes.com*	Beaver RX-550 Plus	2	1050	85	73	37	K	✓	$21-28k
 *Chinook Plus 2*	Beaver SS	1	650	85	67	30	K	✓	$15-17k
	Chinook Plus 2	2	1050	100	83	35	K	✓	$25-36k
Aeroplanes DAR Ltd (was DAR Aviation) *www.aeroplanesdar.com*	DAR-21	2	990	88	78	38	K		
	DAR-21S	2	1000	125	110	38	K		
 *DAR Duo*	DAR-23A and Enclosed	2	900	95	75	37	K		
	DAR Duo	2	750	90	75	35	K	✓	$32k
 *DAR Solo*	DAR Solo	1	507	75	65	25	K		$25-28k

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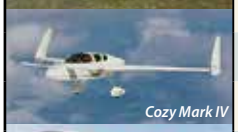
AirCam *www.aircam.com*	AirCam	2	1680	110	85	39	K		$125-165k
 AirCam	Super Drifter	2	1000	85	75	34	K	✓	$47-55k
Aircraft Designs, Inc. *www.aircraftdesigns.com*	Stallion	6	3800	250	235	81	K		$500k
Aircraft Spruce & Specialty *www.aircraftspruce.com*	Acroduster Too SA-750	2	1950	185	155	55	K/P		
	Acrolite 1B	1	750	130	110	43	K/P	✓	$7k
 Acrolite 1B	Baby Great Lakes	1	850	135	118	49	K/P	✓	$40k
	Buddy Baby Lakes	2	1000	135	118	55	K/P		$40k
 Christavia MK 1	Christavia MK 1	2	1500	135	105	40	K/P		$8-14k
	Cozy Mark IV	4	2050	200	185	69	K/P		
 Cozy Mark IV	One Design DR 107	1	1140	180	160	60	K/P		
	Skyotë	1	975		104	44	P	✓	
 Starduster One SA-100	Starduster One SA-100	1	1080	147	132	50	P	✓	
	Starduster Starlet SA-500	1	1000	130	105	55	P	✓	
	Starduster Too SA-300	2	1985	170	130	56	K/P		
 Super Baby Great Lakes	Starduster V-Star SA-900	1	1000	90	75	35	P	✓	
	Super Baby Great Lakes	1	850	155	135	55	K/P		
	Super Starduster SA-101	1	1300	225	170	55	P		
 Wittman W10 Tailwind	Wittman V-Witt Racer	1	700	180	150	48	P		
	Wittman W10 Tailwind	2	1425	230	180	45	K/P		$12-40k

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Dave Prizio:
Building Another GlaStar

Twenty years ago, I started on my first airplane project, a Stoddard-Hamilton GlaStar. I had toyed with the idea of building a Starduster Too, but the impracticality of an open cockpit bi-wing airplane turned me in another direction. I test flew an RV-6 but found its cockpit dimensions and useful load inadequate for hauling around my large frame, even though it was undeniably fun to fly. Then I tried the GlaStar, and I knew it was the plane for me. Good useful load, good speed, lots of room inside—it just fit me.

Wind the clock forward 20 years and here I am again, taking on another GlaStar project as my fourth airplane building adventure. I had looked longingly at a Carbon Cub, and I do truly love that plane, but in the end two things moved me away from it toward another GlaStar. The Carbon Cub is rather narrowly focused on the single mission of backcountry flying, which means that it does that very well but other things not so well. It is also expensive enough that to afford it, I would have to sell my Sportsman, leaving me with a plane—a very nice plane to be sure—that would not be well suited to the cross-country flying that I often do.

The GlaStar seemed to be a good compromise between back-country and cross-country capabilities. It is also affordable enough that I did not need to sell my current plane to purchase the kit and components. Who knows? I may still build a Carbon Cub somewhere down the road, just not today.

I bought a GlaStar project that was some 20 years old from a nice guy who had just run out of good health and motivation to complete it. It was a sad development for him but gave me the opportunity to pick up a project with a lot of high-quality work already done at a good price. The thought was that this would save me time and money. Whether or not that actually happens remains to be seen, but it is a good theory.

To enhance the GlaStar's backcountry performance I have invested in some extended heavy-duty landing gear, some bigger tires, and a T3 tailwheel setup. I have also built some Sportsman flaps to replace the less effective GlaStar flaps. That has been more expensive and

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Aircraft Technologies, Inc.	Atlantis	2	1900	255	180	65	K		
	Meyer-360	1	1600	255	180	60	K		
Airdale LLC *www.airdale.com*	Airdale	2	1400	130	108	48	K		$26-56k
 *Avid Plus*	Airdale LSP	2	1200	120	90	35	K	✓	$19-24k
	Avid Plus	2	1200	120	90	35	K	✓	$25-55k
Airdrome Aeroplanes, Inc. *www.airdromeaeroplanes.com*	Bleriot Model XI (3/4 Scale)	2	676	43	40	28	K	✓	$8-13k
 *DeHavilland DH-2*	Bleriot Model XI (Full Scale)	1	1014	55	50	32	K	✓	$14-21k
	DeHavilland DH-2	1	596	63	61	29	K	✓	$10-12k
 *Dream Fantasy Twin*	Dream Classic Strut Braced	1	465	63	54	26	K	✓	$6-9k
	Dream Classic Wire Braced	1	491	63	57	26	K	✓	$6-9k
	Dream Fantasy Twin	2	630	52	45	27	K	✓	$8-15k
 *Fokker D-VI*	Eindecker E-III	1	480	63	57	28	K	✓	$8-13k
	Fokker D-VI (3/4 Scale)	1	568	78	73	30	K	✓	$9-15k
 *Fokker D-VIII*	Fokker D-VII (80% Scale)	1	770	105	94	34	K	✓	$13-18k
	Fokker D-VIII (3/4 Scale)	1	517	92	80	32	K	✓	$9-15k
	Fokker DR-1 (3/4 Scale)	1	583	78	64	34	K	✓	$13-15k
 *Fokker-III Eindecker*	Fokker DR-1 (Full Scale)	1	872	94	72	32	K	✓	$16-19k
	Fokker E-III Eindecker (3/4 Scale)	1	468	65	54	26	K	✓	$9-15k

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more technically difficult than I expected, but experimental aviation is all about education and recreation. Let's just say I am getting an education now in hopes of some future recreation.

These modifications are not ones I would recommend to a first-time builder, at least not the flap change, because such changes tend to complicate and extend the building process. My previous planes were all built according to the plans, although I did later switch my first GlaStar to conventional gear from its original tricycle configuration. It is only now, on my fourth project, that I am customizing things from the beginning. With the experience gained from my previous projects, I am confident that my end result will be what I want, but I am not so sure I would have been ready to try this before. Certainly, every builder can find his or her own path, even on the first project, but sticking to the tried and true is a pretty good idea until more experience has been gained.

As you consider an airplane project for yourself, look for something that will meet the majority of your flying needs, be affordable to you, and be fun to build and fly. After all, if it isn't fun why do it?

—Dave Prizio

Dave Prizio (left) and Ed Zaleski assemble a Sportsman flap for their new GlaStar project. The Sportsman flaps should be an improvement over the original GlaStar flaps, but require extra effort to make them work. Dave's first GlaStar is shown above.

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Airdrome Aeroplanes, Inc. *(Continued)* *www.airdromeaeroplanes.com*	Fokker E-III Eindecker (Full Scale)	1	927	81	68	34	K	✓	$11k
 Nieuport 17	Morane-Saulnier L	2	640	65	63	31	K	✓	$9-11k
	Nieuport 11 (7/8 Scale)	2	720	80	74	34	K	✓	$12-15k
	Nieuport 17	1	872	97	89	40	K	✓	$17-22k
 Nieuport 28	Nieuport 24 (Full Scale)	1	836	95	83	36	K	✓	$15-18k
	Nieuport 28	1	1212	95	84	39	K	✓	$25-30k
 Sopwith Camel	Sopwith Baby	2	1095	95	81		K	✓	$15k
	Sopwith Camel (Full Scale)	1	1243	103	85	40	K	✓	$33-40k
 Sopwith Schneider	Sopwith Pup (Full Scale)	1	596	95	81	37	K	✓	$27-30k
	Sopwith Schneider	2	1233	91	78	40	K	✓	$18-22k
	Sopwith Tabloid	2	1201	91	78	40	K	✓	$18-22k
 Taube	Spirit of St. Louis	2	1185	105	93	39	K	✓	$28-32k
	Taube	2	1145	80	65	35	K	✓	$18-20k
Alfa Air Service LLC	ALFA HB-207	2	1540	187	161	52	K		
Alisport *www.alisport.com*	Silent 2	1	540	136	50	37	K	✓	$47-53k
	Silent 2 Electric	1	660	136	56	40	K	✓	$116-122k
 Silent Club Self-Launch	Silent 2 Self-Launch	1	660	136	56	40	K	✓	$60-68k
	Silent 2 Targa Self-Launch	1	660	136	56	40	K	✓	$69-76k
	Silent Club	1	530	124	50	36	K	✓	$40-46k
 Silent 2 Targa Self-Launch	Silent Club Electric	1	661	112		40	K		
	Silent Club Self-Launch	1	639	124	53	38	K	✓	$55-60k
Alpaero	Exel	1	683		75	39	K		
Altitude Group LLC *www.altitudegroupllc.com*	Formula GT	2	2650	230	218	68	K		
	P85	2	2475	283	252	70	K		$95-105k
 Radial Rocket RG	Radial Rocket RG	2	2575	267	254	70	K		$111-151k
	Radial Rocket TD	2	2550	255	242	70	K		$105-145k
Alturair *www.alturair.com*	BD-5B	1	860	232	205	66	K		$20-35k
 BD-5G	BD-5G	1	660	232	229	55	K		$20-35k
American Ghiles Aircraft Inc.	Lafayette 4S Revolution	4	1653	199	178	51	K		
	Lafayette Bushplane	2	1080	208	188	40	K		
	Lafayette Classic Storch	2	937	84	78	35	K		
	Lafayette Mountain	2	1080	185	181	40	K		

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American Ghiles Aircraft Inc. *(Continued)*	Lafayette Sportster	2	1080	226	204	57	K		
	Lafayette Super Storch	2	1102	132	118	35	K		
	Lafayette Texan	2	1080	149	140	40	K		
	Lafayette Touring	2	1080	211	190	49	K		
	Lafayette Wallaby	2	937	81	71	31	K		
American Homebuilts' Corp.	John Doe	2	1320	125	110	30	K	✓	$35-45k
American Legend Aircraft *www.legend.aero*	Legend Cub	2	1320	115	98	38	K	✓	$60-84k
 *Super Legend*	Super Legend	2	1750	115	100	28	K	✓	$150-240k
	Texas Sport TX-3	2	1320	115	98	38	K	✓	$55-84k
American Patriot Aircraft LLC	Patriot II	2	1320	138	135	44	K	✓	$33-36k
	Patriot Supercruiser	2	1320	138	135	50	K	✓	$35-75k
AmeriPlanes/ MitchellWing	A-10B	1	550	80	63	28	K	✓	
	A-10D	1	550	76	60	28	K	✓	
	T-10D	2	850	78	65	32	K	✓	
Amphibian Airplanes of Canada Ltd. *www.seastaramphibian.com*	SeaMax	2	1158	125	115	38	K	✓	
 *Seastar Sealoon*	Seastar Sealoon	2	1430	112	100	40	K	✓	$85-105k
	Super Petrel	2	1150	112	100	45	K	✓	$80-100k
Andrew Budek-Schmeisser (was Townsley, Mike) *https://sites.google.com/site/jungsterbipe/home*	Jungster 1 Biplane	1	1000	150	110	55	P		$12-25k
 *Jungster 2*	Jungster 2	1	1139	155	148	55	P		$10-20k
Apis Sailplanes Inc.	Apis 13 Meter	1	540	139	55	34	K		
	Apis 15 Meter	1	661	139	51	36	K		$34-37k
	Apis Electric Self-Launch	1	710	139	51	36	K		$72-76k
Arion Aircraft, LLC *www.flylightning.net*	Lightning	2	1425	184	155	46	K		$60-85k
 *Lightning LS-1*	Lightning LS-1	2	1320	138	138	51	K	✓	$96-115k
	Lightning XS	2	1625	195	180	63	K		$80-100k
Arnet Pereyra, Inc.	Buccaneer II	2	1200	90	70	32	K		
	Buccaneer SX	1	810	90	70	29	K		
	Sabre II	2	1100	90	70	32	K		
	Zephyr II	2	1100	90	70	32	K		
Associate Air LLC	Liberty 181/183	4	3500	145	135	35	K		
Atec Aircraft USA *www.atecaircraft.eu*	Zephyr	2	1200	170	130	41	K		

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FIXED-WING AIRCRAFT

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Auriga Design Inc. *www.auriga.on.ca/aerocat.html*	Aerocat SR	4	3400	185	170	53	K		$225-350k
 *Aerocat SRX*	Aerocat SRX	4	3330	164	150	53	K		$250-300k
	Aerocat TR	4	3400	220	201	53	K		$200-350k
	Aerocat TRX	4	3400	205	185	53	K		$200-350k
AviaBellanca Aircraft Corporation	SkyRocket III	6	4200	340	327	68	K		
Aviat Aircraft, Inc. *www.aviataircraft.com*	Eagle II	2	1578	184	165	58	K		$200-225k
 *Pitts S-1-11B*	Pitts S-1-11B (Super Stinker)	1	1500	205	187	54	P		$100-300k
	Pitts S-1S	1	1150	176	155	62	P		
Aviation Development International Ltd.	Alaskan Bushmaster	4	3000	150	125	44	K		
Aviator Enterprises, Inc.	Aviat Solo	1	900	115	85	35	P		
Avid Aircraft	Avid Champion	1	594	65	63	26	K		
	Bandit	2	1000	95	80	30	K		
	Catalina	3	1200	80	75	36	K		
	Magnum	3	1750	155	130	40	K		
	Mark IV Aerobatic Speedwing	2	1150	135	120	46	K		
	Mark IV High-Gross STOL	2	1150	135	95	36	K		
Azalea Aviation *www.azaleaaviation.com*  *Saberwing*	Saberwing	2	1500	200	160	55	K		$40-45k
Backcountry Super Cubs (Turbine Cubs of Wyoming LLC) *www.supercub.com*	Mackey SQ2	2	2200	120	115	20	K		$106-126k
 *Supercub Replica*	Supercruiser	3	2400	130	115	28	K		$100-120k
	Supercub Replica	2	2400	120	112	28	K		$100-120k
Bakeng Deuce Airplane Factory *www.bakengdeuce.com*  *Bakeng Deuce*	Bakeng Deuce	2	1500	140	110	51	P/K		$75-100k
Ballard Sport Aircraft *www.ballardsportaircraft.com*	Pelican PL Turbo	2	1400	155	152	50	K		$65-85k
 *Pelican Sport 600*	Pelican Sport 600	2	1320	135	130	44	K	✓	$55-75k
Barr Aircraft	Barr 6	6	4500	248	207	62	K		$145-310k
Barry Jay Aviation, Inc.	Acroduster 1	1	1190	180	165	70	P		

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BD-Micro Technologies, Inc. *www.bd-micro.com*	BD-5B	1	830	190	170	62	K		$44-67k
 FLS Microjet	BD-5J Microjet	1	860	290	240	67	K		$100-145k
	BD-5T Turboprop	1	910	240	195	66	K		$89-105k
	FLS Microjet	1	860	320	250	67	K		$200-220k
Bearhawk Aircraft Co. (AviPro Aircraft, Ltd.) *www.bearhawkaircraft.com*	Bearhawk	4	2700	175	160	45	K		$75-110k
 Bearhawk LSA	Bearhawk LSA	2	1320	138	120	30	K/P	✓	$50-65k
	Bearhawk Patrol	2	2000	165	150	35	K/P		$60-85k
Bedecorp LLC *www.bedecorp.com*	BD-4B	4	2400	240	190	55	K/P		$46-66k
 BD-4C	BD-4C	4	2400	240	190	61	K/P		$30-90k
	BD-6B	1	850	180	150	50	K/P		$18-60k
 BD-17L	BD-12C	2	1310	215	200	54			
	BD-17B	1	950	138	132	46	K	✓	$32-60k
	BD-17L	1	1000	138	132	46	K	✓	$32-60k
 BD-18	BD-18	2	1200	190	180	56	K/P		$24-70k
	BD-22L	2	1320		130	49		✓	
Belite Enterprises LLC/ Chipper Aerospace LLC *www.beliteaircraft.com*	Belite UltraCub	1	550	80	62	28	K		$10-20k
 Chipper	Chipper	2	1232	124	112	39	K	✓	$25-40k
	ProCub Lite	1	550	80	62	28	K	✓	$15-20k
 ProCub Lite	Superlite	1	550	63	62	28	K	✓	$13-15k
	Trike	1	550	63	55	28	K	✓	$10-26k
Berkut Engineering	Berkut	2	2200	298	275	65	K		
Better Half VW *www.betterhalfvw.com*	Double Eagle	2	900	85	70	35	K/P	✓	$10-13k
 Legal Eagle	Legal Eagle	1	500	63	60	25	K/P	✓	$3-5k
	Legal Eagle UL	1	500		55	28	K	✓	$4-5k
 Legal Eagle UL	Legal Eagle XL	1	575	63	60	25	K/P	✓	$5-7k
Biplanes of Yesteryear	Mifyter	1	755	95	75	40	K	✓	$23-25k
	Mifyter II	2	1150	85	70	43	K	✓	$29-33k
Blanton, D. L.	Sport Racer	2	1825	200	175	62	P		$25-35k
 Wichawk	V6 STOL	4	2200	135	120	48	P		$25-35k
	Wichawk	3	2000	140	127	56	P		$20-40k

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Blue Yonder Aviation, Inc. *www.ezflyer.com*	E-Z Harvard	1	1300	120	90	32	K	✓	$21-35k
 EZ Fun Flyer	E-Z King Cobra	1	1200	120	90	32	K	✓	$21-35k
	EZ Flyer	2	1320	100	75	38	K	✓	$25-30k
	EZ Fun Flyer	1	600		50	17	K		$14k
 Merlin EZ	Merlin EZ	2	1450	110	85	30	K		$48-65k
	Twin Engine E-Z Flyer	2	1450	100	70	38	K		$36-75k
Boeve Aircraft Inc.	MJ-7	2	2550	265	230	69	K/P		
Bonner Aircraft	Scout	1	550	70	60	35	P		
Bowers (Bowers, David R.) *www.bowersflybaby.com*	Bowers Fly Baby	1	925	110	87	45	P	✓	$10-12k
Bradley Aerospace	Aerobat	1	720	180	150	43	K		
Breezer Aircraft USA, LLC	Breezer II	2	1320	135	120	43	K	✓	$46k
Buethe Enterprises, Inc.	Barracuda	2	2300	220	200	61	P		
BX-Aviation	Cherry BX-2	2	1222	136	124	52	P	✓	$20-50k
C-N-C Aviation  Supercat	Supercat	1	650	100	80	32	P	✓	$7-12k
Cadcor	Chanute	2	2250	265	240	67	K		

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Bob Hadley:
Would I Buy It Again?

My regular flyer since March 2014 has been a Jabiru J250-SP. The how and why of that acquisition was detailed in "To Launch a Light Sport–Redux" in the May 2015 issue of KITPLANES®, so I won't go over the details here, except to say that it was built by Bob Fritz, who started the "Home Shop Machinist" column.

So, instead of answering if I would build it again, I'll change the question to, "Would I buy a Jabiru again?"

All things being equal, yes, I would buy another Jabiru. But if all things weren't equal, maybe not.

Like, for instance, I like the Quest Kodiak: awesome payload, STOL performance with 170-knot cruise, turboprop, etc. But at $2 million a pop, it's never going to happen.

So that brings me back to the Jabiru. For $60,000 (used, in good condition) it's reasonably fast, affordable, and if cargo space is a measure of utility, the Jabiru 230/250 is the one of the best, if not *the best*, two-seat aircraft for cross-country flying.

Oh yes, that cargo area! At about 30 cubic feet, it's not only enormous for a Light Sport Aircraft (LSA), it's enormous for *any* two seat airplane. As one might expect, the space is, shall we say, *density sensitive*. Gross weight and center-of-gravity limits are obviously governing factors. Still, I have about the same area for cargo at my disposal as my neighbor's Cessna 182T. Yes, I know you can put up to 200 pounds in the Cessna, while the Jabiru, with two people and less than a full load of fuel, holds maybe 30 or 40 pounds of cargo (your results may vary). That said, if there were a contest for two-seaters to see which one holds the most popcorn or ping-pong balls, the Jabiru would win hands down.

How the Jabiru has all this space came about because the factory down-spec'd a four-seater, the J430, to meet the LSA category rules. Call it serendipity, or fluke, or whatever you want, you have to admit they were smart to do a simple reconfiguration rather than a complete redesign for entry into the LSA market.

Obviously, the 1320-pound LSA maximum gross weight limit and CG considerations are determinative factors as to what you can and cannot haul, weight-wise, but the sheer volume available opens the door (literally, there's a separate cargo door) for a number of items that would be impossible in most LSAs. Think sleeping bags and camping tents, a bicycle (a racing bike, not a beach cruiser), snowboards, etc.

Is the Jabiru perfect? No. The company has had its ups and down, but it's still here. The latest engines represent 20+ years of production experience, and the airframe 25+ years. As for my J250-SP, the flight characteristics are extremely docile, especially in stalls. In fact, when I'm due for a biannual review, I make sure to remind my flight instructor, Daniel

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Cameron & Sons Aircraft *www.cameronaircraft.com*	P51 Mustang	2	6000	500	420	87	K		$150-450k
Canadian Museum of Flight	SE5A Replica	1	1150	110	85	40	P	✓	$5-15k
Carlson Aircraft, Inc.	Carlson Skycycle	1	800	139	100	55	K		
	Criquet	2	1950	135	95	16	K		
	Sparrow II	2	990	130	95	36	K	✓	
	Sparrow II XTC	2	1250	115	110	39	K	✓	$40-45k
	Sparrow Sport Special	1	775	100	85	31	K	✓	$28-32k
	Sparrow Ultralight	1	504	63	58	27	P	✓	$9-13k
Cassagneres, Ev	Ryan ST-R (replica)	2	1575	140	120	45	P		$10-20k
Cassutt Aircraft *https://www.facebook.com/cassutt/*  *Cassutt IIIM*	Cassutt IIIM	1	850	225	190	65	K/P		$25-40k
CFM Aircraft Ltd.	Shadow-DD	2	860	124	90	38	K		
	Star Streak	2	900	144	115	45	K		
	Streak Shadow SA	2	900	140	110	40	K		
CinCo Enterprises, Inc.	Russia AC4-KC	1	605	130		42	K		

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Wotring, not to expect any kind of break, just a descending nose-up mush and the stall horn blaring.

One thing Jabiru in North America is known for is hosting engine seminars. This is something every engine manufacturer should do. The seminar I attended in 2015 covered everything from tuning to cooling, as well as complete teardown and assembly. One of the most interesting topics was the revision history and design philosophy of Jabiru. In particular, engine failure analysis was a big part of the discussion. This, I should add, is very similar to Brain Carpenter's Rainbow Aviation LSA repairman/inspection class, except their focus is Rotax engines. In both cases I came away more knowledgeable and with a healthy respect for the factory guidelines.

In mid-2018 longtime Jabiru North America sales agent Pete Krojote retired. New USA airplane sales were taken over by Scott Severen of U.S. Sport Planes in Texas, while USA engine sales were taken over by Nick Otterback of Arion Aircraft, in Shelbyville, Tennessee (which was next door to Jabiru North America).

According to Otterback, "We are continuing the seminars...I actually did give the seminar for several years."

As far as spare parts and support, Otterback added, "Arion has bought all inventory that Jabiru North America had. This gave us no downtime on orders. We continue to maintain a very good stock of parts, and we order new stock every Friday from Australia to keep the shelves full.

With a baggage area measuring 39 inches long by 42 inches wide, the Jabiru J250's baggage compartment will hold a full-size pro racing bike (wheels removed) with room to spare.

"Jabiru is not new to our company; we have used the Jab since 2006 in our Lightning sport aircraft. I moved here from Wisconsin with Pete in 2004 when we set up shop in Shelbyville. So we have many years' experience with the engine line, and our A&Ps do as well. We have also taken over the service work as well. This includes anything from annuals to complete overhauls on Jabiru engines."

Someday I might own another airplane. It might not be a Jabiru. But I'm pretty sure that whatever it is, it'll have room for a normal, non-folding bike. On that point the Jabiru has me spoiled.

