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CONTENTS

February 2009 | Volume 26, Number 2

KITPLANES
THE INDEPENDENT VOICE FOR HOMEBUILT AVIATION

On the cover: Kevin Wing photographed the Zenith STOL CH 750 at company headquarters in Mexico, Missouri.

AOPA's Expo 2008: About the market, rules and *optimism*?

Just flew in from the last official show of the year, AOPA's Expo, held in San Jose, California, in early November. (And, no, my arms aren't tired.) The last time I attended AOPA's gathering at this venue, I was a staffer with the association's magazine and, so the popular opinion went, eschewed reason by flying my then-new Pulsar up from Long Beach. Oh, how times have changed.

As with AirVenture this year, the turnout was far better than expected given the recent economic turmoil. I find it interesting that the talk had been about what the industry would do after the election. Then when not much changed, it turned to watching the stock market for a reaction. Now it's a case of hunkering down until after the holidays.

Nevertheless, the vibe of the show was more upbeat than I expected, particularly as general aviation as a whole can be said to be hurting. It's generally felt that the Experimental/Amateur-Built part of the industry will continue apace because its participants are more emotionally connected to their aircraft assets than, say, a Cirrus SR22 owner. I believe the theory, because we have the opportunity to build and fly for less; sometimes it's not the buy-in that wears you down but the staggering costs of upkeep. And just as it seemed my own airport was turning into a ghost town, the price of crude oil dropped and avgas prices, more slowly, came off the redline. It may be a temporary respite, but it's a welcome one.

Another part of the economic discussion centered on what impact the proposed changes to amateur-built rules would have. In fact, I gave an hourlong talk at AOPA that was intended, when it was planned last February, to discuss the new rules and how they applied to builders and wanna-bes. Well, the FAA not only hasn't finalized the rules, it reopened the comment period in October for the changes to the Advisory Circulars. And, I'm told, it is planning to reconvene the Aviation Rulemaking Committee to take another swipe at the changes.

Ameritech's Bob Honig poses with the new LSA ground-adjustable prop, a rare Experimental-class offering at AOPA Expo.

I consider this good news. First, the FAA has elected not to ram through what I believe are poorly conceived and written changes. Second, the delay shows there's no pressing politics to get this done before the new administration. My guess is that the issue will take a lower profile and that we might not have a new set of rules until after AirVenture 2009.

Along those lines, Glasair Aviation announced at the show that it had been through a weeklong inspection by some of the FAA's AIR-200 employees who were behind the proposed rule changes. The upshot was that the company's Two Weeks To Taxi program was found not to be in violation of the "spirit or intent" of the rules calling for a builder to complete the "major portion" of a kitbuilt aircraft. The company is careful to point out that this does not constitute an endorsement by the FAA, but that the agency's representatives found that modern manufacturing techniques helped reduce build time but still leave the major portion for the builder to do. The Glasair Aviation static display at AOPA, with Tom Wathen's beautiful red Sportsman on amphibious floats towering overhead, was busy. And every time I walked by the Velocity display, there were plenty of sunglass-and-baseball-hat types milling around. There were a bunch of other, kinda ugly airplanes on the ramp too, from manufacturers I'm not real familiar with, like Beech and Cessna...

Among the handful of Experimental-class exhibitors at AOPA was Ameritech, showing a new ground-adjustable prop for engines up to 125 hp (Rotax 912, Jabiru, Continental O-200, Lycoming O-235, etc.) It competes directly with the recently developed Sensenich two-blader but is said to be less expensive and faster. We'll have a full report soon.

Marc Cook *has been in aviation journalism for 20 years and in magazine work for more than 25. He is a 4000-hour instrument-rated, multi-engine pilot with experience in nearly 150 types. He's completed two kit aircraft, an Aero Designs Pulsar XP and a Glastar Sportsman 2+2.*

Photo: Marc Cook

CONTRIBUTORS

LEROY COOK

Our man in the Midwest paid an autumn visit to Mexico, Missouri, to sample the new Zenith STOL CH 750. LeRoy, whose finesse in an airplane is practically legendary, returned from the "Show Me" state with high praise for the new design. We're delighted to have LeRoy writing more for us lately, partly because he's an accomplished scribe, but also because he helps us mark our 25th Anniversary as a writer who was here from the start. His flight report begins on Page 8.

JULIA DOWNIE

This month we publish the penultimate of our four yearly Buyer's Guides, all pulled together by the indefatigable Julia Downie. (Next month, we have an Engine Buyer's Guide to tempt you.) Last year, this edition also contained a listing of ready-to-fly SLSA designs—not kits, not ELSAs—but we've deleted them from the magazine because, well, you asked us to. The rotorcraft guide begins on Page 22.

DICK STARKS

You know, Dick just sees stuff differently from the rest of us, no sense trying to call it any other way. While the average KITPLANES® staffer was eyeball deep in the display buildings at Oshkosh this year, Dick was outside (yes!) finding the true gems, curiouser stories and light-makes-right designs that are going to be ever more important in our brave new "simplified" world. Perfect. Dick has long since figured out how to have more fun per dollar than anyone we know. His story begins on Page 18.

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LETTERS

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Say You Want an Evolution?

Great article on the Evolution, and what an excellent design by Lancair. The numbers you gave on the glide ratio were off. By my calculations the glide ratio is 18.6:1—still very impressive. Any idea on what the weight difference will be between the turbine and piston versions?

KURT HANKE

Until Lancair actually mounts one of the new TEO-540s, it's all speculation. (So let's have some, then...) A typical PT6A is just under 500 pounds, and the listed weights of the various TIO-540 engines range from 530 to 630 pounds. We've looked at the mockup of the piston Evo's firewall-forward and are willing to bet there'll be another 15 to 30 pounds of FADEC stuff. So it's likely the piston version will be heavier overall—if you said by 150 to 200 pounds, we wouldn't fight you—but with better fuel specifics, the airplane will need to carry less fuel for any given endurance.—Ed.

Gray Instead of Gold?

First, this aircraft [the Lancair Evolution] looks like it can't miss being successful; it's a beautiful exercise in aircraft design. I can understand a piston engine option. I am curious if the Continental liquid-cooled 550 was considered as a possibility?

Yes, you can turbocharge an engine and maintain its power at high altitude, and consequently the heat generated in the cylinders, but the thin air at the altitudes this aircraft can operate in won't do a great job of cooling any air-cooled engine. (This is not anything new.)

The Continental engine I mention is/was available and seems to be a logical choice in my humble opinion. This engine has been around for a long time, and the few articles I read of pilots using it in engine conversions, years ago, were very good.

JOHN J. PELLEGRINO

Continental has greatly backed off developing and marketing the liquid-cooled Voyager engines. At the same time, Lycoming has become extremely aggressive in seeking out new development possibilities, so the tie-in with Lancair on the Evolution is a natural. No doubt this will be a demanding testbed for this engine design and, in particular, the new all-electronic FADEC.—Ed.

Hold Your Nose

BARF! A million dollar turbo kit airplane that I would aspire to build on the front page? Just a minute as I retrieve my pocket change while the pretty boys rub it in my face. BARF!

VINCE VAIRO

Catalog Dreams

Dear Doug Rozendaal: I read your article about the Lancair Evolution, but I must correct you on one point. Airplanes *are not sexy*! Anyone who thinks so needs to visit Victoria Secret's web site or peruse their catalog or some similar publication to see images that are truly sexy. One can clearly see that there is *no* resemblance to aircraft or any other machines. You writers seem to think that if you squeeze the word sex into your writing it will sell your work. Please can't you be a little more creative? This is not *Playboy* magazine. Sexy comes from the word sex. Sex with an airplane, now that is really getting sick. I will concede that the Evolution is a fine looking machine. A fine machine it may be, but sexy it will *never* be.

DANIEL MACPHERSON

Doug Rozendaal responds: "As a 50-year-old married, fat, balding warbird pilot, I can tell you I get no satisfaction from the Victoria's Secret catalog, only frustration. Whether it is the bent wings of a Corsair, the roar of a Merlin, or the compound curves of the Evolution, I believe that an airplane can be sexy. But I get to play with the airplanes. If I got to play with the Victoria's Secret girls, I might agree with you.... But then my wife would make it so that I could no longer play with the airplanes or *the girls."*

Rolling Along

Your design issue is always a treat, with the "Roll Your Own" article adding substantial content for this longtime reader. Lining up your 297 kits, from $7K stickplane to five-figure luxury rocket, then giving us a real airplane for less, begs the question: How about a design competition, amateur and professional, current LSA specs?

ALLAN RIEKEN

That's not a bad idea, though we'd be interested to see what could be done outside of the very restrictive LSA regulations, where design orthodoxy is the result of designing within a confined box.—Ed.

What's Your Engine?

The "Roll Your Own" story by Ken Scott was very interesting. Would you pass this question on to Scott? It would solve a question of mine providing he had time to answer. Here it is: I understand the choice of VW for power, but why the 1915cc engine? According to Great Plains Aircraft, their 1915cc and 2276cc engines are only 2 pounds different in weight, but 10 in horsepower. So why not have the 10 extra horsepower for the 2 pounds?

DENNIS L. RENZ

Ken Scott responds: "Why did we use the 1915? One, because Mel Ellis already had parts for one; and, two, many years ago my best friend was a VW mechanic. We rebuilt and sold several vans and found that engines above about 2 liters just didn't survive as well. In an airplane, reliability is more important than power."

Product Review

Garmin GPSMAP 696

Bigger *and* better...imagine that!

BY MARC COOK

You could blame a lack of competition for Garmin easing off the development accelerator pedal. After all, the GPSMAP 396—the first to offer XM-carried weather in an all-in-one GPS—was released at Oshkosh 2006, and the 496 followed a year later. This year, nothing new from Garmin—though we did hear rumors centering on a big, touch-screen upgrade from the versatile -96 lineup—as tablet-computer-based solutions started to become more popular.

Well, someone in Olathe hit the passing gear, and the result is the GPSMAP 696. Garmin's new box blurs the line between a permanently mounted multifunction display (MFD) and a portable GPS. It is extraordinarily feature packed. The powerful GPS, slick graphics, satellite weather and music, voice alerts, terrain, comprehensive database and flexible outputs are expected—but there's a lot more.

Big Inside, Big Outside

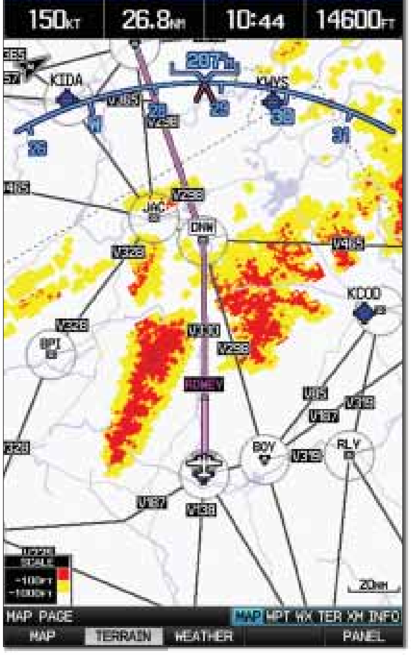
No question the 696 is big boned. The case measures 5.7 inches wide by 7.7 tall (and 2 inches thick), framing a 7-inch-diagonal screen. It literally dwarfs the 496. At 2.2 pounds, it's going to feel like a brick strapped to your leg, so good thing we Experimental types can hard mount the thing. Garmin ships a RAM yoke mount, but I bolted it right to the panel by using the four 6-32 threaded inserts intended to mate with the RAM mount. They're in a square layout about two thirds of the way up the back.

Plan on using ship's power, too; with the backlight running full blast and the XM puck powered up, the internal battery is good for just more than 2 hours, less than half a 496's duration. You might pass up using an external antenna, though; the 696's GPS engine is incredibly sensitive. For example, my Garmin 496 never sees satellites when it's in the hangar, even with the external antenna. The 696 locked on almost immediately, and worked perfectly well with the internal antenna over hours of flying in a high-wing airplane. It also has a fast processor. The only time I noticed it taking time to redraw a screen was when it had a ton of information on it. Impressive.

But more superlative is the change in physical buttonology. The multifunction knob makes the 496's rocker pad seem primitive. As with the -96 series, you get a dedicated range controller, ENT, CLR, MENU, direct-to and NRST keys arranged vertically. Rather than bury flight plans in the menu system, the 696 has a dedicated FLP key. Five contextual buttons run along the bottom. Normally, the multifunction knob controls what you see, annunciated by a

A wholly new aviation-specific form factor frames the new Garmin GPSMAP 696. In addition to the large screen, a key upgrade is the multifunction cursor control, which rotates and skews in four directions; pushing in on the knob enables the cursor.

With so much more screen real estate, the instrument page can be displayed full time without edging out the moving map.



In addition to the expected VFR charts, the 696 will display low- and high-altitude en route charts as well as instrument procedure charts; the approach plates are about 75% of normal scale and can be difficult to read. Still beats paper.

menu at the lower right corner. In this way, the 696 is more like a GNS430. The map page is at the left, and you just twist the knob right to get waypoint information, weather, terrain, XM and general information pages. It's all intuitive and as simple as it can be given the vast amount of information at your disposal.

Weather All Around You

New weather products include an icing forecast and pilot reports (PIREPS). Overall, Garmin has improved the function of the weather sub menu, in particular by fixing a "feature" of the 496 that made it difficult to highlight, say, an AIRMET among the other data on the screen. A new Pan menu allows you to move around on the screen and get the next level of detail easily. As before, two tiers of weather service are available, at $29.95 and $49.95 a month.

Your IFR Friend

Weather is expected in Garmin's top-line portables, but tools for the IFR pilot might not be. Here, they include a full database of low- and high-altitude en route charts as well as NACO-sourced approach plates including airport diagrams, DPs and STARs. The 696 can legally replace a bag full of paper charts; updates are $95 each or $395 for a year subscription for the U.S. (A complete set of paper charts will cost you more than $270 each cycle.) The Jeppesen-provided airport database updates are $49.95 each or $295 for a year. Terrain, obstacle and AOPA databases are updated separately.

Garmin has masterfully integrated the IFR components. When you select an approach at your destination, the 696 automatically pulls up the NACO chart in the WPT view. Even so, that chart is not geo referenced—that is, you won't see an airplane flying on the chart—and the under-scale size of the chart makes it significantly more difficult to read than the paper item. (Charts can be zoomed in on and panned easily.) Understand, also, that the 696 is not itself IFR approved; it is acting as an assistant to your installed gear, not as a sole-source navigator.

Worth the Dough?

Garmin has pushed the limits of a portable navigator in size—price, too. The fully featured 696 retails for $3595 (street price at press time of $3295),

Size matters: Installed in this GlaStar Sportsman's panel next to a 496 in an Air Gizmos mount, the 696's much larger form is plain to see.