—Bob Hadley

FIXED-WING AIRCRAFT

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Circa Reproductions *www.nieuports.com*	7/8 Nieuport 11/17	1	550	85	75	30	P	✓	
	Nieuport 11 EXP (87%)	1	675	80	70	32	P	✓	
	Nieuport 12 EXP (87%)	2	1070	94	75	33	P		
Classic Aero Enterprises	H-2 Honey-Bee	1	750	70	65	35	P	✓	$8-15k
	H-3 Pegasus	1	575	85	70	30	P	✓	$8-15k
Classic Sport Aircraft	S-18	2	1600	215	180	63	K		$30-45k
Clifford Aeroworks	Spad XIII	1	800	90	80	45	K/P		
Clutton, Eric  *Fred*	Fred	1	820	80	75	40	P	✓	$5-12k
Collins Aero	Dipper Amphibian	2	1760	124	120	48			
Comp Air Inc. *www.compairinc.com*	Comp Air 3	3	2450	175	145	45	K		$33-43k
 *Comp Air 4*	Comp Air 4	4	2590	175	155	39	K		$56-90k
	Comp Air 6	6	3200	175	165	39	K		$66-100k
 *Comp Air 6*	Comp Air 7	6	3700	250	230	53	K		$87-325k
	Comp Air 7SLX	6	4200	250	210	54	K		$98-375k
 *Comp Air 7SLX*	Comp Air 8	8	4800	227	210	48	K		$187-425k
	Comp Air 9	8	7200	288	253	71	K		$770-1200k
 *Comp Air 9*	Comp Air 10	10	5700	200	180	56	K		$250-425k
	Comp Air 12	10	10800	356	340	84	K		$750-2400k
	Comp Air Jet	10	10900	400	375	71	K		
 *Comp Air 10*	Merlin GT-582/912	2	1300	120	85	35	K	✓	
	Merlin GT-912	2	1300	120	93	38	K		
Composite Aircraft Technologies *www.compairtechllc.com*	Express 2000 FT	4	3400	230	207	55	K		$200-250k
	Express 2000 RG	4	3800	290	200	50	K		$200-250k
 *Express 2000 RG*	S300 RG	4	3600	320	300	60	K		
	Series 2000 FT	4	3600	230	190	53	K		
Corby Aeronautics Pty Ltd/CSN	Corby Kestrel CM-2	1	800	170	154	52	P	✓	$45-60k
 *Corby Kestrel CM-2*	Corby Starlet CJ-1	1	700	155	140	45	P	✓	$30-40
Corivi Aviation *www.magini.it/ CoriviAviation.htm*	Pegaso	2	1100	155	142	45	K		

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CubCrafters, Inc. *www.cubcrafters.com*	Carbon Cub EX-2	2	1865	138	115	32	K		$100-150k
 *Carbon Cub EX-3/FX-3*	Carbon Cub EX-3/FX-3	2	2000	145	135	37	K		$150-180k
	Top Cub	2	2300	140	115	43	K		
Culp's Specialties *www.culpsspecialties.com*	Culp's Special	2	2300	240	170	72	K/P		$70-250k
 *Sopwith Pup*	Sopwith Pup	2	2300	220	170	72	K/P		$90-240k
Custom Flight Ltd. *www.customflightltd.com*	Lite Star	2	1320	120	100	45	K	✓	$35-60k
 *North Star*	North Star	2	2350	120	115	25	K		$80-100k
D & E Aircraft, Inc. *www.de-aircraft.com*	Kodiak Cruiser 2400/3200	2	3000	150	130	25	K		
D2 Aircraft *http://davisda2.com*	Davis DA-2A and DA-2B	2	1200	160	140	61	P		$20-30k
 *Davis DA-2A*	Davis DA-5	1	775	155	140	60	P		

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FIXED-WING AIRCRAFT

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Dakota Cub *www.dakotacub.com*  *Super 18-LT*	Super 18-160	2	2050	125	100	49	K		$100-125k
	Super 18-180	2	2300	148	100	51	K		$100-130k
	Super 18-LT	2	1320	110	90	44	K	✓	$90-110k
DCS, Inc. *www.teenietwo.com*  *Teenie Two*	Mini Coupe	1	850	110	100	48	P	✓	$8-20k
	Teenie Two	1	590	120	110	48	P	✓	$7-20k
	Tinni Three	2	1200	180	160	50	P		$15-35k
Design Resources  *J.D. Special*	J. D. Special	1	939	170	140	38	P		$11-40k
DFE Ultralights, Inc.  *Ascender 3B*	Ascender 3A	1	455	55	40	25	K	✓	$7-8k
	Ascender 3B	1	490	55	40	28	K	✓	$8-10k
	Ascender 3C	1	585	55	40	28	K	✓	$8-10k
Dova Aircraft	Skylark	2	1200	130	120	42	K	✓	
Dream Aircraft Inc. *www.dreamaircraft.com*  *Tundra*	Tundra	4	2550	132	118	52	K		$110-160k
Duccini *www.campavia.com*  *Morin M85*	Morin M85	2	1200	100	90	37	P	✓	$10-25k
Durand Industries LLC *www.durandmarkv.com*  *Durand Mark V*	Durand Mark V	2	1840	170	135		K/P		$55-85k
Dyke Aircraft  *Delta JD II*	Dyke Delta JD II	4	1950	210	180	60	P		$9-30k
Early Bird Aircraft Co.  *Jenny*	Jenny (2/3 Scale)	2	800	70	60	35	P	✓	$8-13k

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Earthstar Aircraft *www.thundergull.com*	eGull Electric	1	700	63	63	24	K	✓	$30-35k
 *eGull Electric*	Gull 2000	1	550	63	63	27	K	✓	$20-25k
	Odyssey	2	1000	108	87	37	K	✓	$22-35k
	Soaring Gull	1	550	63	63	26	K	✓	$18-23k
 *Odyssey*	Thunder Gull J	1	550	63	63	25	K		
	Thunder Gull JT2	2	850	87	87	34	K		
Ed Marquart	Marquart MA-5 Charger	2	1600	125	116	48	P		
EDRA Aeronáutica, Ltda	Super Petrel	2	1103	110	85	32	K		
Eklund Engineering, Inc. *www.thorpt18.com*	Thorp T-18	2	1600	205	200	59	P		$20-45k
Elmwood Aviation	Christavia MK 1	2	1500	118	105	40	P		
Esqual North America, LLC	Esqual Retractable	2	1200	230	210	50	K		
	Esqual Sport	2	1232	132	132	34	K	✓	
	VM-1 Esqual	2	1232	195	175	43	K		
EU-WISH Aircraft *www.groups.yahoo.com/group/Sidewinder2*	Sidewinder S & GA	2	1550	210	167	60	P		$23-85k
Europa Aircraft *www.europa-aircraft.co.uk*	Europa XS Monowheel	2	1370	175	160	51	K		$75-125k
 *Europa XS Monowheel*	Europa XS Motor Glider	2	1370	155	143	52	K		$95-125k
	Europa XS Trigear	2	1370	161	150	51	K		$75-125k
 *Europa XS Trigear*	Europa XS Trigear Light Sport	2	1320	138	138	51	K	✓	$75-150k
Evans Aircraft *www.evansair.com*	Volksplane 1 (VP-1)	1	685	95	75	45	P	✓	
Excalibur Aircraft *www.excaliburaircraft.com*	Excalibur	2	1050	100	90	32	K	✓	$29-30k
 *Excalibur Stretch*	Excalibur Four Stroke	2	1075	100	90	33	K	✓	$37-39k
	Excalibur Stretch	2	1060	100	90	32	K	✓	$30k
Extra Flugzeugproduktions GmbH *www.extraaircraft.com*	Xtra 200	2	1858	265	172	61	K		$240-300k
Falcomposite Ltd *www.falcomposite.com*	Furio LN 27 RG	3	2756	219	201	54	K		$200-250k
 *Furio LN 27 RG*									

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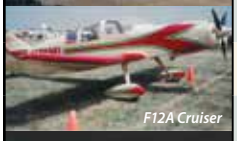
Falconar Avia Inc. *www.falconaravia.com*	AMF-14H	2	1200	115	92	36	K/P	✓	$19-40k
 AMF 14-H	AMF-Super 14D Maranda	2	1850	130	120	39	K/P		$28-40k
	ARV-1K Golden Hawk	2	890		100	40			
	Cubmajor	2	1300	120	100	40	P	✓	$10-33k
 Cubmajor	F11A Sporty	2	1300	130	123	38	K/P	✓	$20-40k
	F11E Sporty	2	1100	130	110	41	K/P	✓	$20-40k
 F12A Cruiser	F12A Cruiser	2	1800	175	150	51	K/P		$22-45k
	Falcon 2000	2	992	84	70	36	K		
	Falconar F9A	1	700	116	100	43	K/P		
 Falconar F9A	Falconar F10A	1	875	130	120	35	P	✓	$9-30k
	Falconar F11E	2	1050		100	42	P	✓	$10-37k
 HM 290/293	Fauvel AV36/361/AV362	1	570	137	60	30	P	✓	$9-20k
	HM 290/293	1	600	90	80	28	P	✓	$5-26k
	HM 360	1	700	120	95	28	P	✓	$7-34k
 HM 380	HM 380	2	1100	120	95	28	P	✓	$7-34k
	Ladybug 380L	2	1330	124	113	28	K/P		
 SAL Mustang	Mignet Flying Flea 290E/293E	1	476	60	50	25	K/P	✓	$10-20k
	SAL Mustang (2/3)	2	2180	200	176	60	K/P		$40-80k
	Turbi D5	2	1089	108	81	34	K/P	✓	$20-35k
Fielden Aero, LLC *www.fieldenaero.com*  Aeropup	Aeropup	2	1323	138	100	40	K	✓	$25-35k
Fighter Escort Wings	FEW P51	2	2000	250	210	62	K		
	P51D	2	2500	240	210	65	K		
	TF51	2	2200	240	210	65	K		
Fisher Flying Products *www.fisherflying.com*	Avenger	1	600	63	60	28	K/P	✓	$9-11k
 Avenger V	Avenger V	1	650	100	85	31	K/P	✓	$10-12k
	Celebrity	2	1230	95	85	40	K/P	✓	$20-25k
	Classic	2	850	100	85	39	K/P	✓	$15-17k
 Celebrity	Dakota Hawk	2	1150	100	100	35	K/P	✓	$25-35k
	FP-202 Koala	1	500	75	55	26	K/P	✓	$10-12k

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Fisher Flying Products *(Continued)* *www.fisherflying.com*	FP-303	1	450	70	60	25	K/P	✓	$8-10k
	FP-404	1	540	80	72	30	K/P	✓	$11-13k
	FP-505 Skeeter	1	500	63	60	26	K/P	✓	$10-12k
	FP-606 Skybaby	1	500	63	60	26	K/P	✓	$10-12k
	Horizon 1	2	1050	100	95	40	K/P	✓	$17-20k
	Horizon 2	2	1050	110	100	38	K/P	✓	$22-25k
	R-80 Tiger Moth	2	1150	100	80	35	K/P	✓	$25-30k
	RS-80 Tiger Moth	2	1300	100	80	40	P	✓	
	Super Koala	2	900	95	75	32	K/P	✓	$17-20k
	Youngster	1	650	110	85	32	K/P	✓	$13-15k
	Youngster V	1	650	110	85	32	K/P	✓	$13-15k
Flight Addictions LLC (Alarie, Russell) *www.daisymae-biplane.com*	Daisy Mae	2	1300	100	80	40	P	✓	$17-30k
Flying Flea Archive USA	Flying Flea HM-14	1	500	70	55	25	P	✓	
	Flying Flea HM-160/1/2	1	472	80	65	20	P	✓	
	Flying Flea HM-290/1FB	1	580	85	75	26	P	✓	
Flying Legend *www.flyinglegend.it/en*	Tucano Replica	2	1433	205	155	51	K	✓	$80-120k
Four Winds	Four Winds 192	4	2480	255	200	51	K		
	Four Winds FX210/FX250	6	3400	287	215	66	K		$196-249k
Free Bird Innovations, Inc.	LiteSport Classic	2	900	85	80	32	K	✓	$15-19k
	LiteSport II	2	900	80	75	32	K/P	✓	$10-15k
	LiteSport Ultra	2	500	62	55	22	K/P	✓	$9-15k
Freedom Aviation	Freedom Aviation	4	3500	230	215	75	K		$230-350k
Glasair Aviation *www.glasairaviation.com*	Glasair III	2	2400	300	278	78	K		$125-300k
	Glasair Super II FT	2	2100	228	210	73	K		$80-200k
	Glasair Super II RG	2	2100	238	221	73	K		$80-200k
	GlaStar	2	1960	167	161	49	K		$50-150k
	Sportsman	4	2350	186	172	48	K		$80-200k
	Two Weeks to Taxi Sportsman	4	2350	186	172	48	K		$200-250k
	Two Weeks to Taxi Sportsman Carbon	4	2500	186	172	50	K		$215-250k


FP-303


FP-606 Skybaby


R-80 Tiger Moth


Super Koala


Daisy Mae


Tucano Replica


Sportsman


Two Weeks to Taxi Sportsman

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Information based on manufacturer-supplied data. All speeds are in m.p.h.
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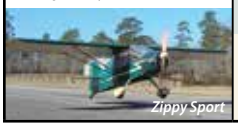
Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Golden Age Aeroworks *www.goldenageaeroworks.com*  LoCamp	LoCamp	2	1320	132	106	35	K	✓	$40-50k
Golden Circle Air, Inc.	T-Bird Cargo	2	1176	88	65	39	K	✓	
	T-Bird I	1	600	78	60	26	K	✓	
	T-Bird II	2	1016	90	70	38	K	✓	
	T-Bird Side-by-Side	2	1000	95	70	36	K		
Great Plains Aircraft Supply Co., Inc. *www.gpasc.com*  Easy Eagle I Bi-Plane	Easy Eagle I Bi-Plane	1	725	110	100	45	P	✓	$8-12k
Green Sky Adventures, Inc. *www.greenskyadventures.com*  Zippy Sport	Micro Mong	1	650	100	80	35	K/P	✓	$14-30k
	Zippy Sport	1	680	120	110	45	P	✓	$10-25k

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Sid Mayeux:
How *Kelli Girl* Came To Be

In April 2015, I launched *Kelli Girl*, my RV-7A, on its first flight, which culminated a seven-year journey of inspiration, education, and, after 1560 hours of logged labor, exhilaration. An aircraft named *Kelli Girl* was always going to take flight. I mean, a decades-old itch constantly reminded me that I would build an aircraft someday, and that I would name that aircraft *Kelli Girl* after my beautiful wife.

But the itch never manifested itself until 22 years into my Air Force career. While assigned to Kirtland Air Force Base in Albuquerque, I was suddenly exposed to two different E/A-B kits, both under construction: first, the Titan T-51 Mustang, then the Van's RV-7A.

I don't recall how I became aware of the Titan T-51 Mustang kit, but I do remember suddenly spending a ton of time online reading and studying the aircraft…and what a kit! Dude! It's a ¾-scale Mustang! Aerobatic, 6 G's, retractable, reasonably nimble, and with an available V-6 "Mini Merlin"! For a South Texas farm boy who spent countless hours pushing Varsol-soaked mops under the (now) Commemorative Air Force's warbird oil drips in Harlingen, I was ecstatic: I simply could not wait to build my own Mustang.

I studied the Titan website and poured over the online T-51 forum, learning, estimating costs, concocting a build space plan. My middle-school-aged younger son Houston took a keen interest in the project, further warming me up to the notion of pulling the trigger. But as the "real" cost numbers started to jell, I simply had to yield to an overriding real-world priority: Houston's older brother Chase was about to start his freshman year at Texas Tech. This project must wait. I was disappointed, and I did catch Houston trying to hide a silent tear.

I kept abreast of the T-51's developments as I dreamed on. However, one of my fellow USAF officers introduced me to his Van's RV-7A project. I had not looked at any kit other than the T-51, but was immediately impressed by the RV-7A when he showed me the build, plans, construction, and designer's performance specifications. When Houston and I visited Paul "Bugsy" Gardetto, two of his sons showed Houston and me how to shape, work, and rivet Alclad…our very first aircraft pieces.

The look on Houston's face proved to me that if ever there was a time to build an amateur-built aircraft, it was now. He was less than half a decade away from leaving the nest, and I wanted this to be a family affair. Find the way…

…Which returned me to a question I had previously answered for myself without realizing I hadn't actually *asked* myself the question. Which aircraft kit shall we build? I knew which aircraft I *wanted* to build…the T-51. However, is that the aircraft I *should* build?

For context, you should know that I was nearing the end of my tour as the USAF's chief of flight safety at the Air Force Safety Center. Risk management, in all its forms (fiscal, safety, mission, etc.), was a key part of my job, and I carried it forward that year to my new assignment as Air Combat Command's director of safety.

I considered the T-51 against the Van's fleet line (RV-7, -8, -9, etc.). The price difference wasn't intolerable, nor did I see any relevant safety risk between the Titan and Van's lines. Aesthetically, the Mustang's looks beat the RV's hands-down.

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Griffon Aerospace *www.griffon-aerospace.com*	Lionheart	6	5200	232	213	56	K		
Groppo Avio *www.groppo.it*  *Trail*	Trail	2	1300	130	100	35	K	✓	$50-60k
Grosso Aircraft Inc.	Easy Eagle	1	725	110	100	45	P		
	Easy Eagle II	2	1150	110	100	45	P		
Gunder Restoration & Design *www.seqair.com*  *F.8L Falco*	F.8L Falco	2	1880	212	190	62	K/P		$130-170k
Hansen Aero *www.tecnam.com*	Tecnam P92 Super Echo	2	1320	140	123	39	K	✓	
Harper Aircraft *www.harperaircraft.com*	Fascination D4-BK	2	1300	172	160	38	K		
	Lil' Breezy	2	800	75	65	28	K	✓	
	Sky Scooter	1	650	62	55	28	K		
	Ultrasport	1	500	60	60	30	K		

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However, one fundamental logistical risk stood out: the chances of a successfully completed build to first flight. For my first attempt to build and fly an E/A-B, I chose the aircraft line with the higher percentage of successfully completed projects. To me, that meant more support, a better build experience, and, well, a greater odds-on chance that Houston and I would fly the thing. I decided this scale tipped in the RV's favor.

Let me be clear. I'm not saying the RV is a better, or worse, aircraft than the T-51. An RV project was simply the *right* choice for my situation. The T-51 is a great kit, and I still hope (plan?) to build one.

So that's how we chose to build an RV, but which one? First of all, I wanted the kit to help the builder (me) as much as possible: Match-drilled parts make the day, so I ruled out the RV-3, -4, and -6. Then we looked at the mission: sport flying (gentleman's aerobatics and formation) plus speedy VFR cross-country. RV-9s aren't really suited to aerobatics, I didn't need a four-seat RV-10, and I'm just not a Rotax guy. That left the RV-7 and -8.

My wife Kelli settled it for me when I asked her if she had anything in mind for *her* aircraft (if I maintain it, she lets me borrow it). Among her inputs, Kelli gave me two key "requests" (which I dutifully understood were actually "requirements").

- "Side-by-side seating," she said. "Sid, you flew over 2000 hours in the back seat of F-4 Phantoms. I will not be your backseat wizzo." Got it. RV-7 or -7A.
- "No surprises," she said, to which I asked for further clarification. "Sid, I want you to build *out* of this airplane the chance that it'll make you say, 'Oh, sh%$.'" After deep thought, I figured a ground loop counts as an Oh sh%$ moment, so a taildragger just wouldn't do.

Sid Mayeux's wife Kelli poses with *Kelli Girl*. It's her RV-7A, but if Sid does the maintenance, she lets him borrow it.

That settled it. We built an RV-7A. The canopy choice (slider versus tip-up) was easy for me. After 2069 Phantom backseat hours with *zero* forward visibility, the RV tip-up canopy's totally unobstructed forward view was heavenly (proven to me when Joe Blank took me up for a factory demo ride in their RV-7A).

The rest is history. Now, after several big mods (constant-speed prop, IFR upgrade, dual P-MAGs), we have logged over 550 Hobbs hours in just over three years and are preparing for our third trip to Oshkosh. I still feel that itch, but scratching it has been an absolute blast.

—Sid Mayeux

FIXED-WING AIRCRAFT

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Hatz Biplane Association *www.hatzbiplane.com*	Hatz CB-1	2	1400	105	90	38	P		$12-80k
 *Kelly-D*	Kelly-D	2	1500	105	90	40	P		$12-80k
Hensley Aircraft *www.hensleyaircraft.com*	H-1 Wolf/Wolf	4	3000	225	210	55	K	✓	
Hevle Aviation LLC *www.hevleaviation.com*	Hevle Classic	2	1320	135	105	45	P	✓	$19-40k
 *Hevle Classic*									
Higher Class Aviation	Hornet	2	1320	115	109	40	K	✓	$32-52k
Hinz	BL1-KEA	2	1590	168	155	53	P		
Hipp's Superbirds, Inc.	J-3 Kitten/Super Kitten	1	500	63	59	24	K/P	✓	$11-30k
	J-4 Sportster/Super Sportster	1	500	63	59	24	K	✓	$10-30k
	Reliant SX	1	600	100	75	31	K/P	✓	
	Reliant/Reliant SX	1	500	63	60	24	K/P	✓	$10-31k
HP Aircraft, LLC *www.hpaircraft.com*	HP-24 Sailplane	1	825	150		42	K	✓	$36-45k
 *HP-24 Sailplane*									
Hummel Aviation *www.flyhummel.com*	CA-2	1	520	63	50	26	P	✓	$4-11k
 *H-5*	H-5	1	850	135	120	41	K/P	✓	$17.2-32k
	Hummelbird	1	550	125	115	38	K/P	✓	$8-15k
 *UltraCruiser*	UltraCruiser	1	575	80	62	28	K/P	✓	$15-28k
	UltraCruiser Plus	1	950	135	125	36	K/P	✓	$20-30k
ICP Srl *www.icpaviazione.it*	Bingo 4S	2	1234	84	75	28	K	✓	$35-45k
	Savannah	2	1235	110	85	30	K	✓	$45-50k
 *Bingo 4S*	Savannah ADV	2	1235	125	115	34	K	✓	$55-60k
	Savannah S	2	1320	123	115	30	K	✓	
 *Savannah S*	Savannah VG	2	1235	110	95	30	K	✓	$45-50k
	Savannah VGW	2	1235	110	95	30	K	✓	$45-50k
Indy Aircraft, Ltd. *www.indyaircraftltd.net*	T-Bird I	1	575	78	60	26	K	✓	$15-30k
 *T-Bird II*	T-Bird II	2	1071	90	66	36	K	✓	$17-55k

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Ion Aircraft *www.ionaircraft.com*  *Ion 100*	Ion 100	2	1320	138	138	43	K	✓	$47-75k
Jabiru Aircraft *www.jabiru.net.au*	Calypso	2	1100	127	103	44	K	✓	$35-55k
	J450	2	1540	155	138	52	K		$65-100k
 *Jabiru J170*	Jabiru J170	2	1320	132	115	51	K	✓	$45-60k
	Jabiru J200	2	1540	159	138	55	K		$60-90k
	Jabiru J230	2	1320	138	138	51	K	✓	$65-100k
 *Jabiru J230*	Jabiru J250	2	1320	138	138	51	K	✓	$60-90k
	Jabiru J400	4	1540	152	138	55	K		$65-95k
	Jabiru J430	4	1540	138	138	57	K		$65-100k
 *Jabiru J430*	Jabiru SP	2	1540	154	130	50	K		
	Jabiru UL	2	990	139	115	40	K	✓	
Javron Aviation *www.javronaviation.com*  *Super Cub PA-18*	Super Cub PA-18	2	1320		115	38	K	✓	$84-152k
Jim Kimball Enterprises Inc. *www.pittsmodel12.com*  *Pitts Model 12*	Pitts Model 12	2	2300	239	170	64	K/P		$115-140k
Jim Maupin, Ltd.	Carbon Dragon	1	300	70		20	P		
	Windrose II	1	780	132	75	52	P		
	Woodstock	1	450	100		35	P		
Johnston Aviation *www.tigercubaircraft.com*	Tiger Cub II	2	1320	125	105	35	K	✓	$34-61k
	Tiger Cub UL	1	600	90	65	25	K/P	✓	$17-21k
Junqua-Diffusion	Ibis RJ.03	2	1034	158	126	57	P		
Jurca Plans, c/o Ken Heit	MJ-10 Spitfire (75%)	1	2860	230	180	65	P		
	MJ-100 Spitfire (100%)	1	6035	355	300	62	P		
	MJ-12 P-40 (75%)	1	2860	275	225	65	P		
	MJ-2 Tempete	1	950	120	102	62	P		
	MJ-5 Sirocco	2	1860	225	200	64	P		
	MJ-77 Mustang (75%)	2	2860	330	230	65	P		
	MJ-8 FW-190 (75%)	1	3000	240	200		P		
Just Aircraft *www.justaircraft.com*	Escapade	2	1320	132	110	42	K	✓	$55-85k
 *Highlander*	Highlander	2	1320	132	105	39	K	✓	$58-85k
	SuperSTOL	2	1320	132	100		K	✓	$55-85k