Garmin's new XM antenna puck is roughly the same size as the 496's but without the annoying magnet in the base.

while the non-weather 695 is $2895 (street of $2695). Call that a $900 difference from the weather-shod 496, and $1100 up comparing the non-weather 695 to the 495. The new box will also pose some mounting challenges in flying aircraft, but, once overcome, is absolutely worth the effort for the combination of the three-times-larger screen, improved operating logic and additional features. From the perspective of capability, Garmin, with the 696, has left its competition eating dust. ✈

For more information, visit www.garmin.com/aviation. Garmin products are widely available.

The 696 locates all connectors along the upper left edge. From right, a more robust power/data connector, the USB jack for system updates and to communicate with the XM antenna, a 3.5mm audio jack (for voice alerts and XM music), the external antenna connector and an SD card slot.

Photos: Courtesy the Manufacturer, Marc Cook

Zenith STOL CH 750

The Heintz family expands with a new Light Sport gap filler: bigger than the old 701, smaller than the 801.

BY LEROY COOK

There are times that an aircraft design can benefit from a fresh start, maximizing its potential to meet a new market need. The Zenith STOL CH 701 has always been a fun little kit airplane, with a loyal following and the potential for continued longevity. But the Light Sport Aircraft standards allow much more to be gained by a little modernizing of the CH 701 basic design, so that individuals operating as sport pilots can take full advantage of its capabilities.

That's why Zenith Aircraft brought out the STOL CH 750 sport-utility kit airplane, which at first glance could be taken for a customized CH 701, or perhaps a shortened CH 801, its four-place cousin. However, the CH 750 represents designer Chris Heintz' fresh look at a two-seat backyard flier, this time optimized to take full advantage of the 1320-pound LSA weight limit and even larger engines than those typically used in the LSA-type airplanes.

The little CH 701 started out life in 1986 with 50- to 65-horsepower two-stroke Rotax powerplants, but now routinely flies with Rotax 912 engines of 80 to 100 hp. This boosts performance but also jacks up the empty weight, while recommended gross weight remains at 1110 pounds. Meanwhile, people have gotten bigger, and everyone wants to take more of their stuff along. So Zenith rose to the challenge by adding a more robust landing gear, moving the aft cabin bulkhead to the rear and putting in more windows to add visibility in the aft quarter. Yes, the cabin has been widened by 3 inches or so, but more importantly the larger swing-up doors now incorporate bubble windows that open up considerable elbow room. The illusion of space is heightened by the extra glass area over your shoulder.

Up front, the CH 750's firewall design is shared with the just-introduced Zodiac CH 650 low-wing sportplane, which means most of the engine packages that have been fitted to the Zodiac can go onto the new 750. In addition to the Rotax four-cylinder powerplants, the six-cylinder Jabiru 3300 can be used, as well as the Continental four-cylinder direct-drive engines. Automotive con-

Zenith scion Sebastien Heintz with the CH 750 outside the company's Mexico, Missouri, headquarters.

Photos: Kevin Wing

versions such as the VW, Subaru and Corvair will no doubt be investigated as well; powerplant weight should not exceed 250 pounds all up.

Not Just Another Pretty Face

Our visit to the factory to fly the CH 750 found the brightly painted demo ship ready and waiting on the flight line, where Roger Dubbert, company demo pilot, and Sebastien Heintz, company president, walked me around the plane. As with Chris Heintz' other STOL designs, the wing uses fixed leading-edge slats to enhance lift, full-span flaperons that serve as both wing flaps and ailerons, and a unique gull-wing root profile that improves visibility from the cockpit. The CH 750's V-type wing-struts, however, have a streamlined cross section rather than the round tubes used on the CH 701. Hoerner-type wingtips add stability and reduce the tip vortices. Two 12-gallon fuel tanks are in the wings, plumbed to feed simultaneously.

The CH 750 landing gear uses a beefy one-piece aluminum spring for the maingear, mounting Matco wheels and hydraulic brakes with 8.00x6 off-road tires. The nosegear fork mounts a similar

Zenith fitted the venerable Continental O-200-A (100 horsepower) to the factory CH 750, but the airframe will handle engines of 80 to 120 hp, up to 300 pounds installed weight.

tire, sprung by a simple bungee-cord system. Unlike most Light Sport Aircraft, which tend to rely on differential braking, direct nosegear steering is available through the rudder pedals.

The high-mounted horizontal tail spans 8 feet 5 inches, about a foot wider than the trailerable CH 701. It features the cambered under-surface of Chris Heintz' other STOL airplanes, the key to good low-speed control, according to the designer. An electric trimtab is fitted to the left elevator. The trademark Heintz rudder is nearly an all-flying surface, with only a vestige of vertical fin and dorsal left fixed.

One could say that the CH 750 is not just another pretty face. As with its siblings, it's designed for ease of construction with hand tools, thus there are no shapely compound curves or complex assemblies. The upswept aft fuselage and a center of gravity located over the maingear are simply examples of form following function; the CH 750 is

Two seats with room to spare. Nominal cabin width is 42 inches, but that can be expanded by a massive 8 inches with optional bubble doors.

designed to rotate nose-high and lift off early, yet sit level on its tricycle gear during taxi.

Metal Minded

Zenith's kits are mostly constructed of 6061-T6 aluminum, put together with Avex blind rivets—lots of them. Out in the plant, Sebastien Heintz showed off the CNC cutters robotically carving out parts and drilling holes, so the

What's in the Box?

The kit contains all parts needed to construct the CH 750 airframe, with CNC cut and drilled parts. The main wingspars are completed by the factory, all welding is finished, and the driven-riveted lower fuselage frame is done. CAD drawings and a photo assembly manual are included; all dimensions are in metric. A finishing kit is an extra $4490, and the powerplant and instrument panel equipment is not included. Sub kits are available for pay-as-you-go building of the tail, wings, fuselage, gear, firewall forward, fuel system and controls.

—L.C.

builder has only to finish the part, line up the pre-drilled holes and Cleco the pieces together to start pulling rivets. Unlike many kit suppliers, Zenith will sell plans and builder manuals for home craftsmen wanting to cut out and bend their own parts from raw stock. However, when you see how quickly the cutters and presses can whip out the same item, perfectly formed, a scratch builder would probably opt to buy some parts instead of building every one.

The prototype CH 750 had been fitted with a reliable old Continental O-200-A as a test of the airframe's ability to handle a heavy powerplant. Even in stripped-down dry weight, it's a 188-pound engine, and closer to 250 pounds installed. An electric boost pump was added, just to ensure positive fuel pressure in some of the extreme climb attitudes, though it's probably overkill, with the unfailing pull of gravity backing up an engine-driven pump. The airplane had self-generating P-model electronic ignition modules from E-MAG Electronic Ignition installed, firing automotive spark plugs instead of 1930s technology mechanical magnetos and aircraft plugs. A Sensenich composite ground-adjustable prop was being used for test flying before I arrived, but it had been exchanged for a nice three-blade Warp Drive propeller for photo purposes.

Gull-wing fans rejoice! The 750's wing features a tapered inboard section to preserve sightlines though the clear roof.

Go Ahead and Fly It

Roger Dubbert trustingly waved me to the left seat to try out the CH 750,

The CH 750's arched instrument panel "makes due" with a Dynon FlightDEK-D180 combined EFIS and engine monitor, and a Garmin VFR stack including an audio panel, SL40 com and portable GPS in a docking mount.

Sport Pilot ready, but which category?

The CH 750 we flew was a factory-built example, of course, and kits are being delivered for Experimental/Amateur-Built versions. But we had to ask if Zenith planned to certify the CH 750 as an ELSA kit, allowing a greater percentage of factory completion. Sebastien Heintz answered with a definite maybe, but cautioned that doing so would freeze the design and make changes difficult. There are plans for a fully built SLSA version from the AMD Company in Eastman, Georgia. In the final analysis, it's hard to beat the powerplant and customizing options offered by the Experimental/Amateur-Built category, where the CH 750 can be set up for night and even IFR flying for the properly rated pilot.

—L.C.

as it was the only side with toe brakes installed. Entry is facilitated by the low seat height, gas-spring-supported doors and lack of a control stick or yoke. Zenith's standard control system is a Y-shaped column that operates out of the center console, providing a stalk for each pilot. My left-hand throttle had an electric flap switch located directly beneath it. The electric elevator trim and indicator were on the panel next to the throttle, and a push-to-talk button was on the yoke.

The panel was a sport pilot's enhanced-VFR dream package. The Dynon FlightDEK-D180 combined an electronic flight and powerplant display, and a Garmin GPSMAP 496 was nestled in an AirGizmos dock. These two highly capable units were supported by a Garmin SL40 com radio, GTX 327 transponder and GMA 340 audio panel, the latter a bit redundant with the SL40's built-in intercom. With

ZENITH STOL CH 750

Price	$19,480
Estimated completed price	$38,000 - $65,000
Estimated build time	350 hours
Number flying (at press time)	2
Powerplant	Continental O-200-A, 100 hp @ 2750 rpm
Propeller	Sensenich two-blade, ground-adjustable
Powerplant options	80-120 hp

AIRFRAME

Wingspan	29.8 ft
Wing loading	9.17 lb/sq ft
Fuel capacity	24 gal
Maximum gross weight	1320 lb
Typical empty weight	775 lb
Typical useful load	545 lb
Full-fuel payload	405 lb
Seating capacity	2
Cabin width	42 in

PERFORMANCE

Cruise speed	100 mph (87 kt) TAS sea level @ 75% of max-continuous, 5.8 gph
Maximum rate of climb	1000 fpm
Stall speed (landing configuration)	38 mph (33 kt) IAS
Takeoff distance (ground roll)	100 ft
Landing distance (ground roll)	125 ft

Specifications are manufacturer's estimates and are based on the configuration of the demonstrator aircraft. As they say, your mileage may vary.

DETAILS

1. Dramatically cambered horizontal stabilizer and "all flying" rudder are familar Chris Heintz design points.

2. A fixed, leading-edge slat improves the CH 750's low-speed handling.

3. The 750 carries forward a Zenith design hallmark: a rudder-pedal-steerable nosewheel.

4. An addition to the CH 750 over the 701 are these rear windows, which help brighten the two-seat cabin.

5. The CH 750's offset elevator hinge helps reduce pitch forces.

In the Zenith shop, quickbuild components for the CH 600 line are assembled. While plansbuiders can still build any Zenith the traditional way, the business has definitely swung toward more work from the factory.

this gear, the CH 750 was ready to go cross-country as well as around the local STOL strips.

The master was flipped on to activate the Dynon display, which was switched to the engine parameters screen. Starting required only the usual O-200 throttle pump before twisting the magneto/start key. Once idling, the avionics switch came on and we changed the Dynon to a flight data display, with horizon, heading, airspeed, altitude and rate of climb augmenting engine data in one compact screen. The GPSMAP 496 was massaged into its map mode, and the transponder was activated, so we were all set.

Taxiing couldn't have been simpler, with great visibility over the nose and responsive direct nosegear steering that obviates any need for the toe brakes. Dubbert had to remind me of the CH 750's almost 3-foot-wider wingspan, compared to the CH 701, as I negotiated a narrow taxiway around the hangars. I noted a generous slice of forward visibility beside the tapered nose and instrument panel, which would come in handy in STOL liftoff and climbout attitudes. In the runup area, the pre-takeoff check required only a brief pause, mostly to set up the avionics. The P-mags checked out perfectly at 1700 rpm, carb heat was confirmed, flaperons were drooped to

Zenith kits are well-known for their simplicity, and even at the factory processes such as flanging wingrib lightening holes are performed the simplest way possible.

Zenith is justifiably proud of the 750's excellent visibility.

10°, and the strobes and boost pump were activated. After verifying neutral trim and free-and-correct controls, it was time to fly.

The STOL CH 750 doesn't linger once the throttle is opened; we were off and climbing in a scant few hundred feet, airspeed tape showing about 45 mph at liftoff and increasing to 65 in the climb. The normal climb attitude places the top of the panel on the horizon, making it easy to watch for traffic. Meanwhile, I could look straight down under my elbow through the door's bubble.

Adjusting to the right-hand Y-yoke isn't difficult; the CH 750's control forces are not hair-trigger light. Pitch response was the quickest axis, the roll control from the flaperons slightly less so and the rudder stiff but effective. I was assured that the nosegear steering would loosen up with use, which would lighten the feel of the rudder circuit. Leveling off at 2500 feet AGL, I played with lazy-eights, steep turns, slow flight and stalls, all comfortably handled.

The CH 750 tracked around the steep banks without losing more than a few mph of airspeed, and it hung on in slow flight at 45 mph with plenty of control. With the flaperons toggled down to max deflection, we could reach 35 mph IAS before the stall broke, and with flaps up we found the stall at 38 mph or so. Punching the yoke forward exited the stalls promptly, and with power applied we were back in business with minimal altitude loss.

Low and Slow's the Way to Go

Speed is not the CH 750's forte; Zenith's sleek low-wing Zodiac CH 650 would be the choice for that role. At 2500 rpm, we were showing 89 mph, not bad considering the bulged windows and draggy gear and struts. A quieter 2400 rpm still gave us 85 mph, and a fuel-sipping 2300 rpm showed 80 mph while burning less than 5 gph. To be fair, these numbers were attained at an inefficient low altitude with the Warp Drive prop, while the factory's 100-mph cruise figure was reportedly developed with the two-blade Sensenich. In either low-speed loiter or cross-country cruise, the CH 750 offers expansive visibility through a wall of windows. When banking into turns, we could watch the horizon through the skylight over the lowered wing while carving a slice of sky.

When we returned to the Mexico (Missouri) Airport, Dubbert introduced me to his private grass strip beside the north-south runway, an operating area more suited to the CH 750 than smooth pavement. The flaperons were lowered below 75 mph, the top of the white arc, and we set up final approach at a conservative 65 mph. Once the CH 750 is flared with power off, speed drops away quickly; we were down and stopped in the length of a football field. Takeoff rolls in the 6-inch-tall grass took no more than 300 feet, using about half flap. I could probably have tried harder and gotten off in one runway-light length.

The Zenith STOL CH 750 is a logically designed evolution of a well-proven design. Given the improved kit production techniques, it should go together in a predictable fashion, even more quickly than the CH 701. It serves in its low-and-slow role quite well, and it fits nicely between the 180-hp four-seat CH 801 and the lighter CH 701. The STOL CH 750 augments, rather than replaces, the other successful products. ✈

For more information, call 573/581-9000, or visit www.zenithair.com. Find a direct link at www.kitplanes.com.

Stoddard-Hamilton put itself on the map with the Glasair II series, but it was the 300-hp Glasair III that elevated its performance image.

1984 25 Years 2009

The Glasair–Lancair Wars

In the 1980s, the two biggest composite aircraft kit manufacturers sparred regularly. But the upside was the rapid development of the kits themselves.

BY MARC COOK

Development of composite aircraft in the 1980s was nothing short of phenomenal. After Burt Rutan kick-started the avant-garde phase of homebuilding in the 1970s, fiberglass aircraft came to be accepted as full-fledged members of the establishment. Across America, builders were sanding foam, scratching itches and smelling up the place with epoxies and resins.

By the mid-1980s, two of the major protagonists of the period would be up to full speed: Stoddard-Hamilton, which had been producing the Glasair line of two-seat kits since 1979 in Arlington, Washington, and newcomer Lancair, headed by Southern California-based graphics designer Lance Neibauer.

It must have been the competition of the time that made each company lock the other into the gunsights. The rivalry stood on differences of construction materials and methods, design aesthetics and, to be honest, more than a spoonful of ego. A fight that was borne by builders and salesmen also spilled into advertising and marketing materials; you would think each company had no other competitors than each other.

Different Philosophies

The Glasair started as a simple, rugged aircraft reflecting practical design philosophies. A squared-off fuselage and empennage is better from a structural point of view, but it's also boxy looking from certain angles, particularly in the early short-fuselage models. It also used an unusual, Mooney-style design, with the fuselage sitting on top of the one-piece wing.

Lancair's drive, under Neibauer's pen, was to emphasize graceful lines—the 235's wasp waist gave it a shrink-wrapped appearance, as though the fuselage had been drawn tight over an engine and two occupants.

Moreover, the Glasair used vinylester resin over various types of foam, cured at room temperature in conventional molds, following boat-making practice of the time. Lancair, perhaps with a slight advantage of arriving later to the game, used high-tech epoxy over honeycomb cores. It widely stated that these materials had a "strength to weight ratio...superior to common wet layup parts, and they are environmentally stable to +250° F." Then, as if to further drive home the point, the company painted its demonstrator aircraft lipstick red, which, of course, sent the conservative S-H crew into paroxysms of disbelief. (Most composite aircraft are white to reduce heat absorption and to keep the 'glass away from the "gooey" stage.) Stoddard responded that vinylester resins were easier to work with, less expensive and didn't risk the allergic reactions some builders had to epoxies.

Early on, the two companies in fact offered very different product. The original Lancair, which housed a Lycoming O-235, first in kit form, would soon take an O-320, was a trigear retractable from the start, and reflected Neibauer's focus on speed and efficiency. The Glasair line,

Photos: Richard VanderMeulen

conversely, broadened the offerings with fixed-gear trike and taildragger models as well as a retractable trike.

Through the 1980s, the companies leapfrogged each other with new models boasting more speed. Stoddard brought out the II series, which offered dramatically improved manufacturing and an increase in factory-built components. At the time, the company claimed a reduction in build time of 40% over the I. The II could also carry engines as large as a 180-horsepower IO-360, which helped close the gap to the quicker (by dint of being smaller) Lancair. Lancair, predictably, responded with an IO-360 of its own.

The Lancair 235 proved sleek, fast, compact and efficient—also, a bit of a handful for low-time pilots.

Stability Issues

We take it for granted that the majority of kit aircraft today have reasonable and appropriate handling qualities, but by the late 1980s, both the Glasair II and the Lancair 320/360 were gaining reputations as "hot rocks," with light pitch forces and marginal (by certified standards) trim stability. The issue came to a head in the early 1990s, when the Australian Civil Aviation Administration refused to "certify" the original Lancair design because it was deemed unstable.

Both companies eventually recognized that builders were coming from

TIMELINE DECEMBER 1984-OCTOBER 1985

DECEMBER 1984

Product News includes a description of the Petrel Flight Computer (a small keyboard with a one-line display across the top), which allows for storage of three (!) flight plans with up to 33 stopovers. Price: $695.

Don Downie profiles Dick VanGrunsven, of Van's Aircraft, and his RV-4 design. At the time, 500 RV-4 kits had been started, and 18 were flying. Even then, RV pilots flew in formation when arriving at shows.

JANUARY 1985

KITPLANES® goes monthly.

A hot topic is amendment of the FAA FARs to include a recreational Primary Aircraft category. Definition: single engine of less than 200 hp, fewer than four occupants, can't carry passengers for compensation, owners perform most maintenance, made from factory-supplied kits with a type certificate.

John Thorp looks back on a career that has spanned more than 50 years, and his designs are reviewed in several feature articles.

FEBRUARY 1985

Harry Zeisloft of EAA extols the virtues of lowering the cost of aviation by using auto fuel, saying that 79% of the aviation fleet is capable of using 80 octane.

Jim Bede offers a three-day seminar for those who are interested in the design of ultralight or homebuilt aircraft. Attendees will learn "design techniques, formulas, and secrets in drag reduction."

The Osprey 2 amphibian from designer George Pereira, meant to be built by a "skilled amateur," is reviewed.

MARCH 1985

Aircraft Spruce's 1984 catalog, at a whopping 290 pages, is available for order for $4. Jim Irwin is profiled at the AC facility in Fullerton, California, a former citrus packing plant.

Dan Denney's Kitfox, which made a big splash at the 1984 Los Angeles Recreational Aircraft Expo, is reviewed by Dave Martin. It resembled the Avid Flyer, because Denney helped design that airplane and developed the Kitfox after leaving the company.

The Prescott Pusher, of Wichita, Kansas, is advertised as an "easy on the budget purchase" with 195-mph cruise, four seats and retractable gear.

JULY 1985

A review of Burt Rutan's VariEze, one of few canard homebuilt designs, is described as "a sports car rather than a family sedan," in which a 6-foot-5 pilot "would have to remove his feet from the rudder pedals to stretch his legs."

Ray Stits discusses his synthetic fabric covering system, known as Poly-Fiber, which was tested on Stits' own homebuilt Playmate.

OCTOBER 1985

A letter to the editor laments the lack of specific flight performance information in the magazine's reviews, and says he wants to see "empty weight, engine choice, fixed or constant-speed prop, cruise speed at altitude, climb… takeoff distance and landing distance…." Message apparently received.

Burt Rutan announces that he has dropped the sale of all plans, citing the "cost of servicing builders' inquiries, declining plans sales and press of other business" as his main reasons for the decision. Rutan and Herb Iverson, owners of Scaled Composites, sold their R&D company to Beech Aircraft Corporation.

Stoddard-Hamilton announces that it will offer a basic Glasair kit for one-third the price of the original. The basic kit allows builders to buy standard aircraft hardware on their own and fabricate metal parts from standard stock according to templates and instructions supplied in the builder's manual.

Jim Weir offers readers an article on how to build a $10 headset, using readily available parts from "The Shack." (Which, at that time, actually carried electronics.)

Chris Heintz' CH-180 Zenair Super Acro Zenith is reviewed. The two-place metal kit airplane became a hit after being built in a week at Oshkosh 1976, using volunteer labor.

ranks other than, say, Pitts owners, and that stability profiles closer to certified aircraft were, ultimately, a good thing. (Although both companies fought the accusations until updated product was released.) Lancair developed a wider-span horizontal stabilizer and elevator that improved longitudinal stability, and also offered a longer engine mount that moved the empty C.G. forward.

Stoddard-Hamilton followed a similar path after stretching the II in 1989. By 1993, the state of the art was the Super II-S, a further stretched II (the fuselage was longer than the II-S by 6 inches) with the wing moved aft, having the effect of moving the empty C.G. forward, and a 30% larger horizontal stabilizer. The industry was maturing.

Moving Up

Both companies produced follow-on models that raised the performance bar. Stoddard unleashed the 300-hp III on the world in 1987—the prototype flew to Oshkosh in 1986—gracing our cover for the first time with the February 1987 issue. Lancair followed suit in 1990 with the remarkable IV, which finally ended the product development foot race the two companies had been in for the better part of a decade. Lancair staked out the high end (adding the IV-P and turbine variants), and S-H retooled into the more modest (and now nearly as numerous) GlaStar utility aircraft.

When you look back on this heated rivalry, remember it for more than the slightly outlandish potshots. These two companies advanced the art of composite aircraft—in design, sure, but more importantly in manufacturing. In their attempts to beat one another, Lancair and S-H both created new, more efficient manufacturing processes, and focused intently on making the designs easier and quicker to build (because more of your brand on the ramp will help sell future designs). Walk the fly-in parking at any airshow today, and early two-seat Glasairs and Lancairs will be seen in ones and twos, not by the dozens as was common in the late 1980s and early 1990s. But their impact on the market continues to be felt. ✢

Larry and Gene Smith of Valley Engineering/Culver Props pose with their neat little Part 103 legal Back Yard Flyer Swing-Wing ultralight.

The Back Yard Flyer...

...and the case of the TP vandals at Oshkosh. Revenge will be *sweet*.

BY DICK STARKS

"Hey!" Sharon cried. "Look over there at my plane! Someone's TP'd it." We were on the red tram to the north end of Wittman Field, heading toward the Replica Fighters Association (RFA) area where her Airdrome Aeroplanes Morane Saulnier "L" Parasol replica was on display. AirVenture 2008 was in full cry, and we were part of it this time.

We had put in one full day at AirVenture, but the endless walking at the show had already caused the onset of the dreaded ailment called "Oshkosh knee." We couldn't walk any more without staggering. This caused oncoming traffic to move to the other side of the street, because they thought two drunks were coming at them.

So Sweetie and I started using the trams on the second day as we traveled from the campground way down south by the ultralight/light plane area up to the north end of the grounds where her Morane was tied down.

Sharon stands with her vandalized Airdrome Aeroplanes Morane Saulnier "L" Parasol replica.

Sharon's Morane was getting a lot of attention, and as soon as she would go out to answer a question from one visitor, a crowd would gather to listen and ask their own questions. I guess there is something about a red-headed, freckle-faced cutie with her own WW-I warbird that lights a lot of men's fuses. (It sure lights *my* personal fuse.) Whatever it was, she was always surrounded by guys wanting to talk to her about her plane.

What Is That?

This time, as the tram went by the RFA area on its way to the next tram stop,

That freckle-faced redhead was always kept busy answering the many questions about the Morane and the Big Twin engine.

we noticed her plane was festooned with what looked like toilet paper. We couldn't believe it.

We got off the tram and thundered back to where the plane was tied down. Silently, we looked it over. Definitely toilet paper. Someone had gone to a lot of trouble to do this. The vandals had taken a considerable amount of pride in their work, too. Sweetie and I looked at each other and nodded our heads. We knew who had perpetrated this nefarious deed. At the same time we both said, "Butch and Rick."

Butch Witlock and Rick Bennett are two other members of The Dawn Patrol, who had both reported in the night before. They had said that they would go up to the RFA's display, and now we knew for sure they had made their arrival known.

Butch built and flew a Graham Lee Nieuport 12 for years. Then, out of the blue, he'd been bitten by the build-another-plane bug. He decided to go over to the dark side and build a German plane. Now he is building one of Robert Baslee's Airdrome Aeroplanes Fokker D-7 replicas. Butch did not like

Gene and Larry have just rolled the Back Yard Flyer out of its trailer/hangar.

Larry Smith (blue shirt) gets ready to rotate the wing on the Back Yard Flyer from its "stored" configuration to its ready-for- flight configuration.

Photos: Dick Starks

the idea of selling his 12 because of the liability issue, so he chose a much safer way of moving it on. The Nieuport 12 is now hanging proudly from the ceiling in the Illinois Aviation Museum in Bolingbrook.

That's half the team. The other half is Rick Bennett, the proud builder of one of the most beautiful Graham Lee Nieuport 23 replicas you'll ever see. He flies it all over the Midwest in airshows, too. Anyway, those two big knuckleheads are now on our we'll-get-even list.

Gene taxis in after another impressive demonstration flight.

The elevator/aileron/flap control mixing system developed by Gene and Larry is clever. As the stick is pulled back for a full-stall landing, the mixer adds about 15° of "flap" to each aileron. Full aileron control is still available when the flaps are actuated.

Low and Slow, and OK with It

We put in a few hours of talking about the Morane at the RFA's area and then headed back to where we really belonged. As far as we're concerned, low, slow and inexpensive is now our aviation world. We both talked it over, and when our FAA medicals expired, we became Sport Pilot fliers. We knew that as we became more mature, there was a chance we'd blow a medical for a non-serious reason, and with the Catch 22 that exists with the FAA concerning the Sport Pilot medical, we would be through flying for good. As Sport Pilots, the low-and-slow crowd was what we could afford anyway.

So it's not a big deal. We love low-and-slow flying, and it's inexpensive. As retired public school teachers we don't have the riches of Peru, and the cost of flying is a biggie!

Down to the light-plane area we went to see the design that really grabbed us by the nose: the Valley Engineering Back Yard Flyer Swing-Wing Ultralight. It's fully Part 103 legal.

When we first saw the plane, Gene and Larry Smith of Valley Engineering were pulling it out of a long trailer. We

6-foot-5 inch Scott Spangler tries out the fit of the Back Yard Flyer's cockpit. He admitted to being over Part 103 legal weight, but said it was one of the few planes he could be comfortable sitting in.

The Valley Engineering Big Twin 40-hp, four-stroke, two-cylinder engine. It comes fully equipped with starter, alternator, dual ignition systems, exclusive automatic carb heat, PSRU and Culver prop. The Big Twin was the winner of the Ultralight Innovation-Custom Powerplant award at AirVenture in 2006.

With a whole crowd of interested heads in the way, watching, the insertion and tightening of the four wing attach bolts took a little longer.

thought that they had just arrived at Oshkosh and were getting ready to set it up for flying. In a way, that is exactly what they were doing.

Three minutes later the plane was ready to go! Gene and Larry have developed a swing-wing concept that has to be seen to be believed. The wing rotates 90° on its vertical axis. After rotation, it takes about 2 minutes to attach the aileron linkage, bolt the wing in place with four wing attach bolts and you're ready to aviate. We were amazed.

It got to be almost comical seeing the expressions on people's faces as Gene and Larry would roll the plane up to the flight line in its "stored" configuration and then in the blink of an eye have it transformed into a plane ready to fly.

Potato, Potato

The Back Yard Flyer is pulled along by one of Valley Engineering's Harley-Davidson Big Twin, four-stroke, 40-horsepower engines. The engine comes with starter, alternator, automatic carb heat and a separate ignition system for each cylinder. Coupled with a Valley Engineering Series Three PSRU swinging a Culver Prop, you have an impressive combination of aircraft, engine, PSRU and prop. The Valley Engineering Big Twin firewall-forward package weighs 120 pounds complete and costs $4995.

The Back Yard Flyer Swing-Wing comes complete, ready-to-fly with a ballistic 'chute for $17,500. If you have trouble finding affordable hangar space, or any hangar space for that matter, you can get the plane with its own custom-designed trailer/hangar for a package price of $25,500.

There are Big Twin engines on Sweetie's Morane and her Kolb Twinstar MK II. Consequently, we have spent a lot of time with Gene and Larry at their plant in Rolla, Missouri. The Smiths, along with Robert Baslee's low-cost Airdrome Aeroplane replicas, are the main reasons we're still able to afford to fly.

The Big Twin comes at a reasonable price compared to a lot of similar powerplants. And it sips only 5 quarts of gas an hour. Add the fact that it's a reliable, slow turning, four-stroke engine, and you have a lot a peace of mind while in the air.