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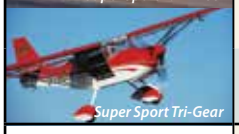
Kitfox Aircraft LLC *www.kitfoxaircraft.com*	Kitfox Lite	1	550	63	55	27	K	✓	
 Series 7 STi	Kitfox Model (Classic) IV	2	1200	120	110	37	K	✓	$45-60k
	Kitfox Series 7 Speedster	2	1550	140	130	47	K	✓	$55-65k
 Super Sport Tailwheel	Kitfox Series 7 STi—STol Inspired	2	1550	140	100	32	K	✓	$60-70k
	Kitfox S7 Super Sport Tailwheel	2	1550	140	123	41	K	✓	$50-60k
 Super Sport Tri-Gear	Kitfox S7 Super Sport Tri-Gear	2	1550	140	123	41	K	✓	$50-60k
Kitplanes for Africa	Bushbaby	2	1100	120	90	35	K		
Kolb Aircraft Company (The New Kolb Aircraft Co) *www.kolbaircraft.com*	FireFly/TriFly	1	500	63	63	27	K/P	✓	$15-18k
	FireStar	2	725	90	80	27	K/P	✓	$22-28k
 FireStar II SS	FireStar II SS	2	850	90	68	34	K	✓	$15-40k
	Kolb Flyer	2	1000	50	30		K	✓	
 FireStar	Kolbra	2	1000	110	75	45	K	✓	$26-39k
	Kolbra Ultralight Trainer	2	1000	100	75	35	K		
 Mark III Xtra	Mark III Classic	2	1000	100	80	41	K	✓	$28-42k
	Mark III Xtra	2	1100	100	90	27	K	✓	$32-45k
 Slingshot	Pelican Sport	2	1320	145	132	44	K		
	Slingshot	2	900	115	85	41	K/P	✓	$21-38k
Lancair International LLC *www.lancair.com*	Evolution	4	4550	345	325	61	K		$1400-1500k
	Lancair ES/Super ES	4	3550	230	215	70	K		$250-350k
 Legacy FGC-550	Lancair IV	4	3550	300	285	75	K		$300-400k
	Lancair IV-P	4	3550	330	300	73	K		$400-500k
 Legacy RG-550	Lancair Legacy FGC-550	2	2200	250	240	65	K		$200-295k
	Lancair Legacy RG-550	2	2200	276	270	65	K		$250-300k
 Legacy FG-390	Lancair Propjet	4	3550		370	74	K		$375-550k
	Lancair Sentry	4	3550		380	74	K		
	Lancair Turbine IV-P	4	3550		370	75	K/P		
 Mako	Legacy FG-390	2	2200	215	200	65	K		$180-225k
	Mako	4	3200		230	65	K		
Legend Aircraft *www.legendaircraft.ca*	Legend	2	3298	356	334	76	K		$300-600k
Legend Lite Inc.	Skywatch SS-11	2	950	90	80	29	K		
Legendary Aircraft	P51	2	2500	290	225	59	K		$125-200k

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Leichtflugzeuge, B & F GmbH - FK-Lightplanes *www.fk-lightplanes.com*	FK 9 Mark IV	2	1100	140	120	42	K		
	FK 12 Comet	2	1100	131	118	42	K		
	FK 14-B Polaris	2	1100	170	155	42	K		
Light Miniature Aircraft	LM-1A-W (85% J-3)	1	675	85	75	32	P	✓	$10-20k
	LM-1X (75% J-3)	1	600	75	65	26	K/P	✓	$8-10k
	LM-2X-2P-W (75% Taylorcraft)	2	875	85	75	38	P	✓	$8-14k
	LM-2X-2P-W (87% Taylorcraft)	2	875	100	85	40	K/P		
	LM-3X-W Aeronca Champ Replica	1	575	75	65	26	P	✓	$8-12k
	LM-5X-W Super Cub Replica	2	1275	90	80	42	K/P	✓	$16-25k
	LM-J3-W Piper Cub Replica	2	1250	85	70	38	K/P	✓	$16-25k
	LM-TC-W Taylorcraft Replica	2	1250	95	85	42	K/P	✓	$16-25k
Light Wing Sport Aircraft	Savannah	2	1144	110	100	28	K	✓	
	X-Air	2	993	75	65	30	K	✓	
	X-Air F	2	993	87	68	27	K	✓	
	X-Air H	2	1079	105	93	33	K	✓	
Liteflite Pty Ltd *www.liteflite.com.au*	Connie	1	570	90	65	35	K		
	Dragonfly 582	2	1080	66	54	28	K	✓	
	Dragonfly 912ULS	2	1080	66	54	28	K	✓	
	Dragonfly C-Model	2	990	65	55	22	K	✓	$35-44k
	Tempest	1	440	80		26	K		


Dragonfly 912ULS

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Dave Forster: "Do You Think You Could Build Something Faster?"

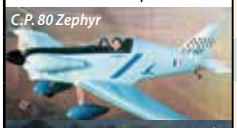
Wham! A bolt from the blue. You've got to love a wife who asks for an airplane to be built. Like any dutiful husband would, I quickly agreed, before she had time to change her mind.

Until that moment, we had been flying an airplane that on a good day would do 90 knots. On lunch fly-outs, we would be the first to depart and the last to arrive. It would not be a challenge to find something faster.

However, as we built our wish list for a new airplane, speed was not the only criteria. It had to have at least two seats (of course) and enough baggage space for a week's camping at Oshkosh. I had grown fond of our bush plane's short-field capability and appreciated a strong climb rate. Altitude more quickly meant more options sooner. It had to be capable of landing on grass, with handling characteristics that wouldn't bite a weekend pilot. I was aware that off-airport survivability drops significantly with increasing stall speed (energy is the square of velocity), so a reasonably slow stall speed was desired. The build time had to be short enough to fly prior to my hair commencing its migration, and metal was preferred. A previously built kit car taught me that fiberglass resin and sandpaper are not two of my most favorite things.

Armed with the list, our search for a suitable aircraft commenced. It didn't take long for the F1 Rocket to come to the top of the list. The next step was to go to one of the big experimental aviation shows, talk to the manufacturers, and ensure nothing new was about to change the equation. A trip to Sun 'n Fun and meeting with Mark Frederick of Team Rocket Aircraft helped reinforce our impressions and, as it turned out, he was from our home state of Texas, which made it easy to schedule a visit to check out the factory and go for a test flight.

For someone not used to small kit aircraft manufacturing, the "factory" was a bit underwhelming: a single hangar filled with Rocket parts and the promise of flight. However, the real kicker was the test flight.

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Littner, S. *www.slittneraircraftplans.com*	C.P. 60 Super Diamant	4	1875	160	155	55	P		
 *C.P. 80 Zephyr*	C.P. 80 Zephyr	1	840	200	175	50	P		
	C.P. 90 Pinocchio	1	1015	150	140	45	P		
	C.P. 150 Onyx	1	475	62	50	22	P	✓	
 *C.P. 328 Super Emeraude*	C.P. 328 Super Emeraude	2	1545	150	142	56	P		
	C.P. 750 Beryl	2	1850	185	160	56	P		
	C.P. 1320-Saphire	4	2075	200	167	53	P		
 *Champion V*	Champion V	2	992	155	143	47	P		
	Jewel	2	992	186	177	40	P		
 *Junior VI*	Junior VI	2	950	125	100	38	P	✓	
	Supercab	2	1250	162	143	35	P		
 *Whisky IV*	Vega	2	1600	150	120	52	P		
	Whisky IV	2	1060	183	130	37	P		
Loehle Aircraft Corp.	5151 Mustang	1	900	90	80	30	K	✓	$22-59k
 *Fokker D-VII*	5151 RG Mustang	1	960	95	85	30	K		$24-61k
	Fokker D-VII	1	525	70	65	20	K	✓	$19-41k
 *KW-909*	Jenny (67% Curtiss Jenny)	2	900	70	60	35	K		
	KW-909	1	900	95	85	30	K		$21-61k
 *Loehle Spitfire*	Loehle Spitfire	1	1200	140	105	38	K		$70-90k
	P-40	1	900	90	85	30	K		$21-61k
	SE5A	1	525	70	65	20	K	✓	$22-41k
 *Spad XIII*	Spad XIII	1	525	70	65	20	K	✓	$22-41k
	Sport Parasol	1	600	70	65	22	K	✓	$13-21k

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When his wife asked if he could build something faster, Dave Forster decided to build this F-1 Rocket.

One of the things I really enjoy is flying around puffy white clouds (at a legal distance, of course!). With our old Falconar Avia Maranda, this really did mean flying around them. The Rocket opened a whole new dimension: the ability to simply pull back and fly over the top. The climb rate was impressive, especially for someone used to the kind of performance where planning over the clouds required a sectional and E6B.

However, regardless of how impressed I was, the critical hurdle in the buying decision came next—the wife's ride. As I stood nervously on the ground, they took off. Have you ever had a time when you knew the next 15 minutes were going to set the course for a substantial impact on the rest of your life? This was it.

I knew she would probably like the airplane and was hopeful that a nice, quiet flight and gentle landing would provide a green light. After a while, the airplane came back into view, entered the pattern, and set up for a nice, gentle landing. However, before the wheels touched, the power came back, it soared up into the sky, and commenced doing something that shouldn't be described in writing. My heart sank and I saw the future unfolding with a steamed wife and evaporated Rocket dreams.

But when the plane came back for a landing, she bounded out of the cockpit and declared, "Wow! That was better than sex!"

I wrote a check on the spot.

—Dave Forster

FIXED-WING AIRCRAFT

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Lucas, Emile	L 5	2	1900	165	145	54	P		
	L 6	2	1713	143	125	50	P		
	L 7	3	1750	142	125	56	P		
	L 8	2	1600	192	165	60	P		
	L 11	2	990	125	103	42	P	✓	
	L 12	2	990	125	103	42	P	✓	
Luceair *www.luceair.com*  *Wittman Buttercup*	Wittman Buttercup	2	1300	150	125	45	K/P	✓	$15-23k
M-Squared, Inc. *www.msquaredaircraft.com*  *Breeze SS*  *Sprint 1000*	Breese DS	1	900	93	65	26	K	✓	$26-35k
	Breese SS	1	900	82	46	24	K	✓	$25-35k
	Breese 2 DS	2	1320	93	75	32	K	✓	$25-60k
	Breese 2 SS	2	1320	87	55	28	K	✓	$26-60k
	Sport 1000	2	1320	103	74	39	K	✓	$36-60k
	Sprint 1000	2	1320	94	58	27	K	✓	$35-60k
Main Planes	Beach Boy ST-II	2	650	85	75	22	P	✓	
Makelan Corporation *www.hatzclassic.com*  *Hatz Classic*	Hatz Classic	2	1700	150	100	43	K/P		$45-60k
Mann, Roger *www.rogermann.org*  *RW4 Midwing Sport*  *RW8 RagWing Pt2S*  *RW11 Rag-A-Bond*  *RW16 Aerial*  *RW22 Tiger Moth*	RW1 Ultra-Piet Pete	1	550	85	55	28	P	✓	$5-10k
	RW2 Special I	1	550	125	70	30	P	✓	$8-18k
	RW4 Midwing Sport	1	550	95	70	28	P	✓	$5-10k
	RW5 Heath Replica	1	550	85	60	28	P	✓	$5-10k
	RW6 RagWing Parasol	1	550	85	66	28	P	✓	$5-10k
	RW7 Duster	1	660	95	65	28	P	✓	$5-10k
	RW8 RagWing Pt2S	2	900	95	75	36	P	✓	$10-25k
	RW9 Motor Bipe	1	525	95	60	36	P	✓	$5-10k
	RW11 Rag-A-Bond	2	850	105	78	38	P	✓	$8-25k
	RW16 Aerial	1	580	90	60	28	P	✓	$5-10k
	RW19 Stork	2	1000	105	75	22	P	✓	$15-30k
	RW20 Stork Side-By-Side	2	1000	105	75	22	P	✓	$10-25k
	RW22 Tiger Moth	2	1050	110	80	35	P	✓	$10-25k
	RW26 Special II	2	950	135	85	38	P	✓	$10-20k
Maverick Air, Inc.	Twinjet-1500	6	5200	405	380	86	K		

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Meyer Aircraft *www.littletootbiplane.com*  Little Toot	Meyer's Little Toot	1	1320	138	125	51	P	✓	$20-45k
Microleve Com. Ind. LTDA *www.microleve.com.br*	Corsario MK-5	2	1100	95	85	30	K		
	ML500	2	980	95	80	20	K		
Mini-IMP Aircraft Co. *www.mini-imp.com*  Mini-IMP	Mini-IMP	1	1000	200	180	45	K/P		$15-27k
Mirage Aircraft, Inc. *www.mirage-aircraft.com*	Celerity	2	1825	225	205	60	P		$27-59k
 Marathon	Marathon	2	1825	205	190	60	P		$23-42k
Montagne Aircraft LLC	Mountain Goat	2	2475	165	159	27	K		
Morrison Aircraft *www.morrisonaircraft.com*	Morrison 6	6	4500	240	240	62	K		$170-332k

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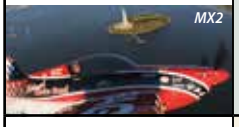
FIXED-WING AIRCRAFT

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Murphy Aircraft Mfg. Ltd. *www.murphyair.com*	Elite	2	1800	145	132	42	K		$75-85k
 Maverick	Maverick	2	950	110	85	32	K	✓	$30-40k
	Moose	6	3500	175	150	58	K		$120k
	Radical	2	1900	160	112	38	K		$80k
 Moose	Rebel	2	1650	140	120	40	K		$55-70k
	Rebel LSA	2	1320	100	90	36	K	✓	$50-60k
 Renegade Spirit	Renegade Spirit	2	950	100	80	40	K/P	✓	$48-55k
	Super Rebel TD	4	3000	160	150	46	K		
	Yukon	4	2550	145	135	46	K		$110k
Mustang Aeronautics *www.mustangaero.com*	Midget Mustang	1	950	202	175	57	K/P		$25-40k
 Mustang II	Mustang II	2	1850	225	220	58	K/P		$40-75k
MX Aircraft Co. *www.mxaircraft.com*  MX2	MXS and MX2	2	2150	255	232	55	K		$325-415k
Norman Aviation Int'l Inc. *www.normanaviation.ca*	Mini Explorer Nordic 8	2	1232	110	90	35	K/P	✓	$60k
	Norman VI-912	2	1200	110	103	34	K/P		
 VI-912-SW	Norman VI-912-SW	2	1058	110	103	34	K/P	✓	$45k
	Norman VI-914	2	1058	135	115	34	K	✓	$55k
Northbrook International	SportStar	2	1232	129	121	45	K		
nV Aerospace (was Rand-Robinson Engineering, Inc.) *www.nvaero.com*	KR-1	1	950	200	165	52	P		$9-15k
	KR-2	2	1050	200	165	52	K/P		$12-24k
 KR-2S	KR-2S	2	1100	200	170	52	K/P		$21-28k
Orion Aviation	Orion-TS	6	4560	325	300	70	K		
Orlando/Sanford Aircraft *www.airplane4sale.com*	Pioneer 200	2	992	108	100	34	K		
Osprey Aircraft *www.ospreyaircraft.com*	GP-4	2	2100	250	240	65	K/P		$50-68k
 Osprey 2	Osprey 2	2	1570	140	130	58	K/P		$25-35k
Pacific Aerosystem, Inc. *www.skyarrowusa.com*	P92-2000 RG	2	1212	155	142	38	K		
	P92-S Echo Super	2	1212	146	130	37	K		
	P96-Golf	2	1212	149	133	38	K		
	Sky Arrow 1450L	2	1433	110	98	40	K		
Partenair Design Inc.	S45 Mark II	2	1925	180	160	55	K		
	S45 Mystere	2	1900	175	160	55	K		

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Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
PAW	Free Spirit MkII	3	2150	285	250	52	K		
Paxman's Northern Lite Aerocraft	Viper	2	1300	130	115	38	K		
Pazmany Aircraft Corp. *www.pazmany.com*	Pazmany PL-1	2	1320	120	115	54	P		$28-40k
 *PL-1*	Pazmany PL-2	2	1416	138	119	52	P		$29-45k
	Pazmany PL-4A	1	850	120	97	39	P	✓	$18-25k
 *PL-9 Stork*	Pazmany PL-9 Stork	2	1673	116	104	33	P		$28-45k
Phantom Aeronautics LLC *www.phantomaero.com*	Phantom X1	1	570	65	57	26	K	✓	
 *Phantom X1*	X-1e (enclosed cockpit)	1	600	80	65	30	K	✓	
Phoenix Manufacturing, LLC (was CGS Aviation) *www.cgsaviation.com*	Hawk Arrow	1	700	90	75	35	K	✓	$22-28k
	Hawk Arrow II	2	1000	100	80	45	K	✓	$24-28k
 *Hawk Arrow II*	Hawk Classic	1	600	80	65	35	K	✓	$19-26k
	Hawk Plus	1	1000	100	85	40	K	✓	$22-28k
 *Hawk Ultra*	Hawk Sport	1	650	90	75	35	K	✓	$20-26k
	Hawk Ultra	1	600	63	55	27	K	✓	$17-19k
Pietenpol Aircraft Company *www.pietenpolaircraftcompany.com*	Pietenpol Air Camper	2	1040	100	80	40	K/P	✓	$6-16k
 *Sky Scout*	Pietenpol Sky Scout	1	1020	70	55	35	P	✓	$4-16k
Pipistrel-USA *www.pipistrel-usa.com*	Apis Bee	1	770	138	52	36	K	✓	$67-76k
 *Apis Bee Electro*	Apis Bee Electro	1	770	138	52	36	K		$67-76k
	Sinus	2	1290	135	127	39	K	✓	$82-100k
 *Taurus*	Taurus	2	1215	138	84	39	K	✓	$82-100k
	Taurus Electro	2	1215	138	84	39	K		$82-100k
 *Virus*	Virus	2	1235	148	140	40	K	✓	$82-100k
	Virus SW (Short Wing)	2	1210	138	138	39	K	✓	$80-100k

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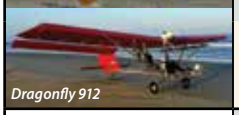
Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Pitman Air LLC *www.pitmanair.com*	Dragonfly 582	2	1080	66	54	29	K	✓	$30-75k
 Dragonfly 582	Dragonfly 912	2	1080	66	54	29	K	✓	$35-75k
	Dragonfly Rancher 582	2	1200	66	54	29	K	✓	$30-75k
 Dragonfly 912	Dragonfly Rancher 912	2	1200	66	54	29	K	✓	$35-75k
Piuma Project (Tiziano Danieli) *www.piumaproject.com*	Original Piuma	1	530	59	50	30	P	✓	$4-5k
 Original Piuma	Piuma Evolution	1	530	72	62	35	P	✓	$4-5k
	Piuma Tourer	1	550	93	84	39	P	✓	$4-5k
 Piuma Evolution	Piuma Twin Evolution	2	980	103	92	44	P	✓	$6-7k
Plane Perfection BRM *www.planeperfection.com*	LA582	2	1232		90	25	K	✓	$40-55k
 LA912	LA912	2	1232		96	25	K	✓	$46-60k

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Tom Wilson:
Stardusted

In a life less planned than others, the Starduster came to me more by being at the right time and place than by sober reflection. Having eagerly worked my own way to a Private while in high school, but sidetracked by racing cars and motorcycles, my early piloting years were spent in rented Cessnas as I indulged the car habit and made a career of writing about them. But early on, I also put in several years working at the local airport, in part at Aberle Custom Aircraft, where besides having certified oil run down my arm, a minor parade of Pitts, Stardusters, and racing biplanes got my attention. Biplanes were more popular in those pre-RV, canard, and bush plane days, and the then prevalent Greatest Generation owners saw the biplanes as natural sport planes, and it seemed so to me, too.

By my early 40s, airplanes were renewing their appeal, and my wife and I had just barely accrued the discretionary income to consider the long-dormant dream of owning one. Possessed of only modest fabricating skills and buried under magazine deadlines, two kids, and a mortgage, there was no hope of building my own plane. I had been around plansbuilt sport plane construction enough to know there was no way I was going to survive 6000 hours of that. I also never considered a certified plane; they were too boring, and you could always rent one if you needed four seats. And then the Starduster Too came on the market right there at my local airport.

The airplane was well known to me (and I bought it anyway) as it had been maintained its entire life by Aberle Custom Aircraft, which tamed some of the usual angst about how it had been built (elsewhere) and maintained (in my hometown). In any case it was a mess, looking like it was hurriedly built in a dark room by a guy welding without a mask and upholstered in an upstate Nevada sporting house, plus it had spent the last seven years standing motionless in a tin shed hangar. I knew better. . .but it had a 540 up front that I swore I could hear breathing when I stuck my head in the hangar. It wasn't anywhere close to boring, Aberle Custom Aircraft was there to help, and the price was set to sell—now.

Never mind that I had no tailwheel endorsement or loggable time in anything more challenging than a 172, the Starduster promised adventure. With its fast climb and 150-mph cruise, cross-countries were reasonable expectations. A confirmed convertible freak and yet to be deflowered romanticist, I didn't mind sitting outside, either.

Even if this particular Starduster was down on its luck and eventually proved to have a 50 percent availability record the first

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Preceptor Aircraft Company	N-3 Pup	1	535	63	60	27	K/P	✓	$18-19k
 STOL King	Stinger	1	660	90	80	35	P	✓	$22-26k
	STOL King	2	1200	115	90	15	K/P	✓	$38-45k
 Ultra Pup	Super Pup	1	1100	90	80	35	K/P	✓	$25-27k
	Ultra Pup	2	1100	105	80	35	K/P	✓	$32-33k
PrecisionTech Aircraft	Fergy F-II B	2	1000	90	80	28	K		
PRIMAC ind. e com. ltda	Moskitto M-10	1	497	73	61	30	K		
Pro-Composites Inc. *www.pro-composites.com*	Personal Cruiser	1	1250	168	140	58	K		$19-29k
 Vision EX	Vision	2	1600	207	155	55	P		$30-50k
	Vision EX	2	1600	207	157	54	P	✓	$30-40k
Produits Aviatech Inc. *www.produitsaviatech.com*	Super Cyclone	4	3500	175	165	38	K		$150-200k
Progressive Aerodyne, Inc. *www.searey.com*	Searey	2	1510	113	98	38	K	✓	$70-110k
 Searey									

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decade—the first annual took 14 months and brother there were some dragons hiding in the shadows—buying a used homebuilt is so incredibly time and money saving over rolling your own that I was able to hang onto the plane—my plane—on a writer's salary. Eventually, the demons were expunged, the engine and prop overhauled, so that while today the plane is still scruffy, it's stronger and more reliable than ever.

As for the Starduster design, it's been perfect for me. Undervalued, the Starduster was financially possible, unlike a two-seat Pitts. I roll and pitch aggressively on nearly all flights but don't need tiddlywink aerobatics. Zooming up and over the clouds on sunset flights is glorious, and the big engine means you don't have to look at your watch to see if anything is happening when you lay on the loud lever. Cross-country stability is excellent, and the world looks great framed by those two wings and crossing stainless steel wires. Yes, storage room is challenging, and you must accept both heat and cold (sometimes simultaneously), plus wind noise, the sun always on your face, and a "say again" attitude toward radio procedures, but airline captains give you thumbs up when you taxi by, and every gas stop is a social event. You wear a leather jacket without affectation.

Now older, I sometimes wish for a plush, sit-inside cross-country ride, and whenever gas gets toward $5 a gallon, I think of my buddies with

Tom flies his Starduster Too over north San Diego County, California. With its O-540 Lycoming, it climbs at 2500 fpm, cruises at 150 mph, and has a 350-foot takeoff roll.

Rotaxes. But then I remember the 350-foot takeoff roll, the 2500-fpm climb, and the immediacy of being out in the sky rather than passing through it. Then I zip my jacket all the way to the fur collar, point the nose into the wind and go.