By the way, Alaina Lewis, Larry Smith's daughter, was the one that gave Rick and Butch the toilet paper. She's now on our list, too. Even better, we know where she lives! ✈

Resources

Airdrome Aeroplanes
www.airdromeaeroplanes.com

Culver Props
www.culverprops.com

The Kansas City Dawn Patrol
www.kcdawnpatrol.org

Valley Engineering
www.valleyengineeringllc.com

2009 Rotorcraft Buyer's Guide

COMPILED BY JULIA DOWNIE

No doubt you've noticed that our annual Light Sport and Rotorcraft Buyer's Guide has gone on Weight Watchers and slimmed down for this year. Actually, it's more surgery than diet. Our readers have said with near unanimity that store-bought, ready-to-fly Special Light Sport Aircraft are not of interest—we're here to *build*, you say—so we have ceased publishing a print version of the SLSA guide as of this issue. That leaves our Rotorcraft Buyer's Guide to stand alone, which it is more than capable of doing.

This year, the changes: Another Butterfly model has escaped chrysalis as the Aurora Butterfly. Air Command has a new gyro in the Elite Tandem 912. Innovator Technologies gains two designs (now at five total) with the Mosquito XE3 and XET. Finally, the Sport Copter has been replaced by the Sport Copter II. Missing from the list: All three American Sportscopter designs, plus RotorWay International has pulled the plug on the Exec because of the success of the much improved A600 Talon. Gyros that meet LSA rules are so noted; as you know, pure helicopters do not fit into Light Sport rules. Please report errors and omissions to *editorial@kitplanes.com*.

Key to the Buyer's Guide Codes

Not applicable	n.a.
Information was not provided	n.p.
Retractable gear	R
Composite	C
Metal	M
Wood	W
Tubing	T
Fabric	F
Meets the parameters of the Light-Sport Aircraft rule	LSA LEGAL

Air Command International, Inc.
Commander Elite 503

Cruise, mph	55	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	50
Stall, mph	n.a.	Empty/Gross Weight, lb.	278/590	No. Completed & Flown	4000
Range, s.m.	150	Length, ft.	10.8	Kit Cost	$18,000
Rate of Climb, fpm	900	Disk Span, ft.	n.p.	Estimated Completed Cost	$19K-$21K
Takeoff/Landing Distance, ft.	250/20	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	N/N
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50/40-72	Cockpit Width, in.	19	www.aircommand.com	LSA LEGAL
		Landing Gear	trigear	903/527-3335	
		Bldg. Materials	C, T		

Air Command International, Inc.
Commander Elite 582

Cruise, mph	65	Fuel Capacity, gal.	5/10	Beginner Build Time, hrs.	50
Stall, mph	n.a.	Empty/Gross Weight, lb.	275/750	No. Completed & Flown	4000
Range, s.m.	140/280	Length, ft.	10.8	Kit Cost	$20,280
Rate of Climb, fpm	900	Disk Span, ft.	n.p.	Estimated Completed Cost	$21K-$23K
Takeoff/Landing Distance, ft.	100/20	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	N/N
Engine Used	Rotax 582	No. of Seats	1		
HP/HP Range	65/40-72	Cockpit Width, in.	19	www.aircommand.com	LSA LEGAL
		Landing Gear	trigear	903/527-3335	
		Bldg. Materials	C, T		

Air Command International, Inc.
Commander Elite EJ22 Single Place

Cruise, mph	65	Fuel Capacity, gal.	5/10	Beginner Build Time, hrs.	40
Stall, mph	n.a.	Empty/Gross Weight, lb.	275/750	No. Completed & Flown	101
Range, s.m.	150/300	Length, ft.	10.8	Kit Cost	$17,500
Rate of Climb, fpm	1200	Disk Span, ft.	n.p.	Estimated Completed Cost	$15K-$25K
Takeoff/Landing Distance, ft.	200/20	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ22	No. of Seats	1		
HP/HP Range	130/100-135	Cockpit Width, in.	19	www.aircommand.com	LSA LEGAL
		Landing Gear	trigear	903/527-3335	
		Bldg. Materials	C, T		

Air Command International, Inc.
Commander Elite EJ22 Tandem

Cruise, mph	75	Fuel Capacity, gal.	15	Beginner Build Time, hrs.	100
Stall, mph	n.p.	Empty/Gross Weight, lb.	680/1155	No. Completed & Flown	101
Range, s.m.	400	Length, ft.	13.5	Kit Cost	$22,475
Rate of Climb, fpm	1200	Disk Span, ft.	29	Estimated Completed Cost	$30K-$50K
Takeoff/Landing Distance, ft.	100/20	Disk Area, sq. ft.	n.a.	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ22	No. of Seats	2T		
HP/HP Range	130/130-180	Cockpit Width, in.	19	www.aircommand.com	LSA LEGAL
		Landing Gear	trigear	903/527-3335	
		Bldg. Materials	C, T		

Air Command International, Inc.
Commander Elite Tandem 912

Cruise, mph	75	Fuel Capacity, gal.	20	Beginner Build Time, hrs.	100
Stall, mph	n.a.	Empty/Gross Weight, lb.	500/1155	No. Completed & Flown	2
Range, s.m.	350	Length, ft.	13.5	Kit Cost	$60,000
Rate of Climb, fpm	1200	Disk Span, ft.	29	Estimated Completed Cost	$60K-$70K
Takeoff/Landing Distance, ft.	100/20	Disk Area, sq. ft.	n.a.	Quickbuild/Plans Available	N/N
Engine Used	Rotax 912	No. of Seats	2T		
HP/HP Range	100/100-120	Cockpit Width, in.	19		
		Landing Gear	trigear	www.aircommand.com	LSA LEGAL
		Bldg. Materials	C, T	903/527-3335	

Aircraft Designs, Inc.
Bumble Bee

Cruise, mph	40	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	400
Stall, mph	n.a.	Empty/Gross Weight, lb.	213/500	No. Completed & Flown	15
Range, s.m.	70	Length, ft.	10	Kit Cost	n.p.
Rate of Climb, fpm	1500	Disk Span, ft.	23	Estimated Completed Cost	$3K-$5K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	415	Quickbuild/Plans Available	N/$250
Engine Used	Rotax 447	No. of Seats	1		
HP/HP Range	42	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.aircraftdesigns.com	LSA LEGAL
		Bldg. Materials	C, M, T	831/621-8760	

Aircraft Designs, Inc.
Sportster

Cruise, mph	75	Fuel Capacity, gal.	17	Beginner Build Time, hrs.	1500
Stall, mph	n.a.	Empty/Gross Weight, lb.	650/1100	No. Completed & Flown	67
Range, s.m.	170	Length, ft.	12	Kit Cost	n.p.
Rate of Climb, fpm	1000	Disk Span, ft.	28	Estimated Completed Cost	$6K-$20K
Takeoff/Landing Distance, ft.	700/n.p.	Disk Area, sq. ft.	616	Quickbuild/Plans Available	N/$535
Engine Used	Lycoming O-320	No. of Seats	2		
HP/HP Range	150/130-160	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.aircraftdesigns.com	LSA LEGAL
		Bldg. Materials	C, M, T	831/621-8760	

Barnett Rotorcraft
Barnett J4B-2

Cruise, mph	93	Fuel Capacity, gal.	17	Beginner Build Time, hrs.	500
Stall, mph	n.a.	Empty/Gross Weight, lb.	512/1085	No. Completed & Flown	187
Range, s.m.	230	Length, ft.	13.7	Kit Cost	$8850
Rate of Climb, fpm	500	Disk Span, ft.	27.3	Estimated Completed Cost	$19K-$39K
Takeoff/Landing Distance, ft.	300/0	Disk Area, sq. ft.	586	Quickbuild/Plans Available	Y/$195
Engine Used	Subaru EJ22	No. of Seats	2		
HP/HP Range	150/100-215	Cockpit Width, in.	24		
		Landing Gear	trigear	www.barnettrotorcraft.com	LSA LEGAL
		Bldg. Materials	F, T	530/742-7416	

Barnett Rotorcraft
BRC540 Coupe

Cruise, mph	110	Fuel Capacity, gal.	17.5	Beginner Build Time, hrs.	400
Stall, mph	n.a.	Empty/Gross Weight, lb.	625/1248	No. Completed & Flown	8
Range, s.m.	210	Length, ft.	14.5	Kit Cost (includes engine)	$58,000
Rate of Climb, fpm	800	Disk Span, ft.	29	Estimated Completed Cost	$30K-$60K
Takeoff/Landing Distance, ft.	300/0	Disk Area, sq. ft.	679	Quickbuild/Plans Available	Y/$210
Engine Used	Subaru EJ25	No. of Seats	2		
HP/HP Range	200/100-200	Cockpit Width, in.	44		
		Landing Gear	trigear	www.barnettrotorcraft.com	LSA LEGAL
		Bldg. Materials	C, F, T	530/742-7416	

Butterfly, L.L.C. (The)
Aurora Butterfly

Cruise, mph	70	Fuel Capacity, gal.	7.4	Beginner Build Time, hrs.	175
Stall, mph	n.a.	Empty/Gross Weight, lb.	485/900	No. Completed & Flown	1
Range, s.m.	75	Length, ft.	11.9	Kit Cost	$37,995
Rate of Climb, fpm	1000	Disk Span, ft.	26	Estimated Completed Cost	$40K-$45K
Takeoff/Landing Distance, ft.	150/0	Disk Area, sq. ft.	530	Quickbuild/Plans Available	N/N
Engine Used	Rotax 912S	No. of Seats	1		
HP/HP Range	100/100-115	Cockpit Width, in.	n.a.		
		Landing Gear	trigear	www.thebutterflyllc.com	LSA LEGAL
		Bldg. Materials	T`	940/433-2007	

Butterfly, L.L.C. (The)
Emperor Butterfly

Cruise, mph	60	Fuel Capacity, gal.	7.4	Beginner Build Time, hrs.	100
Stall, mph	n.a.	Empty/Gross Weight, lb.	280/530	No. Completed & Flown	4
Range, s.m.	60	Length, ft.	11.1	Kit Cost	$16,995
Rate of Climb, fpm	500	Disk Span, ft.	23	Estimated Completed Cost	$18K-$19K
Takeoff/Landing Distance, ft.	500/10	Disk Area, sq. ft.	415	Quickbuild/Plans Available	N/N
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.thebutterflyllc.com	LSA LEGAL
		Bldg. Materials	T	940/433-2007	

Butterfly, L.L.C. (The)
Golden Butterfly

Cruise, mph	75	Fuel Capacity, gal.	14.8	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	895/1330	No. Completed & Flown	3
Range, s.m.	70	Length, ft.	17.3	Kit Cost	$39,995
Rate of Climb, fpm	1500	Disk Span, ft.	31	Estimated Completed Cost	$43K-$49K
Takeoff/Landing Distance, ft.	500/30	Disk Area, sq. ft.	755	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ25	No. of Seats	2T		
HP/HP Range	190	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.thebutterflyllc.com	
		Bldg. Materials	T	940/433-2007	

Butterfly, L.L.C. (The)
Monarch Butterfly

Cruise, mph	60	Fuel Capacity, gal.	7.4	Beginner Build Time, hrs.	125
Stall, mph	n.a.	Empty/Gross Weight, lb.	350/630	No. Completed & Flown	19
Range, s.m.	75	Length, ft.	11.1	Kit Cost	$17,495
Rate of Climb, fpm	850	Disk Span, ft.	24	Estimated Completed Cost	$19K-$25K
Takeoff/Landing Distance, ft.	200/0	Disk Area, sq. ft.	452	Quickbuild/Plans Available	N/N
Engine Used	Rotax 582	No. of Seats	1		
HP/HP Range	65	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.thebutterflyllc.com	LSA LEGAL
		Bldg. Materials	T	940/433-2007	

Butterfly, L.L.C. (The)
Super Sky Cycle

Cruise, mph	70	Fuel Capacity, gal.	17.4	Beginner Build Time, hrs.	200
Stall, mph	n.a.	Empty/Gross Weight, lb.	650/950	No. Completed & Flown	1
Range, s.m.	150	Length, ft.	14.6	Kit Cost	$46,995
Rate of Climb, fpm	1000	Disk Span, ft.	27	Estimated Completed Cost	$50K-$60K
Takeoff/Landing Distance, ft.	200/0	Disk Area, sq. ft.	572	Quickbuild/Plans Available	N/N
Engine Used	Rotax 912	No. of Seats	1		
HP/HP Range	100/100-115	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.thebutterflyllc.com	LSA LEGAL
		Bldg. Materials	T	940/433-2007	

Butterfly, L.L.C. (The)
Turbo Golden

Cruise, mph	75	Fuel Capacity, gal.	14.8	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	1050/1850	No. Completed & Flown	1
Range, s.m.	60	Length, ft.	17.3	Kit Cost	$49,995
Rate of Climb, fpm	1500	Disk Span, ft.	31	Estimated Completed Cost	$53K-$55K
Takeoff/Landing Distance, ft.	500/30	Disk Area, sq. ft.	755	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ25 Turbo	No. of Seats	2T		
HP/HP Range	300	Cockpit Width, in.	n.a.		
		Landing Gear	trigear	www.thebutterflyllc.com	
		Bldg. Materials	T	940/433-2007	

CHR
Safari

Cruise, mph	85	Fuel Capacity, gal.	28	Beginner Build Time, hrs.	700
Stall, mph	n.a.	Empty/Gross Weight, lb.	1000/1500	No. Completed & Flown	130
Range, s.m.	290	Length, ft.	30	Kit Cost	$84,500
Rate of Climb, fpm	1000	Disk Span, ft.	26	Estimated Completed Cost	$90K-$135K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	530	Quickbuild/Plans Available	Y/$150
Engine Used	Lycoming O-320	No. of Seats	2		
HP/HP Range	160/160-180	Cockpit Width, in.	48		
		Landing Gear	skids	www.acehelicopter.com	
		Bldg. Materials	M, T	850/482-4141	

Eagle R&D, Ltd.
Helicycle

Cruise, mph	95	Fuel Capacity, gal.	21	Beginner Build Time, hrs.	400
Stall, mph	n.a.	Empty/Gross Weight, lb.	500/850	No. Completed & Flown	38
Range, s.m.	180	Length, ft.	20.9	Kit Cost	$36,500
Rate of Climb, fpm	900	Disk Span, ft.	21	Estimated Completed Cost	$40K-$45K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	340	Quickbuild/Plans Available	N/N
Engine Used	Solar Turbine	No. of Seats	1		
HP/HP Range	90 hp (de-rated)	Cockpit Width, in.	28		
		Landing Gear	skids	www.helicycle.com	
		Bldg. Materials	C	208/466-4120	

Groen Brothers Aviation's American Autogyro
SparrowHawk III Gyroplane

Cruise, mph	75	Fuel Capacity, gal.	23	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	900/1500	No. Completed & Flown	44
Range, s.m.	225	Length, ft.	12.3	Kit Cost	$45,500
Rate of Climb, fpm	650	Disk Span, ft.	30.1	Estimated Completed Cost	$46K-$60K
Takeoff/Landing Distance, ft.	500/30	Disk Area, sq. ft.	707	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ25	No. of Seats	2		
HP/HP Range	165	Cockpit Width, in.	44		
		Landing Gear	trigear	www.americanautogyro.com	
		Bldg. Materials	C, T	801/973-0177	