—Tom Wilson

FIXED-WING AIRCRAFT

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Prowler Aviation, Inc.	Prowler Jaguar	2	2500	300	250	65	K		
Pulsar Aircraft Corporation	Pulsar 150	2	1450	190	175	55	K		$80-110k
	Pulsar III	2	1200	175	150	50	K		$75-110k
	Sport 150 Taildragger	2	1450	200	185	55	K		
	Super Cruiser	4	2400	190	175	55	K		$100-140k
	Super Pulsar 100	2	1400	190	165	63	K		$85-110k
Quad City Ultralights Aircraft Corp. *www.quadcitychallenger.com*  *Challenger II LSS XL-65*  *Challenger II Special*  *Challenger Special*	Challenger II	2	800	90	75	30	K	✓	$16-23k
	Challenger II CW LSS	2	960	110	95	37	K	✓	$22-27k
	Challenger II LSS XL-65	2	1060	100	90	32	K	✓	$33k
	Challenger II Special	2	850	100	85	37	K	✓	$19-23k
	Challenger Light Sport XS-50	2	960	120	95	32	K	✓	$22-28k
	Challenger Special	1	520	105	90	28	K	✓	$16-22k
	Challenger UL-103	1	500	90	75	25	K	✓	$14-16k
Questair Venture *www.questairventure.com*  *Questair Venture*	Questair Venture	2	2000	305	276	70	K		$130-250k
Quicksilver Manufacturing Inc. *www.quicksilveraircraft.com*  *MX II Sprint*  *Sport 2S*	GT 400	1	570	61	58	27	K	✓	$19-22k
	GT 500	2	1100	97	83	42	K	✓	$31-56k
	MX Sport	1	525	59	49	27	K	✓	$16-18k
	MX Sprint	1	525	54	54	24	K	✓	$15-17k
	MX II Sprint	2	720	55	51	27	K	✓	$21-30k
	MXL II Sport	2	720	61	59	32	K	✓	$22-30k
	Sport 2S	2	1000	69	59	35	K	✓	$27-40k
Quikkit Div. of Rainbow Flyers, Inc.	Glass Goose	2	1800	140	140	42	K		$55-80k
R & B Aircraft *www.bearhawkaircraft.com*  *Bearhawk Patrol*	Bearhawk (plans)	4	2500	142	130	42	P		$24-40k
	Bearhawk LSA	2	1320	138	120	30	P	✓	$60-75k
	Bearhawk Patrol	2	2000	156	140	35	P		$22-40k
R. J. Grega Enterprises LLC	GN-1 Aircamper	2	1100	115	87	25	P		
R&D Aerosports LLC	Legallight	1	550	63	50	25	K	✓	
R&D Aircraft  *Keleher JK-1 Lark*	Keleher JK-1 Lark	1	856	145	135	57	P		

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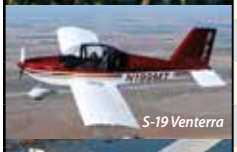
Raceair Designs	Mong Sport	1	960	125	105	50	P	✓	$8-16k
	Skylite	1	520	60	47	27	P	✓	$6-18k
	Zipster	1	540	60	52	27	P	✓	$6-12k
Rainbow SkyReach (Pty) Ltd. *www.fly-skyreach.com*	BushCat	2	1320	125	100	35	K	✓	$55-58k
RANS Designs, Inc. *www.rans.com*	S-4/5 Coyote	1	587	80	70	27	K	✓	
	S-6ES Sport Wing Coyote II	2	1320	130	110	36	K	✓	$43-46k
	S-6S Coyote II Sport Wing	2	1320	130	115	36	K	✓	$43-46k
	S-6S Super Coyote II	2	1200	130	115	36	K		
	S-7 Courier	2	1200	130	118	41	K		
	S-7S Courier	2	1320	130	110	33	K	✓	$47-52k
	S-9 Chaos	1	810	130	120	43	K	✓	$30-40k
	S-10 Sakota	2	1010	130	125	48	K	✓	$34-44k
	S-12XL Airaile	2	1100	100	90	35	K	✓	$25-45k
	S-12XL Super Airaile	2	1100	103	90	35	K	✓	$27-48k
	S-14 Airaile	1	750	90	85	36	K	✓	
	S-16 Shekari	2	1450	172	160	58	K		
	S-17 Stinger	1	587	78	60	28	K	✓	
	S-18 Stinger II	2	1100	90	85	43	K	✓	
	S-19 Venterra	2	1320	138	136	45	K	✓	$50-55k
	S-20 Raven	2	1320		112	33	K	✓	
	S-21 Outbound	2	1800		155	38			
Raven Aircraft Corp. *www.ravenaircraft.com*	Raven 2XS	2	1780	200	188	60	K/P		$70-150k
Ravin Aircraft USA, Inc.	Ravin 500 RG	4	3575	242	220	62	K		$150-250k
Redfern Plans	Redfern Fokker DR1	1	1455	120	100	40	P		$70-100k
	Redfern Nieuport 17 or 24	1	1279	120	100	45	P	✓	$70-100k
Refly, Inc.	Pelican	3	1764	98	86	40	K		
Replica Plans	SE5A Replica	1	1150	110	85	40	P	✓	$5-15k
Revolution Aviation, Inc. (formerly TEAM Tango) *www.revolutionaviation.net*	RAI-1 Tango	2	2000	265	207	70	K		$70-150k
	RAI-1 Tango XR	2	2200	265	207	70	K		$73-150k


BushCat


S-6S Coyote II Sport Wing


S-7S Courier


S-19 Venterra


S-20 Raven


S-21 Outbound


Raven 2XS


Ravin 500 RG


RAI-1 Tango

*Specifications shown may exceed LSA limitations. Aircraft can also be built to meet LSA requirements.
For a side-by-side comparison of models, visit *www.kitplanes.com/aircraftdirectory*.

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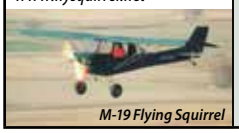
Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Revolution Aviation, Inc. (formerly TEAM Tango) *(Cont.)* *www.revolutionaviation.net*  *RAI-6 Foxtrot XR*	RAI-6 Foxtrot	4	3500	260	200	68	K		$100-200k
	RAI-6 Foxtrot XR	4	3500	260	200	68	K		$100-200k
Richard Steeves *www.coot-builders.com*  *Coot Amphibian*	Coot Amphibian	2	1950	140	110	50	P		$25-50k
Rihn Aircraft Corp.	Rihn DR-109	2	2450	225	168	66	K		
Robbins Wings	R-7	1	550	63	60	30	K	✓	
	R-8	1	550	63	60	30	K	✓	
	R-9	1	860	130	100	30	K	✓	
Rocky Mountain Wings, LLC *www.realflying.com*  *Ridge Runner Model IV*	Ridge Runner Model II	1	900	110	90	29	K	✓	$17-19k
	Ridge Runner Model III	2	900	100	80	28	K	✓	$18-28k
	Ridge Runner Model IV	2	1200	110	100	35	K		$26-38k
	Ridge Runner Ultralight	1	500	62	58	24	K	✓	$17-18k
Rogue Air Parts *www.flysquirrel.net*  *M-19 Flying Squirrel*	M-19 Flying Squirrel	1	800	80	75	38	P	✓	$4-10k

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David Paule:
An RV-3B? Really?

I didn't plan to build an RV-3B. In fact, the RV line wasn't on my radar at all. I've got a very nice, reasonably fast, four-seat airplane and a capacious hangar in which to keep it. If ever I were going to get another airplane, it would be a Kolb Xtra or a Curtiss Junior, for the visibility. And I couldn't really say that I needed either of those; after all, I'd sold a Kolb precisely because I wasn't flying it.

And as for a project, I did, admittedly, enjoy building aluminum airplanes, having had the construction of one as a college job. But then again, I knew well the labor involved.

What's more, I'd sold my fast composite trimaran sailboat. Yes, after sailing for a decade, I gave it up; the ocean was too far away from the mountains of Colorado. But the sailboat taught me something pertinent: I preferred non-engine activities to engine ones. The best part of any day on the water was when I got to shut the motor off.

So a friend built a motorglider and started flying it about 90 minutes per day. He'd climb for about 15 or 20 minutes, shut down that motor, and soar. It was a kit that he built. I could buy one of those and have the fun of shutting down the motor, too. Tempting indeed.

But the memory of him building those very long wings still made me think that it wasn't for me. Wings are good things to have, to be sure, but that plane has an excessive length of them, and they must be built, every foot of them.

For that matter, the Curtiss Junior has seemingly long wings, too. This led to wondering if I could homebuild a Junior, keeping the airplane's grace and, yes, the span, but with slightly better visibility and a more recent engine. No, I decided, I didn't need a project of that magnitude at all. A simple little airplane kit at my age would do nicely.

Around that time I discovered *www.VansAirForce.net*, and Paul Dye and Louise Hose were discussing the construction of their RV-3B, and this got me interested in that airplane. About this time also, I got a demo ride in an RV-12 and was surprised by its superb handling and remarkable visibility. If only it were a taildragger! I have only minimal nosedragger experience and remain somewhat suspicious of them, an unfounded prejudice of mine, perhaps.

People say that the RV-3B handles well. I don't know. I've never flown one.

People don't say the visibility is outstanding, and I'm sure it isn't. But it appeared as if a tall canopy and lots of seat cushions might improve that, anyway.

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Ron Sands Replicas *www.ronsandsreplicas.com*  *Fokker DR1*	Fokker DR1	1	1600	120	110	42	P		
	Primary Glider, 1929	1	375	45	38	30	P	✓	
Rotorvox USA c/o Flightstar, Inc. *http://rotorvox.com*	eSpyder	1	500	80	50	24	K	✓	$15-18k
	Flightstar Loadstar	1	950	95	70	36	K		
	IISC	2	992	83	65	36	K	✓	$30-35k
	IISL	2	950	80	65	36	K	✓	$23-29k
	Spyder	1	680	80	65	36	K	✓	$16-18k
Rutan Aircraft Factory (RAF)	Defiant	4	2997	216			P		
	Long-EZ	2	1325	185	144		P		
	Quickie	2	1000	180	140		P		
	VariEze	2	1050	195	165	55	P		
	VariViggen	2	1700	165	150	48	P		
Sapphire Aircraft Australia Pty Ltd	Sapphire	1	704	112	98	42	K		
Sauser Aircraft Inc.	P6E Replica (82%)	2	2040	145	130	50	P		
SD Planes (SPACEK s.r.o.) *www.sdplanes.com*  *SD-1 Minisport*	SD-1 Minisport	1	540	121	100	39	K/P	✓	$12-20k
	SD-2 Sportmaster	2	1330	160	150	47	K	✓	$60-70k

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People say that the nice thing about the RV-3B is the quality of the social experience, knowing that it's a single-seater.

People don't say that the RV-3B is a thinking man's airplane, which it most certainly is, at least during the construction. People should say that because it's true. I ought to know because I decided to build one, mostly to have a fulfilling project, and it has been that and more for sure. My kits were delivered in 2012, and I've been at it since. And yes, it'll have a full-time big engine, and it'll make those loud engine sounds that I no longer enjoy.

To me, the difficulties inherent with the RV-3B made it a particularly attractive project. The skins didn't have prepunched holes, for example, and some of the parts didn't fit as well as they might have. But apparently the design has decent handling characteristics, and I look forward to that.

What's it like to build? It's an airplane from the '70s, which means it's not computer designed. A number of the parts need to be tweaked before they fit, and the plans, while sufficient, are not always well organized, complete, or ample. Some of the details are obscure at best. But two fuel tank arrangements are included and two canopy-opening designs. The airplane has been around long enough that its major design-improvement iterations are complete: the B model with wing tanks and a better spar being the major one. So far, factory builder support and replacement parts availability have been excellent. I've got the wings and tail done and am skinning the fuselage now. Building it is both fun and challenging, and I haven't gotten bored yet.

—David Paule

David Paule rivets the left-hand skin of his RV-3B. He finds building to be both fun and challenging, and he haven't gotten bored yet.

FIXED-WING AIRCRAFT

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Seaflight (NZ) Ltd.	Shearwater	4	3086	165	155	57	K		
SeaStar Aircraft Inc.	SeaStar	7	5000	275	260	59	K		
Seawind/SNA, Inc. *www.seawind.net*	Seawind 2500	4	3400	187	178	59	K		
	Seawind 3000	5	3400	200	191	59	K		
Serenity Aviation *www.serenityaviation.com*  *Spacewalker*	Spacewalker (a.k.a. Revolution)	2	1320	120	90	45	K/P	✓	$13-50k
Shark Aero *www.sharkaero.com*  *Shark UL*	Shark UL	2	1323	206	150	50	K		$130-175k
Sherpa Aircraft *www.sherpaaircraft.com*  *K650T*	K650T	8	6500	235	197	37	K		$995-1150k
Shirl Dickey Enterprises	E-Racer MK-I	2	1800	240	220		K/P		
Siers Flight Systems, Inc	Barracuda	2	2300	205	200	62	P		$45-120k
Silence Aircraft GmbH *www.silence-aircraft.de*  *Twister*	Twister	1	880	146	145	47	K		$65-90k
Simplex Aeroplanes *www.simplexaero.com*  *Zing*	Cloudster	1	500	63	50	25	P	✓	$7k
	Pinocchio	1	500	70	60	27	K/P		
	Zing	1	500	63	60	27	K/P	✓	
Sinoaustral Aviation Technology PTY LTD (fmr. Bushcaddy International Inc.) *www.bushcaddy.com*  *BushCaddy R80 UL/Sport*	BushCaddy L160	3	2250	125	115	42	K		$60-110k
	BushCaddy L162 Max	4	2650	140	125	37	K		$60-110k
	BushCaddy L164	4	2650	140	125	42	K		$80-120k
	BushCaddy R120	2	1500	120	110	34	K		$60-90k
	BushCaddy R80 UL/Sport	2	1320	120	110	32	K	✓	$50-65k
Sky Classic Aircraft *www.skyclassic.net*  *Smith Miniplane 2000*	Smith Miniplane 2000	1	1000	135	125	60	P		$7-25k
Sky Raider LLC  *Super Sky Raider*	Frontier	2	1320	130	105	38	K	✓	$35-45k
	Sky Raider II	1	1050	85	80	32	K	✓	$22-30k
	Super Sky Raider	2	1050	95	80	32	K	✓	$24-32k

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FIXED-WING AIRCRAFT

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Sky Ranger Aircraft Company, Inc.	SkyRanger II	2	1212	116	105	36	K	✓	$25-50k
	SkyRanger SS	2	1212	116	100	33	K	✓	$25-50k
SkyCraft International Inc.	ARV Super2	2	1168	137	115	58	K		
Skyline Technologies	Sparrow II	2	990	130	95	36	K	✓	
	Sparrow II XTC	2	1250	115	110	39	K	✓	$40-45k
	Sparrow Sport Special	1	775	100	85	31	K	✓	$28-32k
	Sparrow Ultralight	1	504	63	58	27	P	✓	$9-13k
Skypaths Inc.	Pathmaker JK-05	2	1232	128	110	42	K		
SlipStream International (Slip Stream International LLC) *www.slipstream.bz*	Genesis	2	1200	100	75	40	K	✓	$28-32k
	Revelation	2	1100	90	66	37	K	✓	$22-32k
	Scepter	1	1300	85	60	27	K	✓	
 *Ultra Sport*	Ultra Sport	2	1150	100	70	40	K	✓	$28-32k
SLO Air Inc.	NXT	2	2600	375	345	88	K		$250-450k
SoneraiWorks LLC *www.sonerai.com*	Sonerai I	1	700	200	150	55	P		$10-20k
 *Sonerai I*	Sonerai II Original	2	950	200	140	55	P		$10-20k
 *Sonerai II Stretch*	Sonerai II Stretch	2	1150	200	140	55	P		$10-20k
Sonex Aircraft, LLC *www.sonexaircraft.com*	Onex	1	950	155	135	45	K	✓	$29-42k
	Sonex-B	2	1100	150	130	40	K	✓	$36-46k
 *SubSonex Jet*	SubSonex Personal Jet	1	1000	287	240	58	K		$110-150k
	Waiex-B	2	1100	150	130	40	K	✓	$36-46k
 *Waiex-B*	Xenos-B Sport Motorglider	2	1275	120	100	44	K	✓	$40-60k
Specter Aircraft, Inc.	Specter II	2	1600	170	140	54	K		
Spencer Aircar  *Spencer Air Car*	Spencer Air Car	4	3250	155	140	53	P		
Sport Aircraft Works LLC	Dynamic WT9	2	1150	155	150	37	K		$85-95k
	Dynamic WT9 RG	2	1150	178	168	37	K		$95-110k
	Mermaid	2	1430	132	115	40	K		$80-95k
	Parrot	2	1320	138	132	28	K	✓	$70-90k
	Sport Cruiser	2	1320	160	133	34	K		$55-70k

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Sport Performance Aviation LLC *www.flywithspa.com*  Panther	Panther	1	1115	170	138	51	K	✓	$28-50k
Sportair Aviation, Inc.	Corsario MK-5	2	1320	100	85	42	K	✓	$45-60k
	ML500	2	980	80	65		K		
SportairUSA, LC *www.sportair.aero*	Sting Carbon	2	1450	190		43	K		
Sportflight Aviation	Talon Magnum	1	735	105	80	38	K	✓	$22-32k
	Talon XP	2	1050	95	72	41	K	✓	$23-35k
St-Just Aviation International Inc.	Super Cyclone	4	3500	175	165	38	K		
St. Croix Aircraft *www.stcroix.50webs.com*	Pietenpol Aerial	2		110	85	40	P		
 Sopwith Triplane	Pietenpol Aircamper	2	1020	90	75	40	P		
	Sopwith Triplane (1916)	1		120	100	40	P		
Starflight Industria Aeronáutica LTDA	Fox V5 Advanced/ V5 Super	2	919	84	75	35	K		
	Fox V5 Tandem	2	919	80	75	34	K		
	Fox Vector V6	2	919	90	78	35	K		
Steen Aero Lab, Inc. *www.steenaero.com*	Firebolt	2	2000	214	170	61	P		$40-105k
	Great Lakes Sport Trainer	2	1618	138	125	40	P		$50-120k
 Knight Twister	Knight Twister	2	865	180	145	56	P		$25-90k
	Pitts S1-C	1	1150	200	154	64	P		$25-75k
	Skybolt	2	1970	210	170	68	P		$35-100k
Stewart Aircraft Co. *www.stewartaircraft.com*	265/275	2	1320	130	90	43	K	✓	
 FooFighter	FooFighter	1	1100	120	115	48	P	✓	
	Headwind B	1	750	90	85	40	P	✓	$10-35k
Stewart 51 Partner, LLC *www.stewart51.info*	S-51D Mustang	2	3400	315	284	70	K		$300-500k
Storch Aviation Australia Pty Ltd	Slepcev Microlight Storch	2	990	85	78	27	K		
	Slepcev Storch	2	1200	85	78	25	K		
	Slepcev Storch Moose	4	3400	118	100	35	K		
	Slepcev Super Storch	2	1900	100	90	29	K		
Storm Aircraft *www.stormaircraft.com*	Rally 105	2	1455	149	134	34	K		
	Sea Storm Z4	4	2640	165	144	46	K		
	Storm 300	2	1234	163	148	32	K		
	Storm 400	4	1850	180	170	44	K		
	Storm 500	4	2145	180	172	48	K		
	Storm Century	2	1455	178	173	34	K		
	Storm RG	2	1455	178	173	34	K		

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Sunshine Aero Composites	Dart	2	1350	200	160	65	P		$15-30k
Super-Chipmunk Inc.	Super Chipmunk	2	2400	180	160	60	K		
Supermarine Aircraft LLC *www.supermarineaircraft.com*  Mark 26B Spitfire	Mk 26 Spitfire (80% or 90% Scale)	2	1653	220	180	48	K		$130-145k
	Mark 26B Spitfire	2	1985	253	187	51	K		$230-260k
Swick Aircraft	Swick T	2	1280	140	130	42	P		
Tapanee Aviation Inc. *www.tapanee.com*  Pegazair 100	Levitation 2	2	2300	125	115	35	K		$60-170k
	Levitation 4	4	2500	130	120	38	K		$65-180k
	Pegazair 80	2	1058	110	95	15	K		
	Pegazair 100	2	1450	115	105	28	K/P		$45-125k
Tarragon *www.tarragonaircraft.com*  Tarragon	Tarragon	2			193	40			
Taylor, T. *www.taylortitch.co.uk*  Taylor Titch	Taylor Monoplane	1	700	115	100	40	P	✓	$9-11k
	Taylor Titch	1	760	200	160	52	P		$11-15k
Team Mini-Max LLC (was JDT Mini-Max LLC) *www.teammini-max.com*  AeroMax	1030R MAX 103 Ultralight	1	560	62	55	26	K/P	✓	$8-10k
	AeroMax	1	738	100	75	33	K/P	✓	$12-14k
	Enclosed Cockpit, 1300Z	1	560	100	75	31	K/P		
	Enclosed Cockpit, 1600R	1	560	75	72	28	K/P	✓	$7-9k

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Barnaby Wainfan: Designing and Building the Facetmobile

Building an airplane is a major undertaking. For most of us, it is the single biggest draw on our resources other than taking care of necessities and our families. To maintain the level of effort needed to succeed, you have to have a compelling reason to complete and fly that particular airplane. That motivation is as personal as the individual builder. For some, it's the only way to get the machine they dream of flying. Others enjoy the act of construction itself or see the project as a personal work of art.

The path that led to the Facetmobile started many years before actual construction. I am a designer and innovator both by profession and inclination. I remember getting my first issue of *Sport Aviation* when I joined EAA at the age of 16 and thinking that someday I wanted one of my designs to grace the cover.

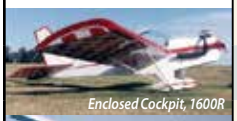
I was driven by the excitement of creating something new and different. I had my own conception of what a personal airplane could be. I wanted to do the experiment and prove that it worked. To do that I had to both design and build the airplane.

The seed of the idea was planted by the cover article on the Dyke Delta in the July 1972 issue of *Air Progress*. I was 16 at the time, and while I lacked the technical education to fully understand why the Dyke Delta worked, I was impressed by both its performance and radical look.

A year later, I passed my flight test for my Private Pilot license and started work on my mechanical and aerospace engineering bachelors degree at Cornell. I started sketching delta-winged light-plane concepts and used my newly acquired engineering knowledge to analyze their performance. Within a year, I set building such an airplane for myself as a life goal.

During my time at Cornell, I started building a KR-2 with my father, who suggested a plansbuilt project as a learning exercise before we started on the original-design delta. I now understand that my dad saw my still-developing engineering skills were not yet to the point where I could design a safe airplane. The KR-2 project was his way of supporting my long-term dream while postponing the delta project until I had the ability to do it right.

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
Team Mini-Max LLC *(Continued)* (was JDT Mini-Max LLC) *www.teammini-max.com*	Enclosed Cockpit, 1650R Eros	1	700	80	75	33	K/P	✓	$10-12k
	Hi-MAX, 1700R	1	560	75	70	31	K/P	✓	$7-10k
	MAX-103 1030H	1	500	90	55	27	K/P		
	Mini-MAX, 1100R	1	560	75	65	31	K/P	✓	$8-10k
	Open Cockpit, 1200Z	1	560	100	65	31	K/P		
	Open Cockpit, 1500R	1	560	75	65	31	K/P	✓	$8-10k
	V-MAX, 1550V	1	700	85	75	38	K/P	✓	$8-10k
Team Rocket Aircraft *www.f1aircraft.com*	F-1 Evo	2	2100	265	235	50	K		$90-175k
	F1 Rocket	2	2000	257	230	56	K		$70-175k
	F4 Raider	2	1750	215	198	52	K		
Thatcher Aircraft Inc. *www.thatchercx4.com*	Thatcher CX 4	1	850	130	125	40	P	✓	$12-18k
	Thatcher CX 5	2	1320		120	42	K/P		$25-32k
The Airplane Factory *www.airplanefactory.com*	Sling 2	2	1540	155	132	45	K	✓	$65-80k
	Sling 4	4	2024	161	138	54	K		$80-100k
	Sling TSi	4	2094	178	167	52	K		$135-200k
The Butterfly Aircraft L.L.C. (The Butterfly LLC)	Banty	1	500	60	50	27			


Enclosed Cockpit, 1600R


Hi-Max, 1700R


Open Cockpit, 1500R


F4 Raider


Thatcher CX4


Sling TSi

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The KR-2 was never completed, although I moved the project with me twice after I left my parents' house. I continued to work on it on and off for a few years and then lost interest. Its end illustrates what my motivations really were. For me it was not worth the effort to simply reproduce what had been done before. That partially built KR survives to this day and is used by a Southern California EAA chapter as a show exhibit illustrating wooden airplane construction.

As time went on, my fascination with the desirable characteristics of low-aspect-ratio configurations increased. I studied other such airplanes including the Arups, the NASA lifting bodies, and the Avro Vulcan and continued to work on my own designs.

By 1988, I had refined my ideas to the point where the detail design of what would become the Facetmobile started in earnest. We began cutting metal in early 1989, 17 years after the picture of N555A on the *Air Progress* cover first caught my attention.

N117WD first flew in April of 1993. In 1994, I flew it from California to Oshkosh, where it earned an EAA award for innovative design and became the cover story for the October 1994 *Sport Aviation*.

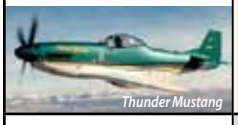
For me, the Facetmobile project was as much about the experiment and the exploration of a new design approach as it was about building

In 1994, Barnaby flew the Facetmobile to Oshkosh and it appeared on the cover of *EAA's Sport Aviation*. *(Photo: Courtesy of EAA)*

simply to have the airplane. In that, it was a complete success, in spite of its relatively short flying life. I remember thinking after I flew it to Oshkosh that even if it never flew again, it had all been worthwhile. I used the knowledge I gained during the project in my professional life, and I am currently working on the design of the Facetmobile's long-delayed successor. If fate is kind, perhaps it too will make it to Oshkosh someday.

—Barnaby Wainfan

FIXED-WING AIRCRAFT

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
The Light Aircraft Company Ltd. (TLAC) *www.g-tlac.com*	Sherwood KUB	1	550	99	64	25	K	✓	
	Sherwood Ranger ST	2	1040	90	70	38	K	✓	$45-69k
 *Sherwood Scout*	Sherwood Ranger XP Aero	2	1040	90	70	40	K	✓	$40-60k
	Sherwood Scout	2	1100	132	92	39	K	✓	$37-58k
Thorp Central (Classic Sport Aircraft) *www.thorpcentral.com*  *Thorp S-18*	Thorp S-18	2	1600	215	180	63	K/P		$30-45k
Thunder Mustang LLC (Gut Works, LLC) *www.thundermustang.com*  *Thunder Mustang*	Thunder Mustang	2	3200	375	345	68	K		$350k
Thunderbird Aviation, Inc.  *Hiperlight SNS-9*	Hiperlight SNS-8	1	500	93	58	27	K	✓	$20-30k
	Hiperlight SNS-9	2	875	113	85	39	K	✓	$31-50k
Titan Aircraft *www.titanaircraft.com*	T-51 Mustang	2	1450	170	150	42	K		$80-100k
 *T-51 Mustang*	T-51 Mustang - V6	2	1800	197	175	48	K		$80-150k
	T-51 Mustang LSA	2	1320	170	140	42	K	✓	$80-100k
 *T-51 Mustang LSA*	Tornado I Sport	1	750	113	95	30	K	✓	$20-35k
	Tornado II FP	2	1200	120	100	40	K	✓	
	Tornado II Trainer	2	1000	125	110	35	K	✓	$35-45k
 *Tornado S*	Tornado MG	1	750	130	100	35	K	✓	$16-25k
	Tornado MG II	2	1000	150	120	35	K		
 *Tornado SS*	Tornado S	2	1140	125	125	35	K	✓	$35-50k
	Tornado SS	2	1200	125	125	40	K	✓	$38-60k
Toxo Aircraft North America	Toxo Sportster	2	1536	180	175	40	K		
Tri-R Technologies	KIS TR-1	2	1300	195	175	55			
	KIS TR-4 Cruiser	4	2400	185	165				
Turbine Design	TD-2	2	4100	400	330	65	K		
Turner Aircraft, Inc. *www.turnert-40airplanes.com*	T-40	1	1060	170	145	45	P		$8-20k
 *T-40A*	T-40A	2	1600	160	147	56	P		$12-30k
	T-40A Super	2	1650	175	155	62	P		$20-35k

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U-FLY-IT Light Sport Aircraft, LLC *www.fly103.com*  Aerolite 103	Aerolite 103	1	600	75	70	27	K	✓	$14-21k
U.S. Aviation	Cumulus	1	640	90	75	32	K	✓	$12-19k
Ullmann Aircraft Company	Panther	4	3050	200	200	67	K		$100k
Ultimate Biplane Corp. *www.ultimatebiplane.com*	10-100	1	1350	190	140	55	K/P		
 10-300	10-200	1	1350	190	170	60	K/P		$60-90k
 20-300	10-300	1	2000	195	190	60	K/P		$95-190k
	20-300	2	2000	200	190	58	K/P		$108-213k
Ultravia Aero Int'l Inc.	Pelican PL	2	1400	155	145	49	K		
	Pelican PL/912S	2	1400	140	130	50	K		
	Pelican Sport	2	1320	132	126	44	K		
Unger, Carl H  Breezy R.L.U.-1	Breezy R.L.U.-1	3	1200	105	80	28	P		$8-12k
Van's Aircraft, Inc. *www.vansaircraft.com*	RV-3	1	1100	207	196	51	K		$35-63k
	RV-4	2	1500	204	192	51	K		$37-73k
 RV-8A	RV-6/6A	2	1600	210	199	49	K		
	RV-7/7A	2	1800	216	206	51	K		$41-97k
 RV-12iS	RV-8/8A	2	1800	222	212	51	K		$41-98k
	RV-9/9A	2	1750	196	188	50	K		$44-82k
 RV-14	RV-10	4	2700	208	197	63	K		$95-121k
	RV-12iS	2	1320	144	135	47	K	✓	$67-88k
	RV-14/14A	2	2050	205	195	53	K		$75-95k
Velocity, Inc. *www.velocityaircraft.com*	Velocity Elite RG	4	2250	230	210	70	K		
	Velocity SE-FG	4	2300	201	184	70	K		$70-140k
 SE-RG	Velocity SE-RG	4	2300	219	200	72	K		$75-150k
	Velocity SUV	4	2250	183	175	65	K		
 V-Twin	Velocity TXL-RG-5	4	2900	290	288	72	K		$175-250k
	Velocity V-Twin	4	3200	230	207	82	K		$235-400k
	Velocity XL-FG	4	2700	238	213	75	K		$110-180k
 XL-RG-5	Velocity XL-FG-5	5	2900	219	200	75	K		$110-185k
	Velocity XL-RG	4	2700	241	219	75	K		$125-195k
	Velocity XL-RG-5	5	2900	247	230	75	K		$125-195k
Velox Aviation Inc.	Rev1, Rev2	2	1980	230	200	63	K		

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Venom Aircraft *www.venomaircraft.com*	Venom	2	3750	375	320	67	K		$350-750k
Viking Aircraft *www.vikingaircraft.com*  *Cygnet SF2-A*	Cygnet SF2-A	2	1100	110	100	48	P	✓	$18-20k
Vintage UltraLight Association *www.vula.org*	Betabird	1	650	80	80	45	P	✓	$2-5k
	Gypsy	1	475	55	45	22	P	✓	$2-5k
 *J3-JR*	J3-JR	1	550	55	45	25	P	✓	$2-4k
	Mr. Easy	1	485	63	50	28	P		
	MW-7	1	600	85	55	35	P	✓	$2-5k
 *Woodhopper*	Skypup	1	400	69	50	26	P	✓	
	Whing Ding	1	310	45	35	24	P	✓	$2-5k
	Woodhopper	1	345	40	30	18	P	✓	$2-5k
Viper Aircraft Corp.	ViperJet Mk II	2	5200	538	400	88	K		$650-795k
VSR *www.snoshoo.com*  *SR-1 Snoshoo*	SR-1 Snoshoo	1	760	260	200	65	P		$15-30k
VSTOL Aircraft Corporation	SS2000	2	860	67	50	20	K		
	SST2000	2	1500	100	60	22	K		$85-105k
VX Aerospace Corporation *www.vxaerospace.com*	FX 300	4					K		
W.A.C.O. Aircraft Company Ohio, Inc.  *WACO M-F*	WACO M-F	3	2500	140	120	48	K		$120-150k
Wag-Aero Group *www.wagaero.com*	Sport Trainer	2	1320	94	85	38	K/P	✓	$35-45k
 *Wag-A-Bond*	Sportsman 2+2	4	2200	128	124	38	K/P		$45-60k
	Wag-A-Bond	2	1320	126	124	43	K/P	✓	$29-40k
WAR Aircraft Replicas	A6M2-Zero	1	900	155	135	55	P		$18-24k
	F-4U Corsair	1	900	155	135	55	P		$18-28k
	F8F Bearcat	1	900	155	135	55	P		$17-26k
 *Focke Wolf 190*	Focke Wolf 190	1	900	155	135	55	P		$16-26k
	Hawker Sea Fury	1	900	155	135	55	P		$16-26k
 *Messerschmidt BF-109*	Hurricane	1	900	155	135	55	P		$17-26k
	Messerschmidt BF-109	1	900	155	135	55	P		$18-24k
 *P-47 Thunderbolt*	P-40 Warhawk	1	900	155	135	55	P		
	P-47 Thunderbolt	1	900	145	135	55	P		$14-26k
	P-51 Mustang	1	900	155	135	55	P		$17-26k

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Warner Aerocraft, Inc. *www.warnerair.com*	Revolution I/Spacewalker I	1	850	140	120	38	P		
	Revolution II/Spacewalker II	2	1400	125	120	42	P		
	Sportster	2	1320	125	110	43	K	✓	$45k-55k
Weedhopper Plans *www.freeweedhopperplans.com*  *Weedhopper 40*	Weedhopper 40	1	550	60	55	20	P	✓	$9-11k
Weedhopper, Inc.	Weedhopper Standard	1	485	55	50	25	K	✓	$4-10k
	Weedhopper Super	1	830	65	60	25	K	✓	$12k
	Weedhopper Two Place	2	840	65	55	28	K	✓	$14k
Western Aircraft Supplies Ltd.	PGK-1 Hirondelle	2	1475	157	145	55	P		
Whisper Aircraft *www.whisperaircraft.com*  *Whisper X 350 Gen II*	Whisper X 350 Gen II	2	2094	196	196	60	K		

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Nigel Speedy: Why I Chose the RV-8

When it comes to choosing the right airplane, there are many considerations. Here is how I ended up building and flying a Van's RV-8.

Back in the day, when I still wore a uniform, I had the opportunity to do a flying instructor course in the Pilatus PC-9, a 1000-hp tandem-seat turboprop. In hindsight I did not fly that airplane all that well, but I sure did enjoy going places fast—fast relative to the helicopters I had been flying up until then. I also liked the aerobatics and formation that we did in this course.

A few years later, I was in the USA, and one of my classmates in a test pilot course was talking about the rudder kit for an RV that he was building. You can build a plane in your garage? What a novel idea.

Fast forward a few more years, and I was back in the USA again and hanging out at the local airport display day. A chap there with a Sirocco (imagine a wooden RV-8, or as he likes to say, "The RV-8 is an aluminum Sirocco.") tells me, "You need to start building now before you get married." Hard to argue with that logic. The question was, what to build?

I want to explore my new home and mostly it will be on weekends, so I wanted a plane that is relatively fast, so I can cover some reasonable ground. I like doing gentle aerobatics. I want to replicate the tandem seat configuration of the PC-9. This was my first kit aircraft project, and I while I enjoy building stuff, I really wanted to be flying, so an aircraft with a good probability of completion in a reasonable time period was important. A stable company with good customer support and popular models also played into my deliberations.

After five years and 2500 hours of construction, the RV-8 does exactly what I wanted it to. Day in and day out, I get 177 knots TAS burning 7.7 gallons per hour. There are certainly many aircraft that are more capable in any one area (STOL, cost, speed, aerobatics, range, economy), but

Nigel Speedy chose to build an RV-8 because it met the criteria that were most important to him: tandem seating, cruise speed, range, aerobatics, cost, and solid support for the type.

I don't think there are many that can outperform the RV-8 in all areas. I tell folks that the RV-8 is not the best at any one thing, but it is very good at most things—at least the things that are important to me.

After two and a half years and 500 hours of flying, I still marvel at the fact that it was built at home. If I were to do it again, I would use 10-inch displays rather than 7-inch ones that are a challenge with older eyes. I would not bother with an IFR GPS, given the amount of actual IFR I do. I would not bother with the aftermarket tip tanks; it can do around 1000 nautical miles on just the mains. I would go with electronic fuel injection and ignition for the tuning ability these systems offer. If a lot of cross-country time with a significant other had been part of the original plan, I would have considered an RV-14 instead for the larger panel space and more sociable side-by-side seating.

My advice is to build a plane within your means that does your mission well. Try to keep it as light and simple as you can. It's worth the effort, and you'll thoroughly enjoy the end result!

—Nigel Speedy

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Williams, Lynn *www.flitzerbiplane.com*	Flitzer (Stummelflitzer) Z-1R	1	1080	110	100	48	P	✓	
 Flitzer Z-21	Flitzer (Stummelflitzer) Z-1S	1	807	110	100	48	P	✓	
	Flitzer Z-21	1	800	97	86	45	P	✓	
Wings of Freedom LLC *www.wingsoffreedomaviation.com*	Flitplane	1	600	70	63	28	K/P	✓	$7-12k
 Phoenix 103	Phoenix 103	1	650	75	63	28	K	✓	$12-15k
World Aircraft Company *www.worldaircraftco.com*	Spirit	2	1320	125	110	35	K	✓	$60-75k
 Vision	Vision	2	1320	125	105	27	K	✓	$60-75k
World War I Aeroplanes	Fokker D.VII	1	1870	117			P		
	SE5A	1	2048	136			P		
X-Air LLC (XAir) *www.x-airlsa.com*	X-Air F	2	900	75	60	28	K	✓	$22-27k
 X-Air H	X-Air H	2	1234	106	81	28	K		$25-30k
	X-Air S (Standard)	2	902	75	63	28	K		$21-25k
York Enterprises *www.yorkaircraft.com*	Laser Z-200	1	1400	180	165	64	P		$30-50k
	Laser Z-2300	2	2050	250	195	60	P		$30-50k
 Laser Z-2300	Ultimate Series	1	1380	220	170	60	P		

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Dick Starks: Why Build?

When I was 14, my dad took me to see the award winning 1927 movie *Wings* with a live piano accompanist. That's when the seed was planted in my mind that took another 39 years to finally take root and blossom.

That movie really burned itself into my soul. After watching it, there were two things written down on slips of paper and added to my bucket list.

One, I'd someday own and *fly* some kind of warbird.

Two, I'd marry Clara Bow.

Well…It took 39 years, but the one about flying my own WW-I fighter plane finally came through.

In between those years, time was spent getting a degree, starting a career, marrying the girl of my dreams (Clara Bow was out of my reach, and besides, I got a much better deal anyway), restoring a 1946 C-120, and learning to fly the C-120. But I still didn't have the brass ring—my own warbird.

During all those years, I went to many airshows and just stood in slack-jawed awe watching the warbirds being flown. The cost of owning and flying any kind of warbird was totally out of reach for a middle-school math teacher.

Then in 1985 I got hooked up again with a grade-school buddy, Tom Glaeser. We'd separated for several years while we were both starting careers and families. Tom became a machinist for TWA. He also had his pilot license. At his urging, I bought the pretty well beat-up 1946 C-120. I totally stripped it, recovered it, painted it, and learned to fly in it. I knew my dream of a WW-I plane had to be a taildragger, so it was the natural plane for me to choose.

Then Tom and I found an article about a "cheap-to-build, fun-to-fly" 7/8-scale WW-I Nieuport 11 replica fighter. In 16 months of part-time labor, we built two of them for the cost of $2,859 *each*, ready to fly. (Tom and I take scrounging to a new Olympic level. That's much less than the cost of a set of main landing gear wheel bearings for a P-51 Mustang.)

That's when life took off. When the word got out that we owned and flew WW-I replica fighters, the invitations to come to airshows all over the country (and world) started pouring in. We got more invitations to go to airshows than we could possibly make, even if we'd been retired.

For about five years all was well, but a sobering reality soon set in. Flying cross-country in an open-cockpit plane that only goes 60 mph in calm air is an unexpected adventure into sheer physical torture.

First, there's *always* a headwind, going and coming. One memorable day, Tom and I got passed by a dump truck *on a gravel road*!

Second, weather is always a major concern. One year it took The Dawn Patrol—Tom, me, Mark Pierce, and Dick Lemons—nine days to get home

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Zenair Ltd. *www.zenair.com*	CH 750 Cruzer	2	1320	125	118	39	K	✓	$20-55k
	STOL CH 750	2	1440	105	95	35	K/P	✓	$40-65k
	STOL CH 750-SD	3	1900	115	105	34	K/P		$65-85k
	STOL CH 801-HD	4	2200	110	105	39	K		$60-100k
	STOL CH 801-SD	4	2700	115	105	35	K		$85-110k
	Zodiac CH 640	4	2200	160	150	47	K/P		$45-100k
	Zodiac CH 650	2	1320	138	138	44	K/P	✓	$35-65k
Zenith Aircraft Co. *www.zenithair.com*	CH 650	2	1320	138	138	44	K/P	✓	$35-65k
	CH 750 Cruzer	2	1320	118	118	39	K/P	✓	$21-50k
	SAM-EX	2	1800	155	142	50	K		$50-80k
	SAM LS	2	1450	155	125	42	K	✓	$50-65k
	STOL CH 701	2	1100	100	90	30	K/P	✓	$30-50k
	STOL CH 701 Amphib	2	1250	90	74	32	P	✓	$38-64k
	STOL CH 750	2	1320	110	100	35	K/P	✓	$38-65k
	STOL CH 750-SD	3	1900	115	105	34	K/P		$65-85k
	STOL CH 801	4	2200	125	105	39	K		$40-80k
	Zodiac CH 601 HD	2	1200	135	115	44	P	✓	$8-46k
	Zodiac CH 601 UL	2	1058	135	115	44	P	✓	$8-45k
	Zodiac XL	2	1320	138	134	44	K/P	✓	$29-60k

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from an airshow only 108 miles away. On the day the weather actually let us fly, it took two hours plus to get home (another headwind).

So, *The Trailer Weenies* were born. We all built trailers to get our planes to the shows and back home.

At every show we've been to since then, a scenario similar to this one repeats itself: I'll be sitting in my folding chair beside my canvas falcon when an airshow attendee walks up.

"Does this thing really fly?"

"Yup. . .I've been flying it since 1986."

"Did you fly it here?"

"Nope, we trailer to airshows."

"Why didn't you fly it here?"

"We only go 60 miles per hour. In this wind, we would never have made it."

There is a long silence while he looks over the plane, then the other shoe drops.

"So, you don't fly cross-country; your plane is too slow. It's open cockpit, so you can only fly in good weather. And you have to trailer it to airshows. . .Why did you build it?"

Just about then, the pilot of the Navy F-18 Super Hornet flying in the show comes ambling by with all his flying gear hanging over his shoulder. He stops and reads the poster I display with the history of my plane.

I walk up to him and say, "Wanna try it on for size?"

His equipment hits the ground with a clank and 15 seconds later he is in the cockpit, stick and throttle in his hands, feet on the rudder bar, and he's peering through my ring gun sight.

I explain the controls (or lack thereof) and what it is like to fly.

That's when he says it. "You know, I've never wanted to fly a prop plane 'til right now."

That's why we build them. There's a mystique about WW-I planes that will live forever.

So, to answer his question, "Why?"

Why not!

—Dick Starks

Sharon Starks in her Airdrome Aeroplanes Morane-Saulnier "L" Parasol makes a pass with Dick Starks in his Graham Lee Nieuport 11 replica.

Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
A-B Helicopters	A/W 95	1	450	65	65		P		
Aero-Works, Inc.	Microlight	1	700		60		K	✓	$19k
	Single Place-High Performance	1	700		65		K	✓	$25k
	Two Place Tandem	2	1318		70		K	✓	$34k
	Ultralight	1	550		55		K	✓	$17k
Aerotrek Aircraft *www.aerotrek.aero/ela.htm*	ELA G8 Cruser	2	1100	100	90		K	✓	$53-63k
	ELA G8 Ranger	2	1100	100	90		K	✓	$50-60k
	ELA G10 Eclipse	2	1168	115	100		K	✓	$82-90k
Air Command International *www.aircommand.com*	Commander Elite 447	1	552	63	50		K	✓	
	Commander Elite 503	1	590	75	55		K	✓	$18-21k
	Commander Elite 582	1	750	95	65		K	✓	$20-23k
	Commander Elite 912 Tandem	2	1155	110	75		K	✓	$60-75k
	Commander Elite 3202	1	590	75	55		K	✓	
	Commander Elite EJ22 Tandem	2	1155	110	75		K	✓	$40-60k
	Commander Elite Mazda	2	1500	120	70				
	Commander Elite S/S F-30	2	750	84	65		K		
	Commander Elite Single-Place EJ22	1	750	95	65		K	✓	$30-40k
Aircraft Designs, Inc. *www.aircraftdesigns.com*	Bumble Bee	1	500	65	40		P	✓	$3-5k
	Sportster	2	1100	90	75		P	✓	$6-25k
American Sportscopter, Int'l. Inc.	UltraSport 254	1	525	63	63		K	✓	$35k
	UltraSport 331H	1	650	104	65		K	✓	$38k
	Ultrasport 496 RT	2	1100	104	69		K		
	UltraSport 496H Hornet	2	1180	104	70		K	✓	$68k
Auto Gyro USA *www.autogyrousa.com*	Calidus	2	1234	120	100		K	✓	$75-78k
	Cavalon	2	1234	120	90		K	✓	$96-99k
	MTO Sport	2	1234	120	100		K	✓	$60-63k
Aviomania Aircraft *www.aviomania.com*	G1sa Genesis Solo	1	660	105	80		K	✓	$19-27k
	G2sa Genesis Duo	2	1200	120	90		K	✓	$35-50k
	Genesis CE (model G1sB)	1	750	100	75		K	✓	$17-27k
	Genesis Sport (model G1sE)	1	800	110	80		K	✓	$23-35k
Barnett Rotorcraft	Barnett J4B	1	850	120	97		K/P	✓	
	Barnett J4B-2	2	1085	112	93		K/P	✓	$19-39k
	BRC540 Coupe	2	1248	138	110		K/P	✓	$44-58k


Commander Elite 582


Commander Elite 912Tandem


Commander Elite EJ22 Tandem


Sportster


Cavalon


Genesis Sport Model G1sE

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Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
CH-7 Helicopters Heli-Sport S.r.l. *www.ch-7helicopter.com*	CH-7 Angel	1	792	100	80				
	CH-7 Kompress	2	1100	129	100				
Chayair Manufacturing & Aviation	Sycamore Mk1	2	1058	90	80		K		
Composite Helicopter International Ltd.	KC 518 Adventourer	6	3200		155		K		$395k
Eagle R&D, LTD *www.helicycle.com*  *Helicycle*	Helicycle	1	850	110	95		K		$40-45k
Eagle's Perch, Inc.	Eagle's Perch	1	1200	113	85		K		
Engineering System Co., Ltd, Aviation Division	GEN H-4	1	420	100	60		K		
FD Composites GmbH *www.arrow-copter.com*  *ArrowCopter AC-20*	ArrowCopter AC-20	2	1230	121	90		K/P		$150k
Groen Bros. American Autogyro *www.americanautogyro.com*  *SparrowHawk Gyroplane*	SparrowHawk Gyroplane	2	1500	100	75		K		$46-60k
Gyro-Kopp-Ters *www.gyro-kopp-ters.com*	Midnight Hawk	1	810	90	60		K	✓	$14-16k
 *Twin Eagle*	Mosquito Hawk	1	700	80	55		K	✓	
	Twin Eagle	2	1210	90	60		K	✓	$19-23k
Helo Werks, Inc.  *HX-2 Wasp*	HX-2 Wasp	2	1225	107	81		K		$125-130k
Hillberg Helicopters	RotorMouse EH 1-01	1	1300	180	160		K/P		
	Shark Mouse EH 1-02	2	1927	185	145		K/P		
	Two Place EH1-02	2	1800	170	130		K/P		
Hinchman Aircraft Co.	H-1 Racer	1	550	85	65		P		
HoneyBee G2, LLC  *G2 Two-Place Tandem*	HoneyBee G2 High Performance Single	1	809	75	60		K	✓	$25k
	HoneyBee G2 Microlight	1	700		60		K	✓	$19k
	HoneyBee G2 Two-Place Tandem	2	1318	85	60		K	✓	$34k
	HoneyBee G2 Ultralight	1	532	63	55		K		$17k