Gyro-Kopp-Ters
Midnight Hawk

Cruise, mph	60	Fuel Capacity, gal.	16	Beginner Build Time, hrs.	60
Stall, mph	n.a.	Empty/Gross Weight, lb.	510/810	No. Completed & Flown	12
Range, s.m.	170	Length, ft.	12.3	Kit Cost	$11,500
Rate of Climb, fpm	600	Disk Span, ft.	25	Estimated Completed Cost	$12K-$15K
Takeoff/Landing Distance, ft.	100/50	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	Y/N
Engine Used	Subaru EA82 SPFI	No. of Seats	1		
HP/HP Range	90	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.gyro-kopp-ters.com	LSA LEGAL
		Bldg. Materials	M, T	386/752-9116	

Gyro-Kopp-Ters
Twin Eagle

Cruise, mph	55	Fuel Capacity, gal.	16	Beginner Build Time, hrs.	120
Stall, mph	n.a.	Empty/Gross Weight, lb.	750/1210	No. Completed & Flown	3
Range, s.m.	170	Length, ft.	14.8	Kit Cost	$16,500
Rate of Climb, fpm	800	Disk Span, ft.	28	Estimated Completed Cost	$17K-$21K
Takeoff/Landing Distance, ft.	100/50	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ22	No. of Seats	2T		
HP/HP Range	130	Cockpit Width, in.	30		
		Landing Gear	trigear	www.gyro-kopp-ters.com	LSA LEGAL
		Bldg. Materials	M, T	386/752-9116	

Helo Werks, Inc.
HX-2 Wasp

Cruise, mph	81	Fuel Capacity, gal.	20	Beginner Build Time, hrs.	350
Stall, mph	n.a.	Empty/Gross Weight, lb.	675/1250	No. Completed & Flown	2
Range, s.m.	123	Length, ft.	19	Kit Cost	$90,000
Rate of Climb, fpm	1225	Disk Span, ft.	23	Estimated Completed Cost	$90K-$100K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	415	Quickbuild/Plans Available	N/N
Engine Used	AirResearch JFS-100	No. of Seats	2		
HP/HP Range	100/100-125	Cockpit Width, in.	49		
		Landing Gear	skid	www.helowerks.com	
		Bldg. Materials	C,T	757/342-6982	

Innovator Technologies
Mosquito Air

Cruise, mph	60	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	253/530	No. Completed & Flown	20
Range, s.m.	60	Length, ft.	20	Kit Cost	$25,000
Rate of Climb, fpm	1000	Disk Span, ft.	18	Estimated Completed Cost	$25K-$31K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	254	Quickbuild/Plans Available	N/N
Engine Used	CRE MZ202	No. of Seats	1		
HP/HP Range	60	Cockpit Width, in.	n.p.		
		Landing Gear	skids	www.innovatortech.ca	
		Bldg. Materials	C, M	403/669-3101	

Innovator Technologies
Mosquito XE

Cruise, mph	70	Fuel Capacity, gal.	12	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	298/610	No. Completed & Flown	22
Range, s.m.	150	Length, ft.	22	Kit Cost	$29,000
Rate of Climb, fpm	1000	Disk Span, ft.	19.5	Estimated Completed Cost	$29K-$37K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	299	Quickbuild/Plans Available	N/N
Engine Used	CRE MZ202	No. of Seats	1		
HP/HP Range	60	Cockpit Width, in.	28		
		Landing Gear	skids	www.innovatortech.ca	
		Bldg. Materials	C, M	403/669-3101	

Innovator Technologies
Mosquito XE3

Cruise, mph	80	Fuel Capacity, gal.	12	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	360/720	No. Completed & Flown	2
Range, s.m.	150	Length, ft.	21	Kit Cost (includes engine)	$34,000
Rate of Climb, fpm	1000	Disk Span, ft.	19.5	Estimated Completed Cost	$34K-$44K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	298	Quickbuild/Plans Available	Y/N
Engine Used	CRE MZ301	No. of Seats	1		
HP/HP Range	85/60-90	Cockpit Width, in.	30		
		Landing Gear	skids	www.innovatortech.ca	
		Bldg. Materials	M	403/669-3101	

Innovator Technologies
Mosquito XEL

Cruise, mph	65	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	250
Stall, mph	n.a.	Empty/Gross Weight, lb.	312/580	No. Completed & Flown	12
Range, s.m.	60	Length, ft.	22	Kit Cost	$30,000
Rate of Climb, fpm	1000	Disk Span, ft.	19.5	Estimated Completed Cost	$30K-$38K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	299	Quickbuild/Plans Available	N/N
Engine Used	CRE MZ202	No. of Seats	1		
HP/HP Range	64	Cockpit Width, in.	28		
		Landing Gear	skids	www.innovatortech.ca	
		Bldg. Materials	C, M	403/669-3101	

Innovator Technologies
Mosquito XET

Cruise, mph	80	Fuel Capacity, gal.	12	Beginner Build Time, hrs.	400
Stall, mph	n.a.	Empty/Gross Weight, lb.	433/820	No. Completed & Flown	2
Range, s.m.	160	Length, ft.	21	Kit Cost	$36,000
Rate of Climb, fpm	1000	Disk Span, ft.	19.5	Estimated Completed Cost	$43K-$46K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	298	Quickbuild/Plans Available	Y/N
Engine Used	Solar T62-2A1	No. of Seats	1		
HP/HP Range	90/60-90	Cockpit Width, in.	30		
		Landing Gear	skids	www.innovatortech.ca	
		Bldg. Materials	C	403/669-3101	

Little Wing Autogyros, Inc.
LW-3

Cruise, mph	75	Fuel Capacity, gal.	8.5	Beginner Build Time, hrs.	1000
Stall, mph	n.a.	Empty/Gross Weight, lb.	351/750	No. Completed & Flown	10
Range, s.m.	150	Length, ft.	18	Kit Cost (includes engine)	$25,000
Rate of Climb, fpm	1000	Disk Span, ft.	27	Estimated Completed Cost	$10K-$40K
Takeoff/Landing Distance, ft.	500/20	Disk Area, sq. ft.	573	Quickbuild/Plans Available	N/$175
Engine Used	Rotec Radial	No. of Seats	1		
HP/HP Range	110/50-115	Cockpit Width, in.	26		
		Landing Gear	tailwheel	www.littlewingautogyro.com	LSA LEGAL
		Bldg. Materials	F, M, T	email: rotopup@aol.com	

Little Wing Autogyros, Inc.
LW-4

Cruise, mph	75	Fuel Capacity, gal.	13.5	Beginner Build Time, hrs.	1000
Stall, mph	n.a.	Empty/Gross Weight, lb.	520/1100	No. Completed & Flown	2
Range, s.m.	200	Length, ft.	18	Kit Cost	$35,000
Rate of Climb, fpm	600	Disk Span, ft.	27	Estimated Completed Cost	$35K-$75K
Takeoff/Landing Distance, ft.	300/10	Disk Area, sq. ft.	573	Quickbuild/Plans Available	N/$175
Engine Used	Rotax 912	No. of Seats	2		
HP/HP Range	100/90-150	Cockpit Width, in.	26		
		Landing Gear	tailwheel	www.littlewingautogyro.com	LSA LEGAL
		Bldg. Materials	F, M, T	email: rotopup@aol.com	

Little Wing Autogyros, Inc.
LW-5

Cruise, mph	90	Fuel Capacity, gal.	28	Beginner Build Time, hrs.	1000
Stall, mph	n.a.	Empty/Gross Weight, lb.	550/1100	No. Completed & Flown	2
Range, s.m.	450	Length, ft.	16	Kit Cost	$35,000
Rate of Climb, fpm	1000	Disk Span, ft.	28	Estimated Completed Cost	$35K-$75K
Takeoff/Landing Distance, ft.	300/20	Disk Area, sq. ft.	615.7	Quickbuild/Plans Available	N/$175
Engine Used	Rotax 914	No. of Seats	2		
HP/HP Range	115/50-115	Cockpit Width, in.	26		
		Landing Gear	tailwheel	www.littlewingautogyro.com	LSA LEGAL
		Bldg. Materials	F, M, T	email: rotopup@aol.com	

Magni USA, L.L.C.
M-14

Cruise, mph	90	Fuel Capacity, gal.	13	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	547/1212	No. Completed & Flown	100
Range, s.m.	170	Length, ft.	13	Kit Cost	$75,000
Rate of Climb, fpm	950	Disk Span, ft.	28	Estimated Completed Cost	$76K-$79K
Takeoff/Landing Distance, ft.	230/25	Disk Area, sq. ft.	615	Quickbuild/Plans Available	N/N
Engine Used	Rotax 912/914	No. of Seats	2T		
HP/HP Range	100/100-115	Cockpit Width, in.	20		
		Landing Gear	trigear	www.magnigyro.com	LSA LEGAL
		Bldg. Materials	C, T	573/883-3541	

Magni USA, L.L.C.
M-16/M-22

Cruise, mph	90	Fuel Capacity, gal.	19	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	595/1212	No. Completed & Flown	450
Range, s.m.	240	Length, ft.	15.3	Kit Cost	$75,000
Rate of Climb, fpm	950	Disk Span, ft.	28	Estimated Completed Cost	$76K-$78K
Takeoff/Landing Distance, ft.	230/25	Disk Area, sq. ft.	615	Quickbuild/Plans Available	N/N
Engine Used	Rotax 912/914	No. of Seats	2T		
HP/HP Range	100/100-115	Cockpit Width, in.	21		
		Landing Gear	trigear	www.magnigyro.com	LSA LEGAL
		Bldg. Materials	C, T	573/883-3541	

Magni USA, L.L.C.
M-18

Cruise, mph	70	Fuel Capacity, gal.	9	Beginner Build Time, hrs.	250
Stall, mph	n.a.	Empty/Gross Weight, lb.	368/771	No. Completed & Flown	40
Range, s.m.	130	Length, ft.	14.8	Kit Cost	$38,000
Rate of Climb, fpm	650	Disk Span, ft.	24	Estimated Completed Cost	$39K-$40K
Takeoff/Landing Distance, ft.	150/25	Disk Area, sq. ft.	452	Quickbuild/Plans Available	N/N
Engine Used	Rotax 582	No. of Seats	1		
HP/HP Range	65	Cockpit Width, in.	19		
		Landing Gear	trigear	www.magnigyro.com	LSA LEGAL
		Bldg. Materials	C, T	573/883-3541	

Raven RotorCraft Inc.
Raven Lite

Cruise, mph	60
Stall, mph	n.a.
Range, s.m.	130
Rate of Climb, fpm	500
Takeoff/Landing Distance, ft.	150/50
Engine Used	Raven 1000 ULXX
HP/HP Range	55/45-65
Fuel Capacity, gal.	5
Empty/Gross Weight, lb.	254/504
Length, ft.	15
Disk Span, ft.	23
Disk Area, sq. ft.	414
No. of Seats	1
Cockpit Width, in.	24
Landing Gear	tailwheel
Bldg. Materials	C, M, T
Beginner Build Time, hrs.	100
No. Completed & Flown	1
Kit Cost	$9995
Estimated Completed Cost	$14K-$16K
Quickbuild/Plans Available	N/N

www.raven-rotor.com
303/440-6234

LSA LEGAL

RotorWay International
A600 Talon

Cruise, mph	100
Stall, mph	n.a.
Range, s.m.	200
Rate of Climb, fpm	1000
Takeoff/Landing Distance, ft.	0/0
Engine Used	R.I. 600S
HP/HP Range	167
/147-167	
Fuel Capacity, gal.	17
Empty/Gross Weight, lb.	965/1500
Length, ft.	29.5
Disk Span, ft.	25
Disk Area, sq. ft.	491
No. of Seats	2
Cockpit Width, in.	44
Landing Gear	skids
Bldg. Materials	C, M, T
Beginner Build Time, hrs.	600
No. Completed & Flown	10
Kit Cost	$97,700
Estimated Completed Cost	$105K-$110K
Quickbuild/Plans Available	N/N

www.rotorway.com
480/961-1001

Sport Copter, Inc.
Lightning

Cruise, mph	50
Stall, mph	n.a.
Range, s.m.	50
Rate of Climb, fpm	1000
Takeoff/Landing Distance, ft.	200/0
Engine Used	Rotax 503
HP/HP Range	46/30-70
Fuel Capacity, gal.	5
Empty/Gross Weight, lb.	252/600
Length, ft.	11
Disk Span, ft.	23
Disk Area, sq. ft.	415.3
No. of Seats	1
Cockpit Width, in.	n.p.
Landing Gear	trigear
Bldg. Materials	C, M, T
Beginner Build Time, hrs.	60
No. Completed & Flown	68
Kit Cost	$16,189
Estimated Completed Cost	$22K-$29K
Quickbuild/Plans Available	N/N

www.sportcopter.com
503/543-7000

LSA LEGAL

Sport Copter, Inc.
Sport Copter II

Cruise, mph	100
Stall, mph	n.a.
Range, s.m.	300
Rate of Climb, fpm	1000
Takeoff/Landing Distance, ft.	100/20
Engine Used	Lycoming IO-360
HP/HP Range	200/180-250
Fuel Capacity, gal.	28
Empty/Gross Weight, lb.	1000/1650
Length, ft.	14.5
Disk Span, ft.	31
Disk Area, sq. ft.	n.p.
No. of Seats	2
Cockpit Width, in.	49.5
Landing Gear	trigear
Bldg. Materials	C, M, T
Beginner Build Time, hrs.	200
No. Completed & Flown	1
Kit Cost	$59,995
Estimated Completed Cost	$82K-$105K
Quickbuild/Plans Available	N/N

www.sportcopter.com
503/543-7000

Sport Copter, Inc.
Vortex

Cruise, mph	75	Fuel Capacity, gal.	8.5	Beginner Build Time, hrs.	160
Stall, mph	n.a.	Empty/Gross Weight, lb.	420/760	No. Completed & Flown	223
Range, s.m.	100	Length, ft.	12	Kit Cost	$22,801
Rate of Climb, fpm	700	Disk Span, ft.	25	Estimated Completed Cost	$32K-$37K
Takeoff/Landing Distance, ft.	50/0	Disk Area, sq. ft.	490.8	Quickbuild/Plans Available	N/N
Engine Used	Rotax 582	No. of Seats	1		
HP/HP Range	67/67-115	Cockpit Width, in.	n.p.		
		Landing Gear	tri with tail	www.sportcopter.com	LSA LEGAL
		Bldg. Materials	C, M, T, W	503/543-7000	

Star Bee Gyros
Gyrobee

Cruise, mph	55	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	150
Stall, mph	n.a.	Empty/Gross Weight, lb.	254/485	No. Completed & Flown	40
Range, s.m.	75	Length, ft.	12	Kit Cost (includes engine)	$14,595
Rate of Climb, fpm	600	Disk Span, ft.	22	Estimated Completed Cost	$10K-$18K
Takeoff/Landing Distance, ft.	400/50	Disk Area, sq. ft.	490	Quickbuild/Plans Available	N/N
Engine Used	MZ 202	No. of Seats	1		
HP/HP Range	55/40-60	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.starbeegyros.com	LSA LEGAL
		Bldg. Materials	T	803/663-1052	