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Manufacturer/ Website	Model	Seats	Gross Weight	Max Speed	Cruise Speed	Stall Speed	Kit/ Plans	LSA Legal*	Price
I'm Fly'N Mfg. LLC	SnoBird Charger	1	600	100	70		K		
Innovator Technologies *www.innovatortech.ca*	Mosquito Air	1	530	70	60		K		$30-37k
	Mosquito XE	1	610	85	70		K		$34-42k
 *Mosquito XEL*	Mosquito XE3	1	720	100	80		K		$39-47k
	Mosquito XEL	1	585	75	65		K		$35-43k
	Mosquito XET	1	820	100	80		K		$51-58k
JAG Helicopter Group, LLC	JAG	2	3200	178	145		K		
Joe Souza Gyroplanes	Bandit Two Place	2	1000	70	40		K		
	Bandit Ultralight	1	598	63	55		K		
	Super Bandit	1	700	85	65		K		
Ken Brock Mfg.	KB-2 Gyroplane	1	600	95	70		K/P	✓	
	KB-3 Gyroplane	1	600	63	60		K/P	✓	
Little Wing Autogyros, Inc. *www.littlewingautogyro.com*	LW 3+2	2	1100	100	75		K/P		
	LW-3	1	950	100	75		P	✓	$10-40k
	LW-4	2	1100	100	75		P	✓	$20-75k
 *LW-5*	LW-5	2	1100	100	75		P	✓	$20-75k
Magni USA, L.L.C. *www.magnigyro.com*	M-14	2	1212	115	90		K	✓	$68-78k
	M-16	2	1212	115	90		K	✓	$69-78k
	M-18	1	771	105	70		K	✓	$39-40k
	M-22	2	1212	115	95		K	✓	$73-80k
 *M-24 Side by Side*	M-24 Side by Side	2	1212	105	90		K	✓	$76-85k
Neico Aviation Inc.	CH-7 Kompress	2	1100	130	100		K		
North American Rotorwerks	Pitbull II	2	1025	88	70		K		
	Pitbull SS	1	610	85	70		K		
	Pitbull UL	1	525	63	58		K		
PAM Group	PAM 100B	1	1060	60	45		K		
Raven RotorCraft Inc. *www.raven-rotor.com*	Raven Lite	1	504	65	60		K	✓	$16-19k
Rotary Air Force SA Pty Ltd (Rotary Air Force Marketing, Inc.) *www.rafsa.co.za*	RAF 2000 GTX SE 2.5 FI Gyroplane	2	1540	140	85		K		$32k
 *RAF 2000*	RAF 2000	2	1540	140	85		K		$71k
Rotor Flight Dynamics *www.rotorflightdynamicsinc.com*	Dominator	1	650	114	65		K/P		
 *Dominator Tandem*	Dominator Tandem	2	1200	95	70		K		$41-45k
Rotorvox USA c/o Flightstar, Inc. *http://rotorvox.com*	Rotorvox Gyrocopter	2	1234	100	80		K	✓	$180-200k
 *Rotorvox Gyrocopter*									

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RotorWay International *www.rotorway.com*	A600 Talon	2	1500	120	95		K		$105-110k
 *A600 Talon*	Exec 162F	2	1500	115	95		K		$70-75k
Safari Helicopters (CHR International, Inc) *www.SafariHelicopter.com*	Safari	2	1500	100	85		K/P		$90-135k
 *Safari 400*	Safari 400	2	1650	100	85		K/P		$134-185k
Showers Aero	Skytwister	1	680	80	65		P		
Sport Copter, Inc. *www.sportcopter.com*	Lightning	1	600	65	50		K	✓	$23-29k
	Sportcopter II	2	1700	120	100		K		$185-218k
 *Vortex M912*	Super Sport	2	1650	120	100		K		$82-105k
	Super Sport Tandem (SST)	2					K		
	Vortex	1	760	80	75		K	✓	$30-34k
	Vortex M912	1	934	110	95		K	✓	$36-65k
Star Bee Gyros *www.starbeegyros.com*	Star Bee Light	1	485	65	55		K	✓	$15-16k
 *Star Bee Light*									
The Butterfly Aircraft L.L.C. (The Butterfly LLC)	Aurora Butterfly	1	950	90	70		K	✓	$51-58k
	Emperor Butterfly	1	520	63	55		K	✓	$19-26k
 *Monarch Butterfly*	Golden Butterfly	2	1400	95	70		K		$60-70k
	Monarch Butterfly	1	630	70	60		K	✓	$23-31k
	Super Sky Cycle	1	1100	90	70		K	✓	$80-87k
 *Turbo Golden Butterfly*	The Ultralight Butterfly	1	507	63	55		K		
	Turbo Golden Butterfly	2	1800	95	70		K		$70-86k
	Ultralight Butterfly	1	509	63	50		K	✓	$18-22k
Vertical Aviation Technologies *www.vertical-aviation.com*	Hummingbird 300L	4	2800	120	110		K		$250-300k
 *Hummingbird 300LS*	Hummingbird 300LS	4	2800	120	100		K/P		$171-250k
Vortech, Inc. *www.prismz.com/helio*	A/W 95 Helicopter	1	500	75	60		K/P		$26-32k
	G-1	1	420	63	50		K/P	✓	$18k
 *Hot Rod*	Hot Rod Helicopter	1	1350	103	90		K/P		$20-30k
	Kestrel Jet Helicopter	1	425	63	55		K/P		$18-20k
	New Choppy Helicopter	1	600	80	65		K/P		$33-36k
	New Choppy Ultralight	1	500	63	55		K/P		$27-30k
 *Skylark*	Shadow Gyroplane	2	1290	100	70		K	✓	$28-33k
	Skylark Helicopter	1	700	95	70		K/P		$34-36k
	The Sparrow	1	500	63	60		K	✓	$9-11k
Zeus Helicopter Inc.	Zeus	2	1580	110	95				

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Oscillating multi-tool with cutting blade.

Making Interior Cuts in Sheet Metal

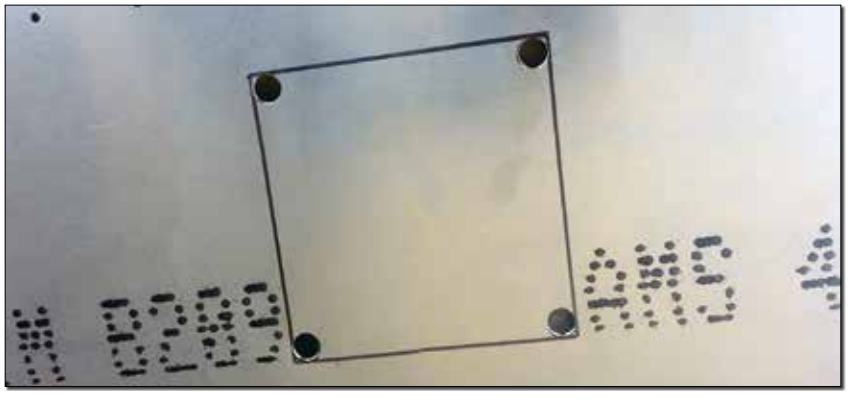
BY JON CROKE

Creating a rectangular access opening in a sheet metal panel begins with selecting the proper tool to make the cuts. If you are new to cutting metal skins in an interior area, your first inclination might be to grab your familiar metal shears. Hopefully, you won't ruin your project using these as you will find that cutting a metal skin in an "enclosed" area doesn't yield the same results compared to cutting at the skin's edge and ending at the opposite side.

We are all familiar with the "curling" metal strip that gets created on one edge of a metal sheet when we cut using hand shears. In fact, this is why there's a choice of "green" and "red" metal shears (also known as left- and right-handed) as this selection determines which side of the cut curls away from the other side. When starting a cut in the interior portion of a sheet, as is required when creating an inspection panel, there is little "give" for one side of the cut to curl away. The result, if we continue with a cut like this, is a highly distorted skin as the metal has no place to go.

Since this discussion is attempting to convince you that the common metal hand shear is not the right tool for interior cuts, then what tools can be used? There are several possibilities, and we will discuss one of them now: the oscillating multi-tool.

This power tool has become very popular at home improvement stores as a means to perform detail work with all kinds of materials: sanding, cutting



Holes at all four corners are needed to relieve stress.

Practicing on scrap material builds skill quickly.

wood and drywall, and grout removal. To this list, we can add making relatively clean cuts in aluminum sheet metal.

These tools can be purchased from Harbor Freight or Amazon for as little as $40. They typically come with an assortment of cutting attachments, each suited for working with a different material. We will be using the metal cutting blade that contains tiny small teeth. My favorite aspect of the tool is its inherent safe design; incidental contact with your finger by the blade while running will not inflict injury! The blade oscillates with a tiny motion at high speed, so without pressure there is no cutting. I was told these tools were used by doctors for removing casts on broken bones long before they appeared to the general public.

For creating a rectangular opening, holes need to be drilled in each corner of the desired area. These are important as they provide needed stress riser relief that occurs in sharp corners to prevent future cracks in the metal. We now have four straight cuts to make that will connect these holes, as well as a place to insert the blade to begin each cut.

Applying firm pressure and following marked lines, the tool will make a steady, easily controlled cut from one hole to the next. I find that about 1 inch of cutting progress can be made in about 5 to 10 seconds on .025-inch aluminum sheet. By practicing your cuts on scrap material, you can quickly learn how to use the tool for best results. If you are reasonably careful and take your time, very little if any sanding of the final edge is needed. A wide variety of interchangeable blades are readily available, and it is worth experimenting to find the ones that cut best for your project.

There are other tools that also do a good job for these interior cuts, but this one is a winner when it comes to safety, speed, and ease of use. Plus, this is the kind of tool that will not be limited to just the realm of aircraft building. It is called multi-tool for a good reason! ✢

JON CROKE

As the founder of Homebuilt HELP.com, Jon Croke has produced instructional videos for experimental aircraft builders for over 10 years. He has built (and helped others build) over a dozen kit aircraft of all makes and models. Jon is a private pilot and currently owns and flies a Zenith Cruzer.

Photos: Jon Croke

MAINTENANCE MATTERS

Differential Compression Test

The differential compression test is a timer-honored tradition in aviation. Because of this, we sometimes do it by rote and forget why we perform this test, its benefits, and shortcomings. The compression test measures the ability of an aircraft engine cylinder to hold air pressure at top dead center (TDC). The name differential compression test comes from the act of comparing the pressure a cylinder will hold to a reference pressure—typically 80 psi—thus allowing us to see the differential between the two pressures. Ideally the differential is small—10 psi or less. The results of the test are shown by placing the pressure the cylinder will hold on the top of the fraction (numerator) and the reference pressure on the bottom (denominator).

A typical result would be shown as "#1-76/80" for an engine where the number one cylinder will hold 76 psi against a reference pressure of 80 psi. The results of this test for each cylinder should be recorded in the engine logbook at least yearly.

Longtime building buddy Ed Zaleski (left) performs a differential compression test on cylinder #1 while a friend hangs onto the prop to keep it from turning and injuring someone. The reference pressure will be on the left gauge, and the pressure in the cylinder will be on the right gauge.

How to Perform the Test

Lycoming Service Instruction 1191A describes the test for their engines and how to interpret the results. A proper test should be conducted on a warm engine. Cold test results may be erroneous and without merit. Be sure to use a tester with a .040-inch orifice for all Lycoming and Rotax engines. Some testers designed for larger engines have an orifice size of .060 inch. They are not approved for use on Lycoming or Rotax engines.

Immediately after shutdown, remove a spark plug from each cylinder, using care to not burn yourself or drop a spark plug. A spark plug dropped on concrete should be considered unusable due to possible internal damage. Then rotate the prop until the number one cylinder is at TDC (not the 20- to 25-degree timing mark). The cylinder is at TDC when the TC mark on the starter ring gear (often called the flywheel) lines up with the split in the engine cases or when a similar mark lines up with the indicator hole in the starter motor. You can test to be sure that cylinder is in the firing position by placing your finger over the open spark plug hole and feeling for the pressure in the cylinder. It is important to do this because each cylinder only fires every other time it passes TDC.

With the cylinder in the firing position, insert the compression tester fitting into the spark plug hole and screw it down hand tight. Next attach the hose to the tester (regulator and gauges). The air valve should be shut when you are doing this. In theory, if the cylinder is at TDC, the prop will not move when you open the air valve, but in practice it is much safer to have a buddy hang on to the prop to be sure it doesn't come around and injure you.

With the air valve open, verify that the reference pressure is exactly 80

Dave Prizio

Dave Prizio has been plying the skies of the L.A. basin and beyond since 1973. Born into a family of builders, it was only natural that he would make his living as a contractor and spend his leisure time building airplanes. He has so far completed three—a GlaStar, a Glasair Sportsman, and a Texas Sport Cub—and is helping a friend build an RV-8. When he isn't building something, he shares his love of aviation with others by flying Young Eagles or volunteering as an EAA Technical Counselor. He is also an A&P mechanic, Designated Airworthiness Representative (DAR), and was a member of the EAA Homebuilt Aircraft Council for six years.

Align the TC mark on the starter ring gear with the small hole in the starter to get the number one cylinder to TDC. Be sure that you are on the compression stroke by feeling for pressure at the spark plug hole. There is a similar mark on the backside of the ring gear that can be aligned with the split in the crankcase if that is easier to see.

psi. Adjust the regulator as needed to achieve this. Then look at the pressure on the other gauge. It will read the air pressure that the cylinder is actually holding. Note this pressure and repeat the process for each cylinder. With a four-cylinder Lycoming engine, it is easiest if you simply rotate the prop 180 degrees each time and follow the engine's firing order—1-3-2-4. The TC mark will not be visible for cylinders two and four, but if you put the prop (assuming 2-blade) in the exact position as for one and three you will be at TDC or very close to it.

With a Rotax engine there are no crankshaft position marks visible, so you can find TDC by feeling for the compression and then placing a soda straw or a piece of safety wire into the spark plug hole to feel for TDC. I prefer the straw because it will not damage engine parts if it gets jammed somewhere. It is also long enough that it can't fall into the cylinder.

Test Results

In a perfect cylinder with no leakage, the reference pressure and the pressure held would be the same. In the real world there is always some leakage. The question then becomes, how much is too much? Lycoming and Continental differ on this topic for their certificated engines, with

You can use a soda straw to feel for TDC if no marks are visible, as is the case with Rotax engines. The straw has the advantages of being too large to fall into the cylinder and isn't a threat to engine parts if it were to get jammed in a cylinder somehow.

Photos: Dave Prizio

Continental putting much less emphasis on the numbers. Rotax uses number guidelines similar to Lycoming's. Consult their maintenance literature for their guidelines and procedures.

Lycoming says any number greater than or equal to 70/80 is a good test result. Cylinders that will hold less than 70 but more than 65/80 are acceptable. Cylinders that hold 60 psi or less are likely candidates for removal and replacement or overhaul. Cylinder readings should be within 5 psi of each other. If the difference between any two cylinders is 15 psi or more, the low cylinder should get a closer look. If a retest after a few additional hours of flight does not reduce the pressure gap, removal and overhaul or replacement should be considered according to Lycoming. It is common for a low cylinder to yield a better test result after additional running, so panic at the first poor reading is unwarranted. However, it should not be ignored either, and retesting soon is definitely called for.

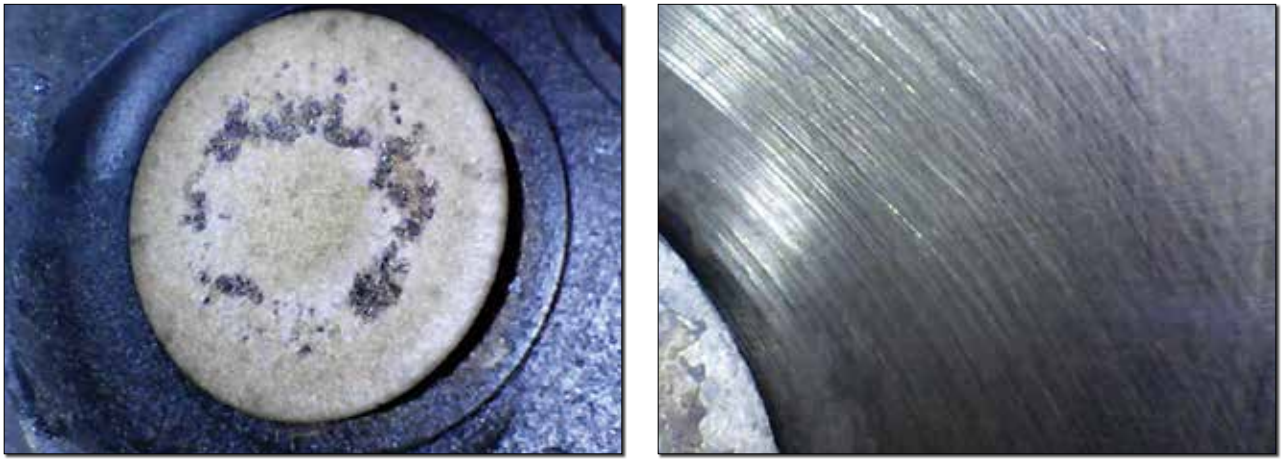
What is just as important as the test result number is determining the source of the leakage. While the test is underway, listen at three key points: the exhaust pipe, the open dipstick tube, and at the carburetor or fuel injection air intake. A burnt exhaust valve will produce a hissing air sound at the exhaust pipe outlet. A leaking intake valve similarly will produce an air sound at the air intake. Failing rings will allow air to escape into the crankcase, thus producing the sound of leaking air at the dipstick tube. It is important to note the source of the leak, especially for any cylinders that test under 70/80.

Any troubling test results should be followed up by a borescope examination. Inexpensive borescopes that work with a laptop computer are readily available today. Anyone who is serious about working on engines should have one.

Sometimes a low reading will come from a piece of carbon stuck on a valve, holding it open just a bit. This is why it is always good to fly a bit and retest if any cylinders are showing excessive leakage.

Rotax Compression Test

Differential compression testing is similar to the process used on Lycoming and Continental engines but with a slight Rotax twist. Since there are no visible timing marks to indicate (TDC), it is necessary to bring each cylinder up on its compression stroke and then use a straw or piece of wire placed in the spark plug hole to find TDC. Safety demands that you take some care to find the exact top of the compression stroke because it is quite hazardous to try and hang on to the prop once you put air pressure into the cylinder. In other words, set the engine to TDC for that cylinder, insert the compression tester hose, clear the prop area, and then connect the tester and pressurize the cylinder. If you are not at TDC, the prop will move with a great deal of torque, more than most people can restrain due to the mechanical advantage of the gearbox. Be sure to be out of the way. The standard compression tester with a .040-inch orifice works well. Each cylinder should hold at least 75% of



(Left) Under the borescope the edges of a good valve will be sharp and the color of the valve face will be even. There is some carbon buildup on this valve, but that should have no effect on engine performance. (Right) The hash marks from the cylinder's original honing should remain visible in a good cylinder. If they are not, it is a sure sign of excessive cylinder wear.

the input pressure (60/80 for example). Note that you will need an adapter with 12-millimeter threads, not the aviation standard 18-millimeter threads.

Low Test, Now What?

One or more of my cylinders "failed." So now what do I do? The first thing to do is retest after at least a few hours of flight. If the cylinder(s) fail again, it is time to dig a little deeper. This is where a borescope comes in handy. These are so inexpensive now that you, or at least someone you know, should have one. If not, go buy one. It will be a lot cheaper than buying a new cylinder. See the July 2016 issue of KITPLANES® for an article on affordable borescopes and how to use them.

What we are looking for with the borescope is evidence that supports the low compression reading we saw with the differential compression test. If you heard leakage at the exhaust pipe, take a good look at the exhaust valve for signs of burning or uneven coloration. These are signs of a failing exhaust valve and are cause to remove and overhaul or replace a cylinder. Similarly, damage to an intake valve means that cylinder should come off for repair or replacement. Failed valves can break off and cause damage to the rest of the engine. It is best not to delay repair of a failing valve.

Air leaking into the crankcase means the rings are not holding the pressure they should. If this is the case, use the borescope to look at the cylinder walls. In a good cylinder, the hash marks from its original honing should still be clearly visible. If they are not, especially if there are areas of metal that are completely free of hash marks, you will probably need to overhaul or replace that cylinder. You will also want to look for scoring that typically follows the path of the piston as it travels up and down. Be sure to look at as much of the cylinder wall area as possible because scoring will often be highly localized.

Automotive Compression Test

Those of you who work on cars will remember that there is another type of compression test that simply requires a single gauge and no compressed air to perform. There is no standard for this test in aviation, but it has some merit even if it is limited. For one thing, it is easy to find a compression tester in any auto mechanic's toolbox. A differential compression tester and source of compressed air may be much harder to come by in a remote location. For another it does a better job of detecting poor ring sealing throughout the length of the cylinder. Remember, the differential test only measures the seal at TDC. This test is in no way a suitable replacement for an aviation differential compression test, but in a pinch, it can give you some useful information. This is especially true if you have no other options. To perform the test, attach the

gauge to each cylinder in turn, and crank the engine over through five compression strokes. Be sure to keep the prop area clear when performing this test. Any cylinder that is 20% or more below the other cylinders is a likely source of poor engine performance.

I tested my own Lycoming O-360 with an admittedly old automotive compression tester and got these results: #1-150 psi, #2-155 psi, #3-150 psi, and #4-120 and 130 psi in two tests. As a double check, I did a differential compression test on #4 and got a reading of 76/80. I am not yet ready to pull off #4, but I will be keeping an eye on it. A borescope examination of the cylinder wall will be my next step.

Some Context

The differential compression test is a good test by itself, but it is a much better test when combined with other information, especially borescope observations. In fact, any anomalous compression result should be followed up by a borescope check to verify the problem indicated by the test. A low compression reading with air leaking out of the exhaust should point to a visual check of the exhaust valve. A failing valve will have uneven coloration across the face of the valve, or in extreme cases you will actually be able to see the burnt edge of the valve. When this information is combined with the compression test results, you have a high confidence level that pulling the cylinder is the right thing to do. On the other hand, if the valve looks good with the borescope, it would be wise to take a more conservative approach, run the engine for a few hours, and retest.

An automotive-type compression tester can be used as an alternative means of checking cylinder condition if that is all that is available. This is not a substitute for a proper differential compression tester, but it can provide some useful information.

If an engine starts to use more oil or seems down on power but the compression test looks good, you may need to widen the scope of your inquiry. Remember, the differential compression test only shows what is happening at TDC. Cylinder wear or scoring lower in the cylinder wall will not reveal itself with a differential compression test. It may show up with an automotive-type compression test, but the borescope is most likely to find the problem. Shiny spots on the cylinder walls where the original hash marks are no longer visible or score lines should be easy to see with a borescope.

There are times when you should regard the differential compression test results with some skepticism. If you have a cylinder or two that read in the mid to low 60s, but the engine seems to be making good power and the borescope shows no obvious problems, it is probably prudent to keep running the engine as it is and just keep an eye on things. New cylinders are expensive, and major maintenance work has a way of producing its own problems. Do not be in any hurry to tear your engine apart if it is running well just because a test didn't come out as well as you had hoped.

A single poor result should first trigger some questions before the engine comes apart:

1. What were the results after flying a few hours and repeating the test?
2. Is there any significant metal in the oil filter and/or sump screen? If so, what kind of metal?
3. What do the low cylinders look like through the borescope?
4. How is the plane running? Good power? Clean spark plugs?

If all of the answers point to a serious problem, then by all means do whatever needs to be done. But if the results are mixed, especially if the engine isn't making metal and the borescope results are good, it may be time to step back and consider your next move at a more relaxed pace. ✚

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RPM	Engine
MAP	Manifold Pressure
O-T	Oil Temperature
O-P	Oil Pressure
F-P	Fuel Pressure
OAT	Outside Air Temp.
TIT	Turbine Inlet Temp.
CRB	Carburetor Temp.
CDT	Compressor Discharge Temp
AMP	Current amps or load
L- R Main	Fuel Quantity, L/R Main
V-2	Second Volts
Amp-2	Second Amps
% HP	Requires FF, OAT and RPM
Fuel Flow	Fuel Flow includes
GPH	Gallons per Hour GPH
REQ	Fuel Required to wp or destination
USD	Fuel used
H:M	Endurance Hours and Minutes
MPG	Miles per Gal

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CHECKPOINTS

Bad Building Practices

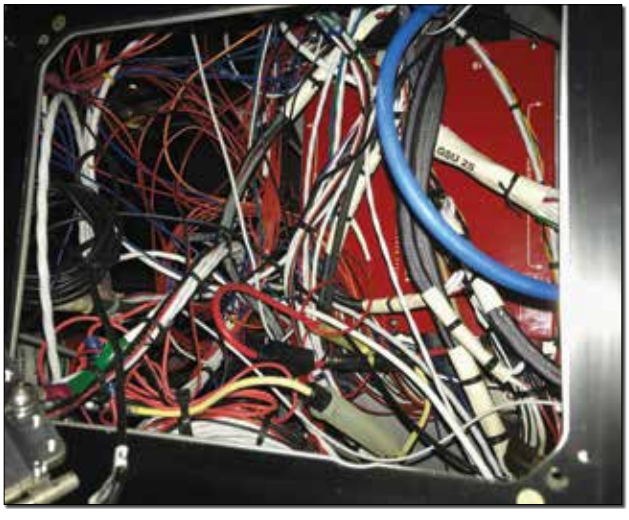
I've been writing a lot about maintenance lately, in part due to the things I see while doing prebuy inspections. For those of you who are maintaining an airplane for the first time, I hope you find these columns worthwhile. I know that as good as the kits have become in the last decade, there's still a lot to be desired when it comes to care and feeding once they are finished.