Vertical Aviation Technologies
Hummingbird 260L

Cruise, mph	90	Fuel Capacity, gal.	57	Beginner Build Time, hrs.	1200
Stall, mph	n.a.	Empty/Gross Weight, lb.	1750/2700	No. Completed & Flown	39
Range, s.m.	375	Length, ft.	30	Kit Cost (includes engine)	$170,520
Rate of Climb, fpm	1250	Disk Span, ft.	33	Estimated Completed Cost	$175K-$225K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	855	Quickbuild/Plans Available	N/N
Engine Used	Lycoming O-435	No. of Seats	4		
HP/HP Range	265	Cockpit Width, in.	60		
		Landing Gear	quadricycle	www.vertical-aviation.com	
		Bldg. Materials	C, M	407/322-9488	

Vortech, Inc.
A/W 95 Helicopter

Cruise, mph	60	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	250
Stall, mph	n.a.	Empty/Gross Weight, lb.	272/500	No. Completed & Flown	7
Range, s.m.	90	Length, ft.	15	Kit Cost	$22,995
Rate of Climb, fpm	1000	Disk Span, ft.	19.5	Estimated Completed Cost	$24K-$26K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	298	Quickbuild/Plans Available	N/$100-$108
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50/50-75	Cockpit Width, in.	n.p.		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
G-1

Cruise, mph	50	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	150
Stall, mph	n.a.	Empty/Gross Weight, lb.	150/420	No. Completed & Flown	14
Range, s.m.	90	Length, ft.	12	Kit Cost	$16,995
Rate of Climb, fpm	900	Disk Span, ft.	12	Estimated Completed Cost	$18K-$19K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	113	Quickbuild/Plans Available	N/$34.95
Engine Used	Kawasaki 440	No. of Seats	1		
HP/HP Range	42/42-55	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
Hot Rod Helicopter

Cruise, mph	90	Fuel Capacity, gal.	18.5	Beginner Build Time, hrs.	600
Stall, mph	n.a.	Empty/Gross Weight, lb.	1000/1350	No. Completed & Flown	2
Range, s.m.	210	Length, ft.	20	Kit Cost	n.p.
Rate of Climb, fpm	1000	Disk Span, ft.	25	Estimated Completed Cost	n.p.
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	491	Quickbuild/Plans Available	N/$233-$245
Engine Used	Subaru EJ25	No. of Seats	1		
HP/HP Range	165	Cockpit Width, in.	n.p.		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	C, T	410/668-2757	

Vortech, Inc.
Kestrel Jet Helicopter

Cruise, mph	55	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	250
Stall, mph	n.a.	Empty/Gross Weight, lb.	170/425	No. Completed & Flown	9
Range, s.m.	20	Length, ft.	12	Kit Cost	$15,995
Rate of Climb, fpm	1000	Disk Span, ft.	25	Estimated Completed Cost	$17K-$18K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	491	Quickbuild/Plans Available	N/$26.95
Engine Used	G8-2-20 jets (2)	No. of Seats	1		
HP/HP Range	36/36-60	Cockpit Width, in.	22		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	M, T	410/668-2757	

Vortech, Inc.
New Choppy

Cruise, mph	65	Fuel Capacity, gal.	6	Beginner Build Time, hrs.	250
Stall, mph	n.a.	Empty/Gross Weight, lb.	285/630	No. Completed & Flown	5
Range, s.m.	120	Length, ft.	15	Kit Cost	$29,995
Rate of Climb, fpm	950	Disk Span, ft.	21	Estimated Completed Cost	$31K-$33K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	346	Quickbuild/Plans Available	N/$58
Engine Used	Hirth 3203	No. of Seats	1		
HP/HP Range	65/55-75	Cockpit Width, in.	23		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
New Choppy Ultralight

Cruise, mph	55	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	200
Stall, mph	n.a.	Empty/Gross Weight, lb.	254/500	No. Completed & Flown	4
Range, s.m.	120	Length, ft.	15	Kit Cost	$22,995
Rate of Climb, fpm	900	Disk Span, ft.	21	Quickbuild/Plans Available	N/$52-$58
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	346	www.prismz.com/helio	
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50/45-60	Cockpit Width, in.	n.p.		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
Shadow

Cruise, mph	70	Fuel Capacity, gal.	12	Beginner Build Time, hrs.	350
Stall, mph	n.a.	Empty/Gross Weight, lb.	750/1290	No. Completed & Flown	6
Range, s.m.	170	Length, ft.	13	Kit Cost	$19,995
Rate of Climb, fpm	1500	Disk Span, ft.	29	Estimated Completed Cost	$28K-$33K
Takeoff/Landing Distance, ft.	100/25	Disk Area, sq. ft.	660	Quickbuild/Plans Available	N/N
Engine Used	Lycoming 0-360	No. of Seats	2		
HP/HP Range	150/150-230	Cockpit Width, in.	48		
		Landing Gear	trigear	www.prismz.com/helio	
		Bldg. Materials	C, M, T	410/668-2757	

Vortech, Inc.
Skylark Helicopter

Cruise, mph	70	Fuel Capacity, gal.	8	Beginner Build Time, hrs.	350
Stall, mph	n.a.	Empty/Gross Weight, lb.	350/700	No. Completed & Flown	6
Range, s.m.	120	Length, ft.	17.5	Kit Cost	$31,795
Rate of Climb, fpm	1000	Disk Span, ft.	19	Estimated Completed Cost	$33K-$34K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	283	Quickbuild/Plans Available	N/$81
Engine Used	Hirth 3503	No. of Seats	1		
HP/HP Range	70	Cockpit Width, in.	26		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
Sparrow

Cruise, mph	60	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	150
Stall, mph	n.a.	Empty/Gross Weight, lb.	254/500	No. Completed & Flown	6
Range, s.m.	90	Length, ft.	9	Kit Cost	$3795 (partial)
Rate of Climb, fpm	900	Disk Span, ft.	23	Estimated Completed Cost	$9K-$11K
Takeoff/Landing Distance, ft.	100/50	Disk Area, sq. ft.	415	Quickbuild/Plans Available	N/N
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50/50-60	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.prismz.com/helio	LSA LEGAL
		Bldg. Materials	C, T	410/668-2757	

2009 Rotorcraft Buyer's Guide

COMPILED BY JULIA DOWNIE

No doubt you've noticed that our annual Light Sport and Rotorcraft Buyer's Guide has gone on Weight Watchers and slimmed down for this year. Actually, it's more surgery than diet. Our readers have said with near unanimity that store-bought, ready-to-fly Special Light Sport Aircraft are not of interest—we're here to *build*, you say—so we have ceased publishing a print version of the SLSA guide as of this issue. That leaves our Rotorcraft Buyer's Guide to stand alone, which it is more than capable of doing.

This year, the changes: Another Butterfly model has escaped chrysalis as the Aurora Butterfly. Air Command has a new gyro in the Elite Tandem 912. Innovator Technologies gains two designs (now at five total) with the Mosquito XE3 and XET. Finally, the Sport Copter has been replaced by the Sport Copter II. Missing from the list: All three American Sportscopter designs, plus RotorWay International has pulled the plug on the Exec because of the success of the much improved A600 Talon. Gyros that meet LSA rules are so noted; as you know, pure helicopters do not fit into Light Sport rules. Please report errors and omissions to *editorial@kitplanes.com*.

Key to the Buyer's Guide Codes

Not applicable	n.a.
Information was not provided	n.p.
Retractable gear	R
Composite	C
Metal	M
Wood	W
Tubing	T
Fabric	F
Meets the parameters of the Light-Sport Aircraft rule	LSA LEGAL

Air Command International, Inc.
Commander Elite 503

Cruise, mph	55	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	50
Stall, mph	n.a.	Empty/Gross Weight, lb.	278/590	No. Completed & Flown	4000
Range, s.m.	150	Length, ft.	10.8	Kit Cost	$18,000
Rate of Climb, fpm	900	Disk Span, ft.	n.p.	Estimated Completed Cost	$19K-$21K
Takeoff/Landing Distance, ft.	250/20	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	N/N
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50/40-72	Cockpit Width, in.	19	www.aircommand.com	LSA LEGAL
		Landing Gear	trigear	903/527-3335	
		Bldg. Materials	C, T		

Air Command International, Inc.
Commander Elite 582

Cruise, mph	65	Fuel Capacity, gal.	5/10	Beginner Build Time, hrs.	50
Stall, mph	n.a.	Empty/Gross Weight, lb.	275/750	No. Completed & Flown	4000
Range, s.m.	140/280	Length, ft.	10.8	Kit Cost	$20,280
Rate of Climb, fpm	900	Disk Span, ft.	n.p.	Estimated Completed Cost	$21K-$23K
Takeoff/Landing Distance, ft.	100/20	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	N/N
Engine Used	Rotax 582	No. of Seats	1		
HP/HP Range	65/40-72	Cockpit Width, in.	19	www.aircommand.com	LSA LEGAL
		Landing Gear	trigear	903/527-3335	
		Bldg. Materials	C, T		

Air Command International, Inc.
Commander Elite EJ22 Single Place

Cruise, mph	65	Fuel Capacity, gal.	5/10	Beginner Build Time, hrs.	40
Stall, mph	n.a.	Empty/Gross Weight, lb.	275/750	No. Completed & Flown	101
Range, s.m.	150/300	Length, ft.	10.8	Kit Cost	$17,500
Rate of Climb, fpm	1200	Disk Span, ft.	n.p.	Estimated Completed Cost	$15K-$25K
Takeoff/Landing Distance, ft.	200/20	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ22	No. of Seats	1		
HP/HP Range	130/100-135	Cockpit Width, in.	19	www.aircommand.com	LSA LEGAL
		Landing Gear	trigear	903/527-3335	
		Bldg. Materials	C, T		

Air Command International, Inc.
Commander Elite EJ22 Tandem

Cruise, mph	75	Fuel Capacity, gal.	15	Beginner Build Time, hrs.	100
Stall, mph	n.p.	Empty/Gross Weight, lb.	680/1155	No. Completed & Flown	101
Range, s.m.	400	Length, ft.	13.5	Kit Cost	$22,475
Rate of Climb, fpm	1200	Disk Span, ft.	29	Estimated Completed Cost	$30K-$50K
Takeoff/Landing Distance, ft.	100/20	Disk Area, sq. ft.	n.a.	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ22	No. of Seats	2T		
HP/HP Range	130/130-180	Cockpit Width, in.	19	www.aircommand.com	LSA LEGAL
		Landing Gear	trigear	903/527-3335	
		Bldg. Materials	C, T		

Air Command International, Inc.
Commander Elite Tandem 912

Cruise, mph	75	Fuel Capacity, gal.	20	Beginner Build Time, hrs.	100
Stall, mph	n.a.	Empty/Gross Weight, lb.	500/1155	No. Completed & Flown	2
Range, s.m.	350	Length, ft.	13.5	Kit Cost	$60,000
Rate of Climb, fpm	1200	Disk Span, ft.	29	Estimated Completed Cost	$60K-$70K
Takeoff/Landing Distance, ft.	100/20	Disk Area, sq. ft.	n.a.	Quickbuild/Plans Available	N/N
Engine Used	Rotax 912	No. of Seats	2T		
HP/HP Range	100/100-120	Cockpit Width, in.	19		
		Landing Gear	trigear	www.aircommand.com	
		Bldg. Materials	C, T	903/527-3335	

Aircraft Designs, Inc.
Bumble Bee

Cruise, mph	40	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	400
Stall, mph	n.a.	Empty/Gross Weight, lb.	213/500	No. Completed & Flown	15
Range, s.m.	70	Length, ft.	10	Kit Cost	n.p.
Rate of Climb, fpm	1500	Disk Span, ft.	23	Estimated Completed Cost	$3K-$5K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	415	Quickbuild/Plans Available	N/$250
Engine Used	Rotax 447	No. of Seats	1		
HP/HP Range	42	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.aircraftdesigns.com	
		Bldg. Materials	C, M, T	831/621-8760	

Aircraft Designs, Inc.
Sportster

Cruise, mph	75	Fuel Capacity, gal.	17	Beginner Build Time, hrs.	1500
Stall, mph	n.a.	Empty/Gross Weight, lb.	650/1100	No. Completed & Flown	67
Range, s.m.	170	Length, ft.	12	Kit Cost	n.p.
Rate of Climb, fpm	1000	Disk Span, ft.	28	Estimated Completed Cost	$6K-$20K
Takeoff/Landing Distance, ft.	700/n.p.	Disk Area, sq. ft.	616	Quickbuild/Plans Available	N/$535
Engine Used	Lycoming 0-320	No. of Seats	2		
HP/HP Range	150/130-160	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.aircraftdesigns.com	
		Bldg. Materials	C, M, T	831/621-8760	

Barnett Rotorcraft
Barnett J4B-2

Cruise, mph	93	Fuel Capacity, gal.	17	Beginner Build Time, hrs.	500
Stall, mph	n.a.	Empty/Gross Weight, lb.	512/1085	No. Completed & Flown	187
Range, s.m.	230	Length, ft.	13.7	Kit Cost	$8850
Rate of Climb, fpm	500	Disk Span, ft.	27.3	Estimated Completed Cost	$19K-$39K
Takeoff/Landing Distance, ft.	300/0	Disk Area, sq. ft.	586	Quickbuild/Plans Available	Y/$195
Engine Used	Subaru EJ22	No. of Seats	2		
HP/HP Range	150/100-215	Cockpit Width, in.	24		
		Landing Gear	trigear	www.barnettrotorcraft.com	
		Bldg. Materials	F, T	530/742-7416	

Barnett Rotorcraft
BRC540 Coupe

Cruise, mph	110	Fuel Capacity, gal.	17.5	Beginner Build Time, hrs.	400
Stall, mph	n.a.	Empty/Gross Weight, lb.	625/1248	No. Completed & Flown	8
Range, s.m.	210	Length, ft.	14.5	Kit Cost (includes engine)	$58,000
Rate of Climb, fpm	800	Disk Span, ft.	29	Estimated Completed Cost	$30K-$60K
Takeoff/Landing Distance, ft.	300/0	Disk Area, sq. ft.	679	Quickbuild/Plans Available	Y/$210
Engine Used	Subaru EJ25	No. of Seats	2		
HP/HP Range	200/100-200	Cockpit Width, in.	44		
		Landing Gear	trigear	www.barnettrotorcraft.com	
		Bldg. Materials	C, F, T	530/742-7416	