There are other areas that could use some focus as well, and they have to do with what I call "bad practices" during the building process. Some of these can actually affect the reliability and maintainability of the aircraft once it is flying. I have even seen these bad practices in aircraft that were built by "repeat offenders" or "guns for hire" builders. I am not here to judge whether some of these practices are done to cut corners or just out of plain ignorance. It could even be that no one pointed out the bad practice on the first airplane, and so it just continues to propagate on subsequent projects. However, the impact is the same.

Electrical Systems

In my 40+ years of being around aircraft, both certified and amateur-built, it seems to me that electrical systems have never been a strongpoint of A&Ps or builders of E/A-B aircraft. I remember when I was studying for my own A&P license there wasn't much material on electrical systems. Suffice it to say that there was a time when electrical systems weren't all that complicated in our airplanes. Many of the instruments were direct reading gauges, such as oil and fuel pressure, tachometer, vacuum, and pitot-static systems. No electricity was required for much of anything except lights and radios, if so equipped. Some airplanes didn't even have an electrical system, and many of those airplanes are still flying today. My Stearman is an example.

In contrast to aircraft with simple electrical systems, most of the aircraft we fly today are becoming *totally* dependent upon a robust electrical system, from startup to shutdown. Some builders today even put in dual electronic ignition systems, which require a healthy electrical system and also need a backup battery. Unfortunately, what often gets forgotten is how to test the backup system. I inspected an RV-10



This speaks for itself and was done on a "build-for-hire" airplane. If you haven't done wiring before, there is more to it than just connecting the wires. Proper support and routing will make for a reliable airplane, as well as ease of maintenance.

D connectors require a backshell that provides strain relief for the wiring, as well as screws for fastening them to the device. Do not leave them off like pictured here!

Vic Syracuse

Vic is a Commercial Pilot, CFII with ASMEL/ASES ratings, an A&P/IA, DAR, and EAA Technical Advisor and Flight Counselor. Passionately involved in aviation for over 40 years, he has built 11 aircraft and logged over 9000 hours in 72 different kinds of aircraft. Vic volunteers as a Young Eagle pilot and Angel Flight pilot. He chairs the EAA Homebuilt Council and is a member of EAA's Board of Directors. He also has his own sport aviation business called Base Leg Aviation.

Metal sleeved hoses usually have a good path to ground. Cable tying power leads directly to them without some kind of insulation will eventually lead to an electrical short. You can see the distortion of the insulation on the wires here. It's known as "cold-flowing."

that had a backup electrical system, and the backup battery tested at 5 volts when I checked it!

While we are required to build 51% of our aircraft as amateur builders, the FAA does allow us to seek help in certain areas that are complicated, such as the engine and the avionics. That's really good news, especially given how complicated the avionics have become. As a matter of fact, one of the most often-asked questions I hear from prospective builders is, "How can I get help on the instrument panel?" As many of you know, there is now a whole cottage industry of providers who will design and build your panel for you, even calling it "plug and play." It's a great relief for those who are intimidated by wiring.

However, much like taking time to learn some of the necessary skills to build the airplane in the first place, whether

The pilot experienced a main alternator failure while traversing heavily traveled military airspace. The standby alternator failed to work as the hoses pictured in the background were resting against the orange housing. That caused enough friction on the spinning bell that the shear coupling fractured, rendering the unit inoperative.

Photos: Vic Syracuse

Overtightening an oversized lug does not prevent failure. This one eventually broke off at the alternator. You can see the distortion marks on the lug from overtightening it.

I see way too many examples of this: The stick hits the instrument panel and does not allow full forward control deflection.

it is sheet metal, fabric, or composite, a builder should take the time to learn some basic wiring skills. Most of these panels are not quite as plug and play as you would think, or hope, for that matter. Sure, most of the avionics get prewired and sometimes tested by the panel provider, but there is still a myriad of wires in the airplane that need to be connected, such as ignition systems, lights, pumps, etc. Some of them have their own nuances, such as using shielded wire for magnetos and knowing where and when to ground the shield.

Not using proper support for wire bundles is another common bad practice. Take a look at the picture of the wiring to a VPX system I discovered in an RV-10 that was built for hire. Not only is the wiring a rat's nest, but also the 25-pin connectors at the VPX did not even have backshells on them and were not fastened to the main box! They disconnected from the VPX with only a slight tug on them. A good bump in some rough turbulence could have the whole panel going blank at the worst possible time!

Strain relief of wires and tubing is really important in a high-vibration environment such as a piston airplane. If not supported properly, the wires will eventually fail at the connection, and tubing, such as that used in primer lines, will work harden and then crack. Not good!

When crimping lugs onto the ends of wires, it is important that the lug is sized for both the size of the cable and the lug to which it is attached. Using a large lug on a small terminal just sets it up for a premature failure, usually at the most inopportune time. Imagine taking your family on a Florida vacation and transitioning through heavily traveled military airspace and having your main power lead from the alternator, known as the B lead, break off due to both of the above mentioned bad

Drilled head bolts are drilled for a reason. Usually the part is subject to high vibration or rotation, such as this wheel pant bracket. It requires safety wire. I pointed this out to one builder/pilot and received a very questioning look. I was vindicated when we looked at the other wheel pant and the bolt was completely missing!

By now many of you know one of my pet peeves has to do with labeling all controls in the cockpit. In this case, can you imagine a non-pilot rear-seat passenger pulling the throttle back right at takeoff? "I thought it was the control for the vent, and I was hot."

practices. Kinda puts a damper on the trip, doesn't it? I know of one airplane on which this really happened.

Fluids

Another area of misunderstanding has to do with the fluids needed in the airplane once it is finished. Brake systems seem to be prone to problems here, as some builders don't understand that automotive brake fluid and aircraft hydraulic fluid are totally different and not compatible with each other. Filling your aircraft brake system with automotive hydraulic fluid will cause the seals and O-rings to swell up and fail within a matter of days, requiring a complete replacement of all seals and O-rings. It's a messy job and not a lot of fun, especially when a builder is on the homestretch and thinking about that pink slip and flying!

Control Systems

One last area I want to highlight that really needs some attention is interference with the control system. I repeatedly see where builders have increased the height of the instrument panel in order to fit everything in it, along with adding a fancy stick grip with lots of buttons to control everything, and a nice cushy interior with fat, fluffy seats to boot. There's absolutely nothing wrong with that, and I am just as guilty here. However, you do have to pay attention to ensure that nothing interferes with the control stick/column throughout its entire range of motion. If the stick hits the panel or the engine controls, it's a no-go item. Period. It probably isn't going to be much fun when you are doing stalls only to find out when you push the stick forward it catches the trim button or PTT, or worse yet, binds up. Or how about running out of control deflection just as you are making that crosswind landing and really need it? Not exactly keeping the fun factor alive, are we?

Stay tuned for some more material on bad practices. My goal is to help you recognize them before you make them, so you can build a safe and reliable airplane. ✢

HOME SHOP MACHINIST

Dialing in with Test Indicators

Scope out any machine shop and you'll find two basic types of indicators: *dial* indicators, which have a telescoping spindle, and *test* indicators, which (usually) have a smaller dial face and a pivoting stem. Although both are similar in form, particularly with respect to the dial face or digital readout, their respective duties in the shop are distinctly different. Dial indicators are for measuring, and test indicators are for—you guessed it—testing!

While the focus of this column is test indicators, some discussion of dial indicators is necessary to put test indicators in perspective. Dial indicators are accurate only when the spindle stroke is perpendicular to the object being measured. The readout "indicated" is the linear displacement of the spindle. You can, of course, use a dial indicator at an angle other than perpendicular, but the readout will not accurately represent the feature being measured due to cosine error. Cosine error also occurs with test indicators, but as we'll see, the compact size, versatility of the articulating stem (versus the telescoping spindle), and the general method of using test indicators (for checking, not measuring), are reasons to use a test indicator instead of a dial indicator for many jobs.

Compared to typical dial indicators, which might have a range of zero to ½ inch, zero to one inch (the most common), or zero to two inches, test indicators have a very small "measuring" range: usually around ±0.050 of an inch.

Every indicator has some sort of mounting arrangement. Dial indicators usually have interchangeable backs to facilitate the attachment of various

Dial and digital indicators (left and top) can't be beat for precision linear measurement. But for squaring up mill vises, "dialing in" lathe parts (aka adjusting concentricity), dial test indicators (right) are the workhorses of the machine shop.

This test indicator has dovetail rails on the top and back for fixing compatible mounting posts.

Bob Hadley

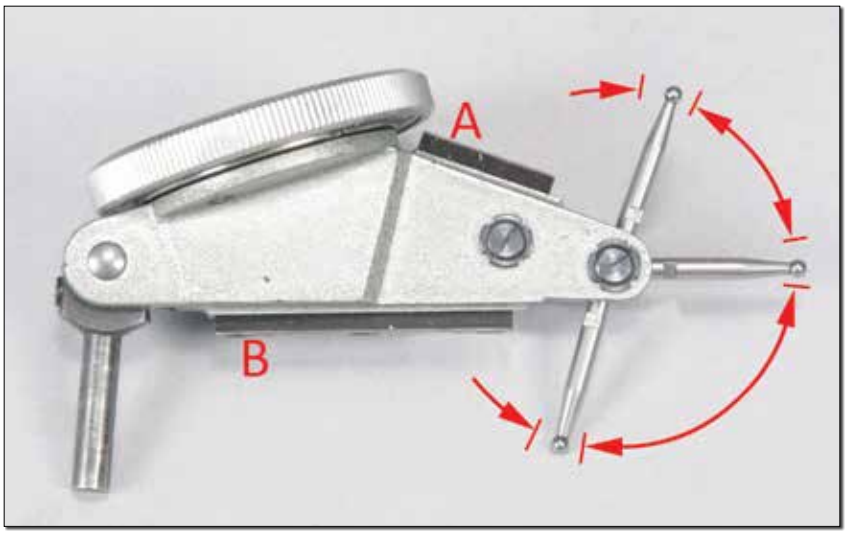
Bob Hadley is the R&D manager for a California-based consumer products company. He holds a Sport Pilot certificate and a Light-Sport Repairman certificate with inspection authorization for his Jabiru J250-SP.

accessories such as a magnetic base or articulating arm. Test indicators might have a pivoting mounting post or dovetail rails, or both.

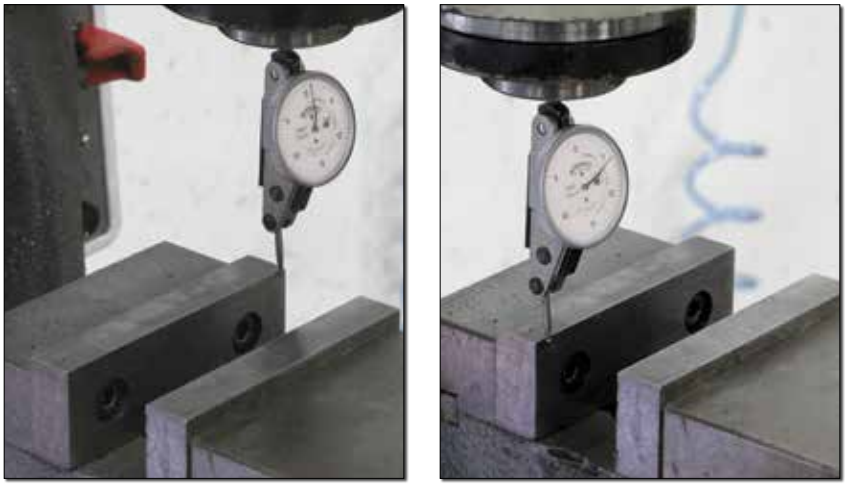
The key feature that makes the test indicator so versatile is the clutching stem. This allows you to adjust it to whatever angle you need and also protects the indicating mechanism from overtravel.

Squaring up a vise or fixture on a milling machine is probably the most common application of a test indicator. To do this, mount a test indicator securely in the quill, in either a collet or a chuck. Position the vise or reference edge using a machinist's square, and bolt lightly to the mill table. Traverse the reference edge to be squared—usually the fixed jaw of the vise along the X axis (left to right)—toward the indicator (Y axis) until it just lightly bears against the indicator stem. Then move the table back and forth and position the vise with a mallet (using light taps) until the indicator dial shows "0" deflection across the entire face—then tighten, recheck, and repeat as necessary until the vise is square.

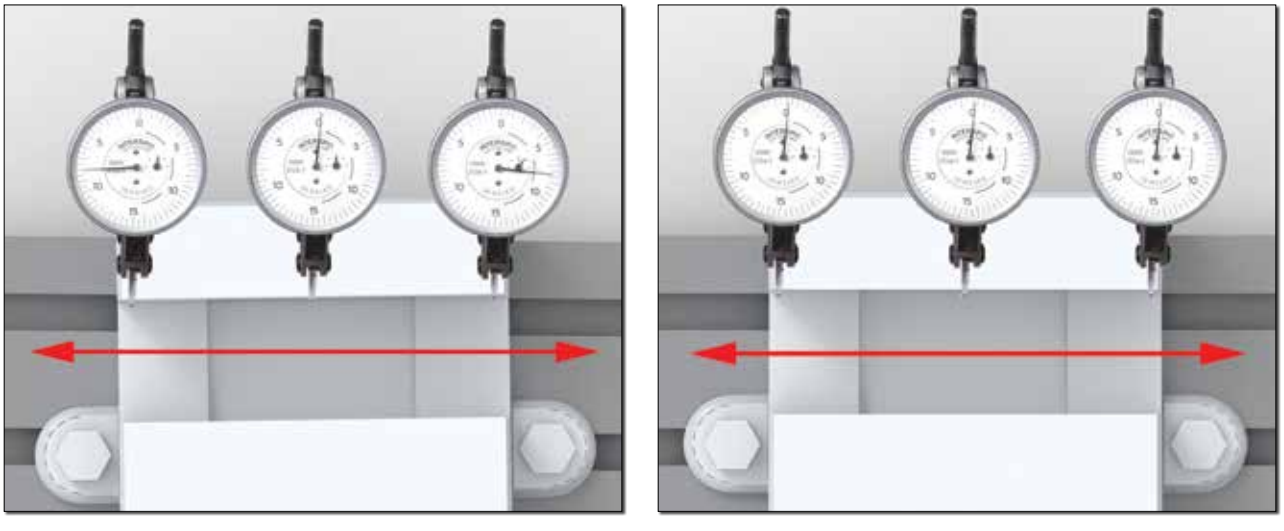
Machined surfaces, even precision-ground jaws of a machinist vise, are rarely perfectly smooth. You can expect the needle of any dial test indicator to vibrate or even bounce around as it travels over slight imperfections in the surface. For the most part you can ignore these movements and focus on



This test indicator features a pivoting mounting post (left) plus dovetail rails (A and B). The arrows around the measuring stem show the angle adjustability and measuring range.

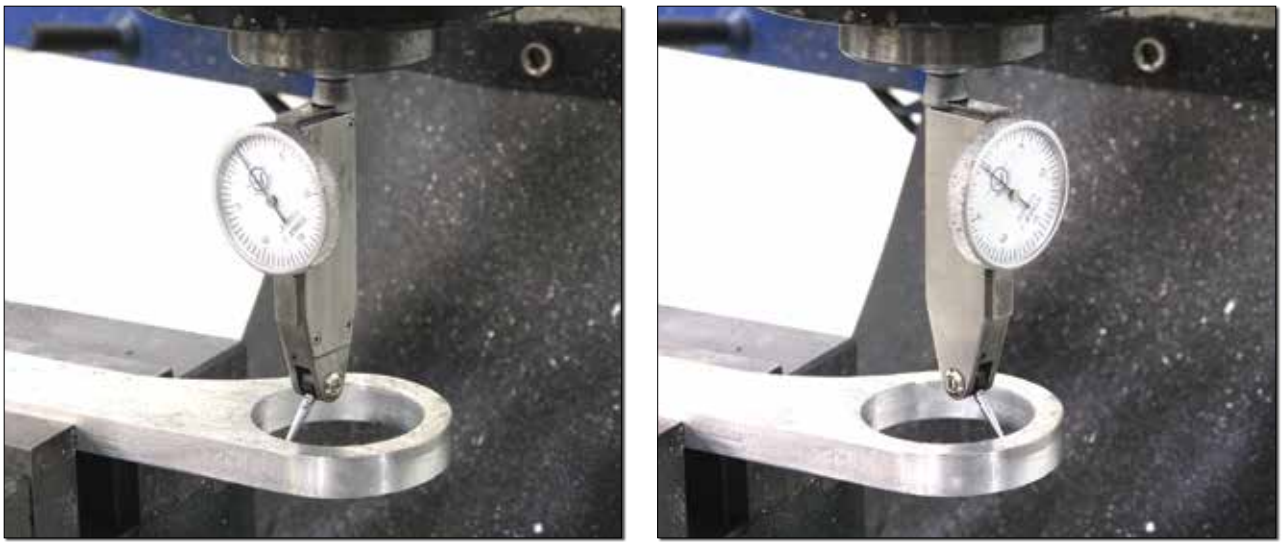


Using a test indicator to square a vise. Note the dial reading "suggests" the left side is about 0.005-inch forward of the right side.



(Left) One of the useful features of test indicators is the ability to "zero" the middle and then read plus and minus deviations. (Right) A "dialed in" vise will show no deviation in the average reading across the entire face.

Photos: Bob Hadley

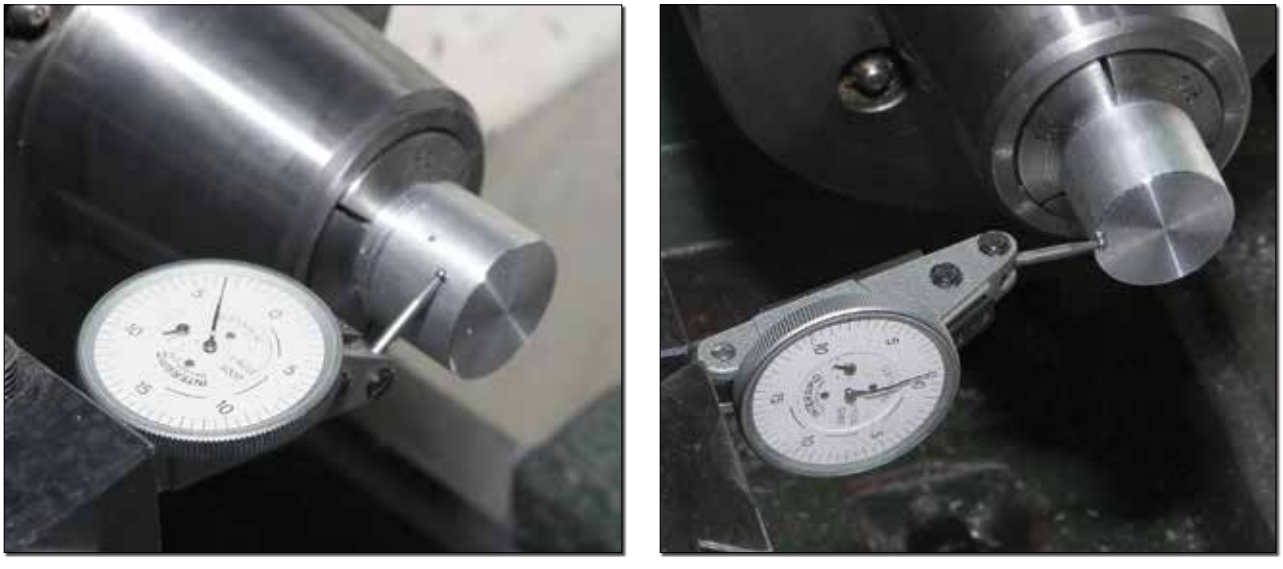


Dialing in the center of a bore is a simple matter of adjusting the indicator to make contact, then adjusting the X and Y axis until the test indicator reads zero around the entire 360 degrees of spindle rotation. Safety note: the machine is turned off and the spindle is rotated by hand. Never turn a machine on when using a test indicator!

the average reading from the left, center, and right points. If the reading is too bumpy and inconsistent, check if the surface needs to be cleaned or, if damaged, dressed flat.

A test indicator can be useful for centering previously milled or drilled holes on the mill. Often these are second-operation setups where the part is being returned to the mill, and the center of a hole must be accurately located in order to machine additional features. This is where the adjustability of the stem and mounting features come into play. By adjusting one or the other, or both, you can locate the center of a hole up to 3 inches or more (depending on your particular indicator).

The precision of lathe work can be greatly enhanced by the use of test indicators. By setting up an indicator in a tool holder, you can dial in an independent four-jaw chuck to a level of precision better than any three-jaw scroll chuck. This is basically the same as checking for runout, but, as previously mentioned, test indicators are for indicating deviations *from*, and then adjusting *to*, the "zero" setting. They should not be relied upon for measuring absolute values. This goes back to the cosine error issue with plunger-type indicators. True, test indicators have measurement graduation marks in increments of 0.0005 inch or less, but these presume "ideal" measuring conditions (as described in the owner's manual that came with the indicator). However, the versatility and usefulness of the test indicator comes from its ability to probe positions that are less than—usually much less than—ideal. ±



Three-jaw chucks are rarely perfectly concentric. Test indicators can help check out-of-true (left) and face runout (right). Repositioning the part in the chuck can often improve runout. Strategically placing shims between the part and one or more of the chuck jaws can also help.

AERO 'LECTRICS

The Other Oshkosh (Part II)

Let's be straight about Oshkosh right off the crack of the bat. At my first "Oshkosh," way back in the year of our Lord 1973, we all called this aviation extravaganza after the city in which it was held. Then in early 1998 the term "AirVenture" was coined by the folks on mahogany row at 3000 Poberezny Road (EAA headquarters), mostly to trademark the name for their merchandise. Mostly the only folks who call it AirVenture after 20 years are in the headquarters building. All of us who come from outside of Wisconsin call it "Oshkosh," but if you live in or near Oshkosh, you simply call it "da EAA." To do it local justice, you've got to hold your nose shut and sound like a duck under water when you pronounce "dah EEEEEE AAA AAA."

In "The Other Oshkosh," which appeared in the August 2016 issue of KITPLANES®, I took you on a grand tour of a "city" that increases the population of Oshkosh by about half again. It's called Camp Scholler for the 32,000 people car-camping at the Oshkosh show the last week of July. For December 2018, I thought you might like to see some of the stuff *other* than airplanes that are reasons why 50,000 of us make the long trek to "Baghdad on Lake Winnebago" every year.

The SOS Brothers Beer Tent is very long!

You get the idea right from the names of the professional baseball and football teams of Wisconsin (the Milwaukee [beer] Brewers and the Green Bay [meat] Packers) that beer and bratwurst are consumed in this part of the world. You would be right. In gargantuan quantities.

SOS

It stands to reason that a tent approximately the size of a football field and run by the four Sosnoski brothers (Al, Carl, Dean, and Steve) would be called the SOS Brothers Beer Tent. It would also stand to reason that the young female "beeristas" working so hard delivering 37 different types of adult beverages and a full menu of lunch and dinner fare to the (mostly elderly male) patrons shouldn't be forced to work in the heat of a Wisconsin summer fully clothed… bikinis are the order of the day. Seems that the SOS Beer Tent goes through about 100 cases of beer *every day* of the Oshkosh show. That's about 225 gallons of beer a day, or enough beer to fully fuel 5½ RV-8s. Besides the beer brothers

The SOS Brothers Beer Tent.

Jim Weir

is the chief avioniker at RST Engineering. He answers avionics questions in the internet newsgroup www.pilotsofamerica.com–Maintenance. His technical advisor, Cyndi Weir, got her Masters degree in English and Journalism and keeps Jim on the straight and narrow. Check out their website at www.rst-engr.com/kitplanes for previous articles and supplements.

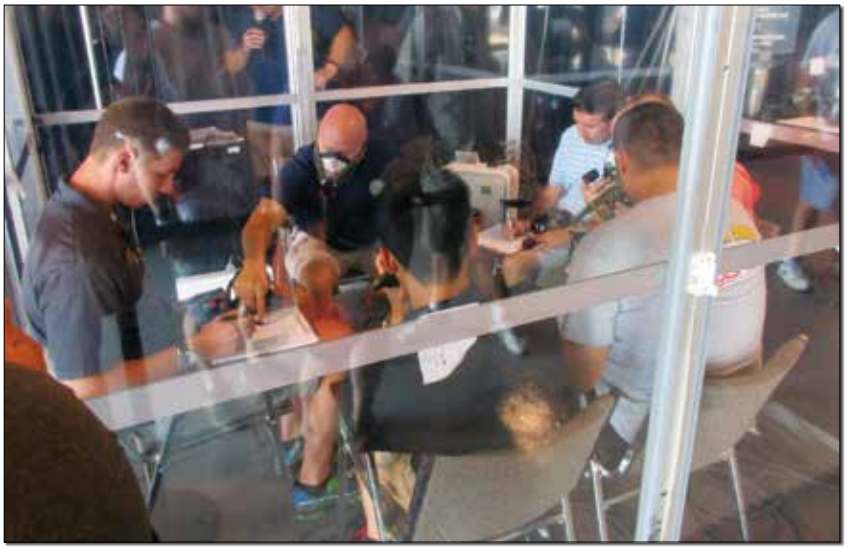
FAA operations/maintenance inspectors. These guys have a real and practical approach to general aviation matters.

and the eight beeristas, about 30 people (chefs, security, etc.) make up the workforce of this landmark on the west edge of Wittman Field. Find it with the huge yellow balloon flown rain or shine over the tent.

FAA

Down at the north end of Waukau Avenue, just to the south of the control tower, you'll find the FAA building, officially called the FAA Aviation Safety Center. Most of us think of an FAA inspector as either a grizzled old fellow with granny glasses looking over our shoulder to catch us doing something wrong or a wet-behind-the-ears young twerp who couldn't find his fanny with both hands in a phone booth and a GPS. Actually, the folks I talked to (and I made it my business to spend a fair amount of time chatting with these folks) were quite competent regarding general aviation. More than one of them said things like, "When I flew the 182 to Sun 'n Fun this year…," and "The Citabria just coughed once at the top of the Immelmann…"

Where else in the space of a large hangar can you talk to a maintenance inspector with grease under his fingernails, a couple of lawyers who were straight from the FAA Office of the Chief Counsel in D.C., and a few real MDs from the Office of Aerospace Medicine that can talk about the requirements for manned space flight and then switch to a detailed discussion of BasicMed without taking a breath? The FAA sends fully qualified people from all 21 of its divisions and departments, most of them from either Oklahoma City or D.C. This is the real deal, folks. The FAA does *not* send pencil pushers to this show. These folks are real-world absolute experts in their fields and



The FAA exhibit wouldn't be complete without a high-altitude chamber.

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Photos: Jim Weir

The NASA building at Oshkosh.

NASA models of how we are going to fly on Mars.

are more than willing to share what they know with anybody that cares to learn.

NTSB

What is *not* generally known is that the National Transportation Safety Board (NTSB) is also housed in the FAA Center. The NTSB puts on 25 different forums and discussions on everything from dissecting a particular accident in exquisite detail to drones in the airspace. I personally found them fascinating in their exhaustive detail of accident investigation.

NASA

Moseying on down Knapp Street and directly across Knapp from the forums buildings are two relative newcomers to the EAA show: the NASA building and the Innovation Showcase building.

I am happy to report that NASA is totally spun up on the manned Mars project(s). One item I found absolutely fascinating was something I did some calculations on when I was working on the Viking Mars Lander program back in the late 1960s. We didn't know anything about the Martian atmosphere, other than it was mostly carbon dioxide, but we made some educated guesses about density, gravity, and all that other stuff we really needed to calculate how radio waves would act near the surface of Mars. Turns out we made some pretty good (and some pretty bad) guesses, but I did some theory that I was studying for my flight instructor rating and applied it to Mars.

Turns out that NASA has refined a lot of the data we "guessed" and found that the Martian "air" will sustain flight! That's what I found with my calculations, but lead-acid batteries turning motors with a 25% efficiency would have required a 1969 airplane the size of an aircraft carrier to haul it the most trivial of distances. We had no idea that neodymium super magnets for a motor and lithium batteries would shrink that carrier down in 2018 to something more like a Cessna 210 or so. It is really nifty to walk around that building and see how far we've come in space exploration in 50 years. Just think, we are going to have a homebuilt aircraft on Mars in 2030 or so.

Now, Oshkosh 2019 starts on July 22, exactly 50 years and two days after brothers Armstrong and Aldrin touched Apollo 11 down on the surface of the moon. That calls for a celebration!

Innovation Showcase

Moving over next door to the Innovation Showcase building, we come to the bleeding edge of homebuilt technology. You will see stuff in this building all the way from a "heliocycle" using high-lift electric motors to power a motorcycle-sized vehicle using drone motors on steroids, to drones that drop packages on precise command from hundreds of miles away. You are really seeing stuff in this building that will be in our garages and workshops in five to 10 years. I can't wait for that heliocycle sucker to show up at the Sturgis motorcycle rally one of these days.

That's about it for the second installment of the "Other Oshkosh" series, and I tell you—I haven't *begun* to scratch the surface of this event. Look forward to Part III about this time next year. Until then…Stay tuned… ∓

The helicycle machine with the inventor sitting in the driver's seat.

The Innovation Showcase building.

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BUILDERS' MARKETPLACE

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WIND TUNNEL

Design Process: Wing Size and Landing Distance

As we have been discussing for the past two months, it is quite common for stall speed requirements to drive the wing of an airplane to be larger than up-and-away performance optimization would suggest. We have already looked at how stall speed affects takeoff performance and how certification stall-speed regulations can affect wing size. It's worth noting in passing that, even though homebuilders are not constrained by the FAR requirements, these requirements generally stem from good safety-related considerations.

Continuing along that theme, we now turn our attention to the effects of stall speed on the end of the flight. The two factors we must consider are landing distance (in a normal landing) and safety (in an emergency situation).

Landing Distance

Once the airplane touches down, it must come to a stop. How much distance this takes is a function of how fast the airplane is going. Touchdown speed, in turn, is a function of the stall speed of the airplane in its approach configuration. FAR Part 23 specifies approach speed as 1.3 V_{SO}. Typically, "over the fence" speed is a bit below this, and the airplane decelerates a little during the flare. Accordingly, touchdown speed will be somewhere between 1.3 V_{SO} and 1.0 V_{SO}.

After touchdown, the brakes are capable of generating a given deceleration. This is limited by the capacity of the brakes to absorb energy and the traction between the wheels and the runway surface. This limit is not a characteristic of the aerodynamics of the airplane, so to the first order, the deceleration available from the brakes is independent of the approach speed. Accordingly, the roll required to come to a halt will be proportional to the square of the touchdown speed.

Accurate calculation of landing distance is complex since it is dependent on the details of the airplane configuration, runway conditions, brakes, tires, engine residual thrust, etc. This level of detail is beyond what is useful for preliminary sizing and certainly beyond what I can cover here.

Fortunately, for initial sizing purposes, we can use a simple equation generated by a statistical analysis of FAR Part 23 certified airplanes. A good approximation of landing roll on a smooth, dry, level, paved runaway is given by:

$S_{Lg} = 0.265\ V_{SO}^2$

Where:

S_{Lg} = Landing roll in feet

V_{SO} = Approach configuration stall speed in knots

(Source: "Airplane Aerodynamics and Performance," Jan Roskam and Edward Lan, eq 10.100, p 494)

Figure 1 shows a plot of the landing roll as a function of stall speed as calculated

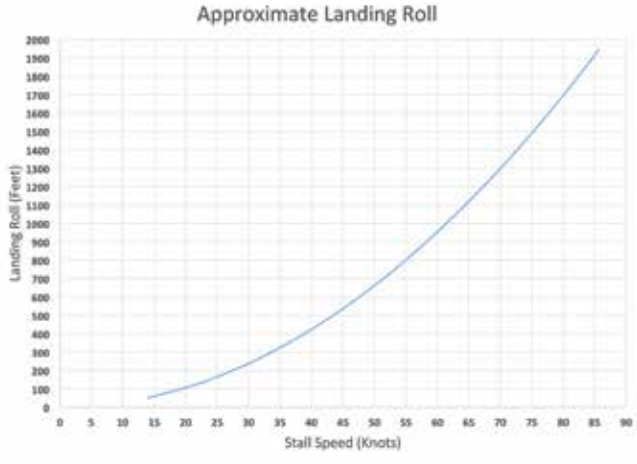


Figure 1: As stall speed increases, landing roll increases, too.

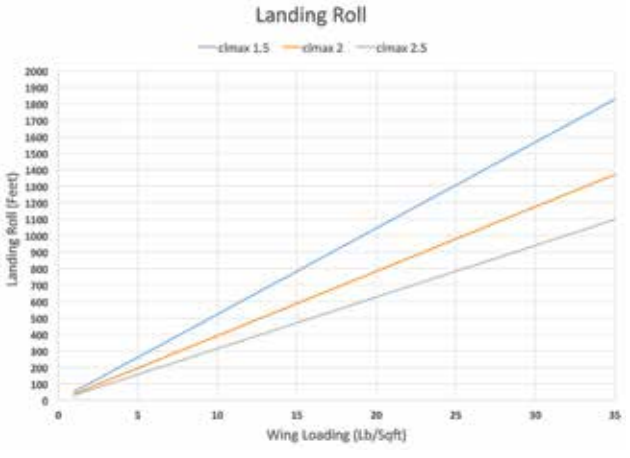


Figure 2: Landing distance as a function of wing loading for three values of C_{Lmax}.

Barnaby Wainfan *is a Technical Fellow for Northrop Grumman's Advanced Design organization. A private pilot with single engine and glider ratings, Barnaby has been involved in the design of unconventional airplanes including canards, joined wings, flying wings, and some too strange to fall into any known category.*

by the equation above. The plot clearly shows the quadratic behavior of landing roll with stall speed. Looking, for example, at the FAR Part 103-mandated 24-knot stall speed, we see a landing roll of about 150 feet. At the Light Sport (LSA) stall speed of 45 knots, landing roll is up to approximately 550 feet. At the maximum V_{SO} allowed by FAR Part 23 for most single-engine airplanes (61 knots), landing roll is up to about 1000 feet. Although homebuilts are not required to meet any of the certification standards, this should serve as a strong indication of the consequences of higher stall speeds on runway requirements.

The impact of this effect on wing sizing is shown in Figure 2.

At sea level, standard day conditions, the stall speed of an airplane is given by:

V_{stall} (knots) = 17.194 * SQRT {(W/S) x ($1/C_{Lmax}$)}

Notice that stall speed is proportional to the square root of wing loading (W/S). Since landing roll is proportional to stall speed squared, these two variations lead to the conclusion that landing roll is linearly proportional to wing loading. This behavior is illustrated in figure 2. The figure shows landing distance as a function of wing loading for three values of C_{Lmax}, which represent the effect of different types of high-lift systems.

Looking at typical wing loadings, we can see that at about 3 pounds per square foot, (ultralight) landing distances range approximately between 100 and 150 feet. With a Cessna 150-like wing loading (10 pounds per square foot), we are looking at a landing roll that ranges between about 300 and 500 feet, and at 20 pounds per square foot, landing roll ranges between 600 and 1000 feet. Wing loadings higher than 20 pounds per square foot are rare on single-engine airplanes, and this is one of the reasons why.

Safety

It is a sad fact that not every meeting between an airplane and the ground is a safe, routine landing. While we cannot design for every eventuality, it is highly desirable for the occupants of the airplane to have a reasonable chance of survival in the event of a forced landing or a mishap involving running off the runway during an attempted takeoff or landing.

Survivability in an accident is determined primarily by the deceleration loads placed on the airplane structure and occupants as the airplane impacts the ground. These forces are determined by the combination of the speed at impact and the angle of the velocity vector relative to the ground (or obstacle) on impact. The shallower the angle and the slower the speed, the greater the chance of survival.

Figure 3 shows a plot of the survivable threshold of impact angle as a function of impact speed derived from SAE data on general aviation crash events.

Looking at Figure 3, we can once again see the effect of speed, and to some extent the reasons for certain regulatory limits.

Notice first that at the LSA stall speed of 45 knots, almost any impact that is not vertical is survivable. As long as the pilot maintains control and does not dive into the ground, an incident is likely to be survivable. At the FAR Part 23 single-engine stall speed limit of 61 knots, the critical impact angle is about 35 degrees. Once again, even allowing for the pilot keeping some margin of airspeed above stall, any reasonably controlled impact is likely to be survivable as long as the airplane does not collide with an obstacle.

Notice finally, that an uncontrolled arrival at any speed above about 76 knots is likely to be fatal.

The vertical bars on the figure show the stall speeds for several wing loadings at a typical value of C_{Lmax}. This also adds some understanding as to why light airplanes rarely have wing loadings greater than about 20 to 25 pounds per square foot. If we accept that a forced landing will occur at slightly above stall speed even with good piloting technique, we can see that as W/S increases above 25 pounds per square foot, the margin for error gets very small, and by slightly above 30 pounds per square foot, any flight that does not end in a controlled landing on a runway or other smooth, flat surface is likely to have an unhappy end.

With all of the considerations we have been discussing for the past few months in mind, the designer can now choose a wing size for the airplane.

Next month, we will turn our attention to the next critical configuration concern: balance. ±

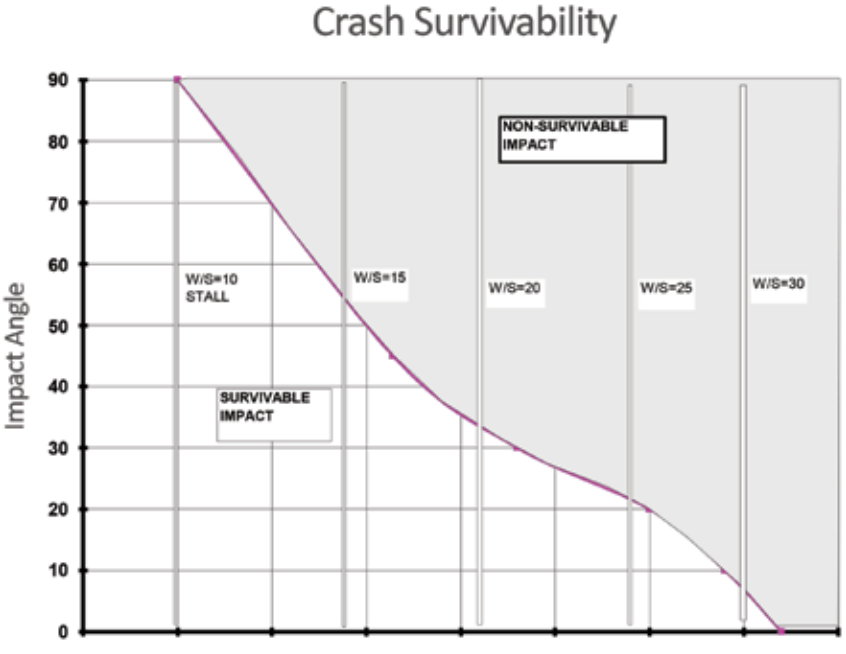


Figure 3: As stall speed and impact angle increase, crash survivability decreases.

Illustrations: Barnaby Wainfan

REAR COCKPIT

Flying Glass

Like the now quaint discussions regarding manual versus automatic transmissions in whatever gets you to the airport, the merits of glass versus steam gauges were settled a long time ago. Glass panels are less expensive, require far less maintenance, are more durable, and offer much more information with greater intuitive ease (mainly). To consider anything but glass for a new build or heavy airframe overhaul these days is to pencil a line on a sectional chart.

But for all that, glass screens are soulless, same-looking belly buttons with all the come hither of Darth Vader's abdomen. Or maybe I'm just getting old.

Of course, being stuck in the third-hand rag-and-tube era of homebuilding, I had never flown a glass panel until last summer when I spent 30 hours staring at one during the annual cheeseland hajj, courtesy of the boss and his recently built Tundra. The affects were simultaneously predictable and occasionally unexpected.

To the first order, I expected aviating via TV to be initially confusing, then easy, and it was. But what I didn't expect was that the confusion never totally went away. Confusion is not exactly the right word, but let's say once I was well past the handshake stage, I still had to stop and think what all those numbers meant. There are a lot of numbers on a glass panel. They roll and scroll, change colors and flash, but they are all just numbers. Or more correctly, numerals, in keeping with the precision of the glass panel.

This, um, confusion, has two components, one I'll label absolute value and the other relative importance. Absolute value is where digital displays shine. If you want to know your exact altitude to the foot, the digital altimeter display is fabulous. See, we're 3828 feet above the ocean blue. This is pretty handy if you're in Phase 1 testing and doing the lab coat and clipboard thing, but I really don't care about the last two digits the rest of the time. To me 3828 feet is "3800 feet" or "3800 feet plus a little bit." If I'm in a cruise climb, 3828 feet is, "Good, I'm past 3800 feet, and she's still climbing OK," or something like that.

How it's really done today: one hand in your lap, another pushing a button. Glass instrumentation simply can't be beat in almost any metric. Thirty years on it's just taking some of us a while longer to get used to it!

Curiously, in cars I differ from most folks in my preference for digital speedometers. Somehow "84" in big numerals on the instrument cluster lets me instantly know just how far over the limit I am. But tachometers should always be analog of some sort.

My other concern—relative importance—has been beat to death in digital versus analog discussions for ages, but is so core to the human factors in play I feel compelled to plow that field again. In short, if Mickey's big hand is pointing just past the 8 and his little hand is near the 3, and from looking outside I can see dogs running across someone's yard, then I know I'm at 3800 feet or close enough for practical concern. For sure I'm not at 380 feet or 38,000 feet, so it has to be 3800 feet. But far more importantly, I know if Mickey's big hand is steady I'm holding altitude, and if it's swinging up or down I instantly know

Tom Wilson

Pumping avgas and waxing flight school airplanes got Tom into general aviation in 1973, but the lure of racing cars and motorcycles sent him down a motor journalism career heavy on engines and racing. Today he still writes for peanuts and flies for fun.

I'm climbing or descending, and how fast, too. Typically that's far more important to me than my precise altitude. It's the 'ol rate of change thing.

I guess things would be different if I were in the clouds and couldn't see the dog running across the yard.

Of course, the tower over at the downtown airport always asks you to read your altitude to them about fifteen seconds after takeoff, and then I have to convert my analog situational awareness into some precise number for them. I know they're traffic-copping me on my altimeter setting but that hasn't eased my pain in being bothered with such an inane waste of time and brainpower when I'm busy looking out the window. Geez, I can tell I'm higher than the office buildings, climbing, and I'm watching for traffic. To have to turn Mickey's hands into precise numerals at that point…if I had a glove I'd slap them. If I had glass maybe I wouldn't find it such a bother.

Perhaps a better example is the fuel flow instrument. My Bendix fuel injected 540 takes a little technique to start when hot, something akin to safety wiring a turnbuckle via a mirror. Thankfully my analog fuel flow instrument decodes the fuel system's gurglings with amazing fidelity, and mainly because it is a mechanical instrument, an eyewitness to the laws of physics and not some second-hand electronic representation thereof.

So, while going through the witch doctor dance that is starting a hot Lyc, I glue an eyeball on that analog fuel flow instrument's needle. If, while caressing the boost pump the needle rises and falls similarly to a cold start, then I know the fuel in the lines is still liquid and I can expect a nearly flooded condition (a warm engine needs no extra fuel enrichment to start, so pretty much any priming is too much). But if the needle flutters when the mixture knob goes in or when I hit the boost pump, I know heat has boiled fuel in the lines and urged a bit of gas down to a cylinder. Just how much the fuel flow needle wiggles and wags clues me in on if there was just a little vaporized fuel in the lines or if we have a full-blown case of the vapors, in which case you might as well flood it and renew your membership in the chug-a-lug black smoke club.

Given a glass display, the fuel pressure is mainly given in numerals, sometimes augmented by an electronic rendition of an analog display. The trouble is the numerals might fluctuate a bit during the hot start prime, but you can't tell by how much. A cascade of numbers is a mess and gives no clue as to how big a mess. And the ersatz electronic analog dial with its cheery yellow, green, and red arcs is too small for hot start priming accuracy and electronically dampened anyway. Heck, it might be a bar graph, in which case you might as well show a goat a watch in my case.

The real answer is electronic fuel injection, where the all-knowing, ever vigilant computer does all thinking and doing, leaving us to what? Enter waypoints in a GPS, I suppose.

Of course, you can't beat glass for navigation, where stalwartly lashing yourself to the rudder post, E6B in one hand, stick in the other, ear to the AN range and an eye glued to the CDI is replaced by keeping the little airplane icon on the magenta line, and watch out for the red terrain or green blob weather. It's just like guiding the little metal bee along with a magnet in one of those plastic maze kid's toys. Well, OK, a kid's toy from six decades ago…

And I wasn't expecting the slight nausea engendered from looking at all those surveyor's guide lines and such as they rolled and pitched on the screen. Guess I was looking too much at the screen and not enough out the windshield. Nor did I predict how having to-the-foot or single-degree accuracy would goad me into chasing my altitude and heading like a primary student in a windstorm.

In the end I'll eventually come to glass, of course. The cost and benefit arguments are just too compelling, and with a white beard I already look old enough without a constellation of mechanical gyros whining nearby. Doesn't mean I won't miss the romance of the flickering needle under the red dome light, though. ∓

UNAIRWORTHY

Burnt Intake Hose

In the tightly cowled engine compartment of an E/A-B aircraft, exhaust systems can do unseen damage over time unless care is taken to protect various components. In this case, the intake tube hose on a Lycoming engine shows severe signs of overheating due to its proximity to the exhaust system. When touched, it was very brittle and started flaking apart. Left unchecked, it will eventually cause an intake leak and the cylinder will run lean. ∓

—Vic Syracuse

Photo: Tom Wilson

Letters from Home

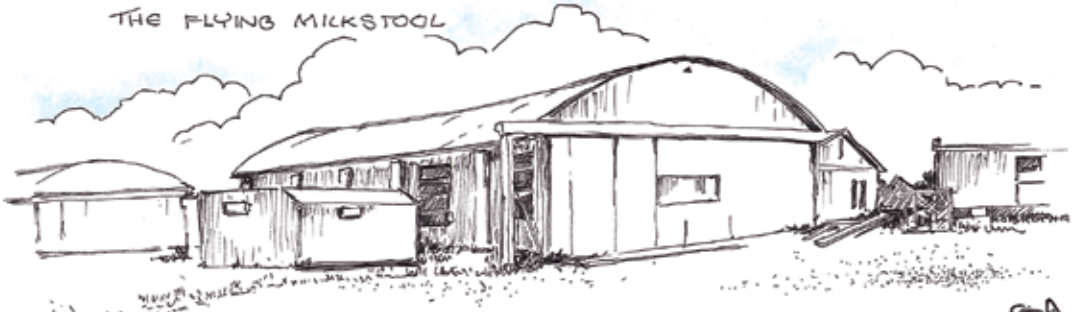
With a recent move to Loveland, CO. I had a chance to visit the airport that first whetted my appetite for aviation in Ft Collins.

It was a wonderfully emotional experience for someone not known to have a lot of emotion. The hangars had been gutted of aviary life (except for the resident birds!) Where the buildings had once exuded adventure they now just are filled with industrial detritus. But it was my airport!

We rode our bikes here on Sunday after lunch, lay at the end of the runway and looked up until chased away by angry pilots!

The first plane I remember was funny looking and standing on its nose in a corner. Salvaged cub wings, a fuselage you straddled with motorcycle handle bars and trike gear. It was a Skycycle and my first experimental aircraft! SEE POPULAR MECHANICS JUNE 1953.

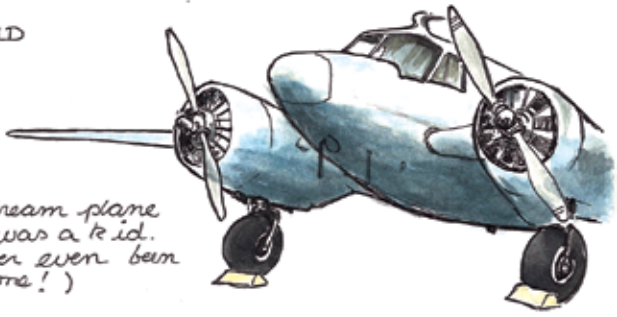
THE FLYING MILKSTOOL



CHRISTMAN FIELD

"Dutch Rolls" all the way to S. Dakota in a crosswind!

My dream plane when I was a kid. (I have never even been inside one!)



Yep! We even had a B-17 visit the field when the Commander of the AF ROTC came through on an inspection tour. It lost some of its "panache" when a tug had to pull it out of 12" of Colorado summer sun softened asphalt where it had parked!

Those were the days.....

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