Butterfly, L.L.C. (The)
Aurora Butterfly

Cruise, mph	70	Fuel Capacity, gal.	7.4	Beginner Build Time, hrs.	175
Stall, mph	n.a.	Empty/Gross Weight, lb.	485/900	No. Completed & Flown	1
Range, s.m.	75	Length, ft.	11.9	Kit Cost	$37,995
Rate of Climb, fpm	1000	Disk Span, ft.	26	Estimated Completed Cost	$40K-$45K
Takeoff/Landing Distance, ft.	150/0	Disk Area, sq. ft.	530	Quickbuild/Plans Available	N/N
Engine Used	Rotax 912S	No. of Seats	1		
HP/HP Range	100/100-115	Cockpit Width, in.	n.a.		
		Landing Gear	trigear	www.thebutterflyllc.com	
		Bldg. Materials	T`	940/433-2007	

Butterfly, L.L.C. (The)
Emperor Butterfly

Cruise, mph	60	Fuel Capacity, gal.	7.4	Beginner Build Time, hrs.	100
Stall, mph	n.a.	Empty/Gross Weight, lb.	280/530	No. Completed & Flown	4
Range, s.m.	60	Length, ft.	11.1	Kit Cost	$16,995
Rate of Climb, fpm	500	Disk Span, ft.	23	Estimated Completed Cost	$18K-$19K
Takeoff/Landing Distance, ft.	500/10	Disk Area, sq. ft.	415	Quickbuild/Plans Available	N/N
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.thebutterflyllc.com	
		Bldg. Materials	T	940/433-2007	

Butterfly, L.L.C. (The)
Golden Butterfly

Cruise, mph	75	Fuel Capacity, gal.	14.8	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	895/1330	No. Completed & Flown	3
Range, s.m.	70	Length, ft.	17.3	Kit Cost	$39,995
Rate of Climb, fpm	1500	Disk Span, ft.	31	Estimated Completed Cost	$43K-$49K
Takeoff/Landing Distance, ft.	500/30	Disk Area, sq. ft.	755	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ25	No. of Seats	2T		
HP/HP Range	190	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.thebutterflyllc.com	
		Bldg. Materials	T	940/433-2007	

Butterfly, L.L.C. (The)
Monarch Butterfly

Cruise, mph	60	Fuel Capacity, gal.	7.4	Beginner Build Time, hrs.	125
Stall, mph	n.a.	Empty/Gross Weight, lb.	350/630	No. Completed & Flown	19
Range, s.m.	75	Length, ft.	11.1	Kit Cost	$17,495
Rate of Climb, fpm	850	Disk Span, ft.	24	Estimated Completed Cost	$19K-$25K
Takeoff/Landing Distance, ft.	200/0	Disk Area, sq. ft.	452	Quickbuild/Plans Available	N/N
Engine Used	Rotax 582	No. of Seats	1		
HP/HP Range	65	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.thebutterflyllc.com	LSA LEGAL
		Bldg. Materials	T	940/433-2007	

Butterfly, L.L.C. (The)
Super Sky Cycle

Cruise, mph	70	Fuel Capacity, gal.	17.4	Beginner Build Time, hrs.	200
Stall, mph	n.a.	Empty/Gross Weight, lb.	650/950	No. Completed & Flown	1
Range, s.m.	150	Length, ft.	14.6	Kit Cost	$46,995
Rate of Climb, fpm	1000	Disk Span, ft.	27	Estimated Completed Cost	$50K-$60K
Takeoff/Landing Distance, ft.	200/0	Disk Area, sq. ft.	572	Quickbuild/Plans Available	N/N
Engine Used	Rotax 912	No. of Seats	1		
HP/HP Range	100/100-115	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.thebutterflyllc.com	LSA LEGAL
		Bldg. Materials	T	940/433-2007	

Butterfly, L.L.C. (The)
Turbo Golden

Cruise, mph	75	Fuel Capacity, gal.	14.8	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	1050/1850	No. Completed & Flown	1
Range, s.m.	60	Length, ft.	17.3	Kit Cost	$49,995
Rate of Climb, fpm	1500	Disk Span, ft.	31	Estimated Completed Cost	$53K-$55K
Takeoff/Landing Distance, ft.	500/30	Disk Area, sq. ft.	755	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ25 Turbo	No. of Seats	2T		
HP/HP Range	300	Cockpit Width, in.	n.a.		
		Landing Gear	trigear	www.thebutterflyllc.com	
		Bldg. Materials	T	940/433-2007	

CHR
Safari

Cruise, mph	85	Fuel Capacity, gal.	28	Beginner Build Time, hrs.	700
Stall, mph	n.a.	Empty/Gross Weight, lb.	1000/1500	No. Completed & Flown	130
Range, s.m.	290	Length, ft.	30	Kit Cost	$84,500
Rate of Climb, fpm	1000	Disk Span, ft.	26	Estimated Completed Cost	$90K-$135K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	530	Quickbuild/Plans Available	Y/$150
Engine Used	Lycoming O-320	No. of Seats	2		
HP/HP Range	160/160-180	Cockpit Width, in.	48		
		Landing Gear	skids	www.acehelicopter.com	
		Bldg. Materials	M, T	850/482-4141	

Eagle R&D, Ltd.
Helicycle

Cruise, mph	95	Fuel Capacity, gal.	21	Beginner Build Time, hrs.	400
Stall, mph	n.a.	Empty/Gross Weight, lb.	500/850	No. Completed & Flown	38
Range, s.m.	180	Length, ft.	20.9	Kit Cost	$36,500
Rate of Climb, fpm	900	Disk Span, ft.	21	Estimated Completed Cost	$40K-$45K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	340	Quickbuild/Plans Available	N/N
Engine Used	Solar Turbine	No. of Seats	1		
HP/HP Range	90 hp (de-rated)	Cockpit Width, in.	28		
		Landing Gear	skids	www.helicycle.com	
		Bldg. Materials	C	208/466-4120	

Groen Brothers Aviation's American Autogyro
SparrowHawk III Gyroplane

Cruise, mph	75	Fuel Capacity, gal.	23	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	900/1500	No. Completed & Flown	44
Range, s.m.	225	Length, ft.	12.3	Kit Cost	$45,500
Rate of Climb, fpm	650	Disk Span, ft.	30.1	Estimated Completed Cost	$46K-$60K
Takeoff/Landing Distance, ft.	500/30	Disk Area, sq. ft.	707	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ25	No. of Seats	2		
HP/HP Range	165	Cockpit Width, in.	44		
		Landing Gear	trigear	www.americanautogyro.com	
		Bldg. Materials	C, T	801/973-0177	

Gyro-Kopp-Ters
Midnight Hawk

Cruise, mph	60	Fuel Capacity, gal.	16	Beginner Build Time, hrs.	60
Stall, mph	n.a.	Empty/Gross Weight, lb.	510/810	No. Completed & Flown	12
Range, s.m.	170	Length, ft.	12.3	Kit Cost	$11,500
Rate of Climb, fpm	600	Disk Span, ft.	25	Estimated Completed Cost	$12K-$15K
Takeoff/Landing Distance, ft.	100/50	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	Y/N
Engine Used	Subaru EA82 SPFI	No. of Seats	1		
HP/HP Range	90	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.gyro-kopp-ters.com	LSA LEGAL
		Bldg. Materials	M, T	386/752-9116	

Gyro-Kopp-Ters
Twin Eagle

Cruise, mph	55	Fuel Capacity, gal.	16	Beginner Build Time, hrs.	120
Stall, mph	n.a.	Empty/Gross Weight, lb.	750/1210	No. Completed & Flown	3
Range, s.m.	170	Length, ft.	14.8	Kit Cost	$16,500
Rate of Climb, fpm	800	Disk Span, ft.	28	Estimated Completed Cost	$17K-$21K
Takeoff/Landing Distance, ft.	100/50	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	N/N
Engine Used	Subaru EJ22	No. of Seats	2T		
HP/HP Range	130	Cockpit Width, in.	30		
		Landing Gear	trigear	www.gyro-kopp-ters.com	LSA LEGAL
		Bldg. Materials	M, T	386/752-9116	

Helo Werks, Inc.
HX-2 Wasp

Cruise, mph	81	Fuel Capacity, gal.	20	Beginner Build Time, hrs.	350
Stall, mph	n.a.	Empty/Gross Weight, lb.	675/1250	No. Completed & Flown	2
Range, s.m.	123	Length, ft.	19	Kit Cost	$90,000
Rate of Climb, fpm	1225	Disk Span, ft.	23	Estimated Completed Cost	$90K-$100K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	415	Quickbuild/Plans Available	N/N
Engine Used	AirResearch JFS-100	No. of Seats	2		
HP/HP Range	100/100-125	Cockpit Width, in.	49		
		Landing Gear	skid	www.helowerks.com	
		Bldg. Materials	C,T	757/342-6982	

Innovator Technologies
Mosquito Air

Cruise, mph	60	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	253/530	No. Completed & Flown	20
Range, s.m.	60	Length, ft.	20	Kit Cost	$25,000
Rate of Climb, fpm	1000	Disk Span, ft.	18	Estimated Completed Cost	$25K-$31K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	254	Quickbuild/Plans Available	N/N
Engine Used	CRE MZ202	No. of Seats	1		
HP/HP Range	60	Cockpit Width, in.	n.p.		
		Landing Gear	skids	www.innovatortech.ca	
		Bldg. Materials	C, M	403/669-3101	

Innovator Technologies
Mosquito XE

Cruise, mph	70	Fuel Capacity, gal.	12	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	298/610	No. Completed & Flown	22
Range, s.m.	150	Length, ft.	22	Kit Cost	$29,000
Rate of Climb, fpm	1000	Disk Span, ft.	19.5	Estimated Completed Cost	$29K-$37K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	299	Quickbuild/Plans Available	N/N
Engine Used	CRE MZ202	No. of Seats	1		
HP/HP Range	60	Cockpit Width, in.	28		
		Landing Gear	skids	www.innovatortech.ca	
		Bldg. Materials	C, M	403/669-3101	

Innovator Technologies
Mosquito XE3

Cruise, mph	80	Fuel Capacity, gal.	12	Beginner Build Time, hrs.	300
Stall, mph	n.a.	Empty/Gross Weight, lb.	360/720	No. Completed & Flown	2
Range, s.m.	150	Length, ft.	21	Kit Cost (includes engine)	$34,000
Rate of Climb, fpm	1000	Disk Span, ft.	19.5	Estimated Completed Cost	$34K-$44K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	298	Quickbuild/Plans Available	Y/N
Engine Used	CRE MZ301	No. of Seats	1		
HP/HP Range	85/60-90	Cockpit Width, in.	30		
		Landing Gear	skids	www.innovatortech.ca	
		Bldg. Materials	M	403/669-3101	

Innovator Technologies
Mosquito XEL

Cruise, mph	65
Stall, mph	n.a.
Range, s.m.	60
Rate of Climb, fpm	1000
Takeoff/Landing Distance, ft.	0/0
Engine Used	CRE MZ202
HP/HP Range	64
Fuel Capacity, gal.	5
Empty/Gross Weight, lb.	312/580
Length, ft.	22
Disk Span, ft.	19.5
Disk Area, sq. ft.	299
No. of Seats	1
Cockpit Width, in.	28
Landing Gear	skids
Bldg. Materials	C, M
Beginner Build Time, hrs.	250
No. Completed & Flown	12
Kit Cost	$30,000
Estimated Completed Cost	$30K-$38K
Quickbuild/Plans Available	N/N

www.innovatortech.ca
403/669-3101

Innovator Technologies
Mosquito XET

Cruise, mph	80
Stall, mph	n.a.
Range, s.m.	160
Rate of Climb, fpm	1000
Takeoff/Landing Distance, ft.	0/0
Engine Used	Solar T62-2A1
HP/HP Range	90/60-90
Fuel Capacity, gal.	12
Empty/Gross Weight, lb.	433/820
Length, ft.	21
Disk Span, ft.	19.5
Disk Area, sq. ft.	298
No. of Seats	1
Cockpit Width, in.	30
Landing Gear	skids
Bldg. Materials	C
Beginner Build Time, hrs.	400
No. Completed & Flown	2
Kit Cost	$36,000
Estimated Completed Cost	$43K-$46K
Quickbuild/Plans Available	Y/N

www.innovatortech.ca
403/669-3101

Little Wing Autogyros, Inc.
LW-3

Cruise, mph	75
Stall, mph	n.a.
Range, s.m.	150
Rate of Climb, fpm	1000
Takeoff/Landing Distance, ft.	500/20
Engine Used	Rotec Radial
HP/HP Range	110/50-115
Fuel Capacity, gal.	8.5
Empty/Gross Weight, lb.	351/750
Length, ft.	18
Disk Span, ft.	27
Disk Area, sq. ft.	573
No. of Seats	1
Cockpit Width, in.	26
Landing Gear	tailwheel
Bldg. Materials	F, M, T
Beginner Build Time, hrs.	1000
No. Completed & Flown	10
Kit Cost (includes engine)	$25,000
Estimated Completed Cost	$10K-$40K
Quickbuild/Plans Available	N/$175

www.littlewingautogyro.com
email: rotopup@aol.com
LSA LEGAL

Little Wing Autogyros, Inc.
LW-4

Cruise, mph	75
Stall, mph	n.a.
Range, s.m.	200
Rate of Climb, fpm	600
Takeoff/Landing Distance, ft.	300/10
Engine Used	Rotax 912
HP/HP Range	100/90-150
Fuel Capacity, gal.	13.5
Empty/Gross Weight, lb.	520/1100
Length, ft.	18
Disk Span, ft.	27
Disk Area, sq. ft.	573
No. of Seats	2
Cockpit Width, in.	26
Landing Gear	tailwheel
Bldg. Materials	F, M, T
Beginner Build Time, hrs.	1000
No. Completed & Flown	2
Kit Cost	$35,000
Estimated Completed Cost	$35K-$75K
Quickbuild/Plans Available	N/$175

www.littlewingautogyro.com
email: rotopup@aol.com
LSA LEGAL

Little Wing Autogyros, Inc.
LW-5

Cruise, mph	90
Stall, mph	n.a.
Range, s.m.	450
Rate of Climb, fpm	1000
Takeoff/Landing Distance, ft.	300/20
Engine Used	Rotax 914
HP/HP Range	115/50-115
Fuel Capacity, gal.	28
Empty/Gross Weight, lb.	550/1100
Length, ft.	16
Disk Span, ft.	28
Disk Area, sq. ft.	615.7
No. of Seats	2
Cockpit Width, in.	26
Landing Gear	tailwheel
Bldg. Materials	F, M, T
Beginner Build Time, hrs.	1000
No. Completed & Flown	2
Kit Cost	$35,000
Estimated Completed Cost	$35K-$75K
Quickbuild/Plans Available	N/$175

www.littlewingautogyro.com
email: rotopup@aol.com
LSA LEGAL

Magni USA, L.L.C.
M-14

Cruise, mph	90
Stall, mph	n.a.
Range, s.m.	170
Rate of Climb, fpm	950
Takeoff/Landing Distance, ft.	230/25
Engine Used	Rotax 912/914
HP/HP Range	100/100-115
Fuel Capacity, gal.	13
Empty/Gross Weight, lb.	547/1212
Length, ft.	13
Disk Span, ft.	28
Disk Area, sq. ft.	615
No. of Seats	2T
Cockpit Width, in.	20
Landing Gear	trigear
Bldg. Materials	C, T
Beginner Build Time, hrs.	300
No. Completed & Flown	100
Kit Cost	$75,000
Estimated Completed Cost	$76K-$79K
Quickbuild/Plans Available	N/N

www.magnigyro.com
573/883-3541
LSA LEGAL

Magni USA, L.L.C.
M-16/M-22

Cruise, mph	90
Stall, mph	n.a.
Range, s.m.	240
Rate of Climb, fpm	950
Takeoff/Landing Distance, ft.	230/25
Engine Used	Rotax 912/914
HP/HP Range	100/100-115
Fuel Capacity, gal.	19
Empty/Gross Weight, lb.	595/1212
Length, ft.	15.3
Disk Span, ft.	28
Disk Area, sq. ft.	615
No. of Seats	2T
Cockpit Width, in.	21
Landing Gear	trigear
Bldg. Materials	C, T
Beginner Build Time, hrs.	300
No. Completed & Flown	450
Kit Cost	$75,000
Estimated Completed Cost	$76K-$78K
Quickbuild/Plans Available	N/N

www.magnigyro.com
573/883-3541
LSA LEGAL

Magni USA, L.L.C.
M-18

Cruise, mph	70
Stall, mph	n.a.
Range, s.m.	130
Rate of Climb, fpm	650
Takeoff/Landing Distance, ft.	150/25
Engine Used	Rotax 582
HP/HP Range	65
Fuel Capacity, gal.	9
Empty/Gross Weight, lb.	368/771
Length, ft.	14.8
Disk Span, ft.	24
Disk Area, sq. ft.	452
No. of Seats	1
Cockpit Width, in.	19
Landing Gear	trigear
Bldg. Materials	C, T
Beginner Build Time, hrs.	250
No. Completed & Flown	40
Kit Cost	$38,000
Estimated Completed Cost	$39K-$40K
Quickbuild/Plans Available	N/N

www.magnigyro.com
573/883-3541
LSA LEGAL

Raven RotorCraft Inc.
Raven Lite

Cruise, mph	60	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	100
Stall, mph	n.a.	Empty/Gross Weight, lb.	254/504	No. Completed & Flown	1
Range, s.m.	130	Length, ft.	15	Kit Cost	$9995
Rate of Climb, fpm	500	Disk Span, ft.	23	Estimated Completed Cost	$14K-$16K
Takeoff/Landing Distance, ft.	150/50	Disk Area, sq. ft.	414	Quickbuild/Plans Available	N/N
Engine Used	Raven 1000 ULXX	No. of Seats	1		
HP/HP Range	55/45-65	Cockpit Width, in.	24		
		Landing Gear	tailwheel	www.raven-rotor.com	LSA LEGAL
		Bldg. Materials	C, M, T	303/440-6234	

RotorWay International
A600 Talon

Cruise, mph	100	/147-167		Bldg. Materials	C, M, T
Stall, mph	n.a.	Fuel Capacity, gal.	17	Beginner Build Time, hrs.	600
Range, s.m.	200	Empty/Gross Weight, lb.	965/1500	No. Completed & Flown	10
Rate of Climb, fpm	1000	Length, ft.	29.5	Kit Cost	$97,700
Takeoff/Landing Distance, ft.	0/0	Disk Span, ft.	25	Estimated Completed Cost	$105K-$110K
Engine Used	R.I. 600S	Disk Area, sq. ft.	491	Quickbuild/Plans Available	N/N
HP/HP Range	167	No. of Seats	2		
		Cockpit Width, in.	44	www.rotorway.com	
		Landing Gear	skids	480/961-1001	

Sport Copter, Inc.
Lightning

Cruise, mph	50	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	60
Stall, mph	n.a.	Empty/Gross Weight, lb.	252/600	No. Completed & Flown	68
Range, s.m.	50	Length, ft.	11	Kit Cost	$16,189
Rate of Climb, fpm	1000	Disk Span, ft.	23	Estimated Completed Cost	$22K-$29K
Takeoff/Landing Distance, ft.	200/0	Disk Area, sq. ft.	415.3	Quickbuild/Plans Available	N/N
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	46/30-70	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.sportcopter.com	LSA LEGAL
		Bldg. Materials	C, M, T	503/543-7000	

Sport Copter, Inc.
Sport Copter II

Cruise, mph	100	Fuel Capacity, gal.	28	Beginner Build Time, hrs.	200
Stall, mph	n.a.	Empty/Gross Weight, lb.	1000/1650	No. Completed & Flown	1
Range, s.m.	300	Length, ft.	14.5	Kit Cost	$59,995
Rate of Climb, fpm	1000	Disk Span, ft.	31	Estimated Completed Cost	$82K-$105K
Takeoff/Landing Distance, ft.	100/20	Disk Area, sq. ft.	n.p.	Quickbuild/Plans Available	N/N
Engine Used	Lycoming IO-360	No. of Seats	2		
HP/HP Range	200/180-250	Cockpit Width, in.	49.5		
		Landing Gear	trigear	www.sportcopter.com	
		Bldg. Materials	C, M, T	503/543-7000	

Sport Copter, Inc.
Vortex

Cruise, mph	75	Fuel Capacity, gal.	8.5	Beginner Build Time, hrs.	160
Stall, mph	n.a.	Empty/Gross Weight, lb.	420/760	No. Completed & Flown	223
Range, s.m.	100	Length, ft.	12	Kit Cost	$22,801
Rate of Climb, fpm	700	Disk Span, ft.	25	Estimated Completed Cost	$32K-$37K
Takeoff/Landing Distance, ft.	50/0	Disk Area, sq. ft.	490.8	Quickbuild/Plans Available	N/N
Engine Used	Rotax 582	No. of Seats	1		
HP/HP Range	67/67-115	Cockpit Width, in.	n.p.		
		Landing Gear	tri with tail	www.sportcopter.com	LSA LEGAL
		Bldg. Materials	C, M, T, W	503/543-7000	

Star Bee Gyros
Gyrobee

Cruise, mph	55	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	150
Stall, mph	n.a.	Empty/Gross Weight, lb.	254/485	No. Completed & Flown	40
Range, s.m.	75	Length, ft.	12	Kit Cost (includes engine)	$14,595
Rate of Climb, fpm	600	Disk Span, ft.	22	Estimated Completed Cost	$10K-$18K
Takeoff/Landing Distance, ft.	400/50	Disk Area, sq. ft.	490	Quickbuild/Plans Available	N/N
Engine Used	MZ 202	No. of Seats	1		
HP/HP Range	55/40-60	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.starbeegyros.com	LSA LEGAL
		Bldg. Materials	T	803/663-1052	

Vertical Aviation Technologies
Hummingbird 260L

Cruise, mph	90	Fuel Capacity, gal.	57	Beginner Build Time, hrs.	1200
Stall, mph	n.a.	Empty/Gross Weight, lb.	1750/2700	No. Completed & Flown	39
Range, s.m.	375	Length, ft.	30	Kit Cost (includes engine)	$170,520
Rate of Climb, fpm	1250	Disk Span, ft.	33	Estimated Completed Cost	$175K-$225K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	855	Quickbuild/Plans Available	N/N
Engine Used	Lycoming O-435	No. of Seats	4		
HP/HP Range	265	Cockpit Width, in.	60		
		Landing Gear	quadricycle	www.vertical-aviation.com	
		Bldg. Materials	C, M	407/322-9488	

Vortech, Inc.
A/W 95 Helicopter

Cruise, mph	60	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	250
Stall, mph	n.a.	Empty/Gross Weight, lb.	272/500	No. Completed & Flown	7
Range, s.m.	90	Length, ft.	15	Kit Cost	$22,995
Rate of Climb, fpm	1000	Disk Span, ft.	19.5	Estimated Completed Cost	$24K-$26K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	298	Quickbuild/Plans Available	N/$100-$108
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50/50-75	Cockpit Width, in.	n.p.		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
G-1

Cruise, mph	50	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	150
Stall, mph	n.a.	Empty/Gross Weight, lb.	150/420	No. Completed & Flown	14
Range, s.m.	90	Length, ft.	12	Kit Cost	$16,995
Rate of Climb, fpm	900	Disk Span, ft.	12	Estimated Completed Cost	$18K-$19K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	113	Quickbuild/Plans Available	N/$34.95
Engine Used	Kawasaki 440	No. of Seats	1		
HP/HP Range	42/42-55	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
Hot Rod Helicopter

Cruise, mph	90	Fuel Capacity, gal.	18.5	Beginner Build Time, hrs.	600
Stall, mph	n.a.	Empty/Gross Weight, lb.	1000/1350	No. Completed & Flown	2
Range, s.m.	210	Length, ft.	20	Kit Cost	n.p.
Rate of Climb, fpm	1000	Disk Span, ft.	25	Estimated Completed Cost	n.p.
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	491	Quickbuild/Plans Available	N/$233-$245
Engine Used	Subaru EJ25	No. of Seats	1		
HP/HP Range	165	Cockpit Width, in.	n.p.		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	C, T	410/668-2757	

Vortech, Inc.
Kestrel Jet Helicopter

Cruise, mph	55	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	250
Stall, mph	n.a.	Empty/Gross Weight, lb.	170/425	No. Completed & Flown	9
Range, s.m.	20	Length, ft.	12	Kit Cost	$15,995
Rate of Climb, fpm	1000	Disk Span, ft.	25	Estimated Completed Cost	$17K-$18K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	491	Quickbuild/Plans Available	N/$26.95
Engine Used	G8-2-20 jets (2)	No. of Seats	1		
HP/HP Range	36/36-60	Cockpit Width, in.	22		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	M, T	410/668-2757	

Vortech, Inc.
New Choppy

Cruise, mph	65	Fuel Capacity, gal.	6	Beginner Build Time, hrs.	250
Stall, mph	n.a.	Empty/Gross Weight, lb.	285/630	No. Completed & Flown	5
Range, s.m.	120	Length, ft.	15	Kit Cost	$29,995
Rate of Climb, fpm	950	Disk Span, ft.	21	Estimated Completed Cost	$31K-$33K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	346	Quickbuild/Plans Available	N/$58
Engine Used	Hirth 3203	No. of Seats	1		
HP/HP Range	65/55-75	Cockpit Width, in.	23		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
New Choppy Ultralight

Cruise, mph	55	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	200
Stall, mph	n.a.	Empty/Gross Weight, lb.	254/500	No. Completed & Flown	4
Range, s.m.	120	Length, ft.	15	Kit Cost	$22,995
Rate of Climb, fpm	900	Disk Span, ft.	21	Quickbuild/Plans Available	N/$52-$58
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	346	www.prismz.com/helio	
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50/45-60	Cockpit Width, in.	n.p.		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
Shadow

Cruise, mph	70	Fuel Capacity, gal.	12	Beginner Build Time, hrs.	350
Stall, mph	n.a.	Empty/Gross Weight, lb.	750/1290	No. Completed & Flown	6
Range, s.m.	170	Length, ft.	13	Kit Cost	$19,995
Rate of Climb, fpm	1500	Disk Span, ft.	29	Estimated Completed Cost	$28K-$33K
Takeoff/Landing Distance, ft.	100/25	Disk Area, sq. ft.	660	Quickbuild/Plans Available	N/N
Engine Used	Lycoming O-360	No. of Seats	2		
HP/HP Range	150/150-230	Cockpit Width, in.	48		
		Landing Gear	trigear	www.prismz.com/helio	
		Bldg. Materials	C, M, T	410/668-2757	

Vortech, Inc.
Skylark Helicopter

Cruise, mph	70	Fuel Capacity, gal.	8	Beginner Build Time, hrs.	350
Stall, mph	n.a.	Empty/Gross Weight, lb.	350/700	No. Completed & Flown	6
Range, s.m.	120	Length, ft.	17.5	Kit Cost	$31,795
Rate of Climb, fpm	1000	Disk Span, ft.	19	Estimated Completed Cost	$33K-$34K
Takeoff/Landing Distance, ft.	0/0	Disk Area, sq. ft.	283	Quickbuild/Plans Available	N/$81
Engine Used	Hirth 3503	No. of Seats	1		
HP/HP Range	70	Cockpit Width, in.	26		
		Landing Gear	skids	www.prismz.com/helio	
		Bldg. Materials	T	410/668-2757	

Vortech, Inc.
Sparrow

Cruise, mph	60	Fuel Capacity, gal.	5	Beginner Build Time, hrs.	150
Stall, mph	n.a.	Empty/Gross Weight, lb.	254/500	No. Completed & Flown	6
Range, s.m.	90	Length, ft.	9	Kit Cost	$3795 (partial)
Rate of Climb, fpm	900	Disk Span, ft.	23	Estimated Completed Cost	$9K-$11K
Takeoff/Landing Distance, ft.	100/50	Disk Area, sq. ft.	415	Quickbuild/Plans Available	N/N
Engine Used	Rotax 503	No. of Seats	1		
HP/HP Range	50/50-60	Cockpit Width, in.	n.p.		
		Landing Gear	trigear	www.prismz.com/helio	LSA LEGAL
		Bldg. Materials	C, T	410/668-2757	

SUBIE, RISE AGAIN!

Maxwell Propulsion takes over the old NSI line of Subaru conversions and changes everything but the engine.

BY MARC COOK

Among the concerns of builders who select alternative powerplants for their homebuilts are a few that have absolutely nothing to do with the engines themselves. The top two are probably: Has the company done a good job of engineering any components unique to the installation and is its business model sufficiently sound to ensure the company's survival? Let's face it: The engine manufacturer will likely have an installed base sufficiently large to support long-term survival.

But what about those components unique to the installation, all those cool firewall-forward bits, special systems, one-off castings? What happens should the manufacturer go out of business or, almost worse, stay in business but abandon an earlier design with no economically feasible way for the builder to "get current" and complete or maintain his airplane?

Builders using the NSI system of Subaru-engine conversions found out when that company failed in 2005 after months of reported difficulties by builders who could not get complete packages as promised. In the normal course of events, this would mark the end; any NSI installations yet to run and waiting for final parts would be doomed, as would any flying examples that needed repair or replacement parts. Warranty? Good luck.

Photos: Marc Cook

Ducts outboard of the cylinder heads feed the firewall-mounted radiator. The Maxwell conversion retains the Subaru's mass-airflow sensor, visible on the pipe between the K&N air filter and the SCEET hose to the throttle body.

Enter the Maxwells

Dr. John and Gwen Maxwell didn't intend to get into the alternative engine business but, as the landlords of the old NSI facility, they found themselves with the assets of the company in place of the rent. Rather than let the concern die and the existing customers twist in the wind, the Maxwells started the long task of learning everything they needed to know about the industry and the product the previous company had been selling. It was, they now say, an eye-opening affair.

After an interim crew, Gwen Maxwell has taken over as chief operating officer, with the staff filled out by Craig Woolman, Colin Gillespie, and Dominic Acia, who operated a popular Subaru-tuning business until joining the company. It's important to understand that while the company is expected to be profitable in the long run, the Maxwells have other investments that allow them to develop the components of the firewall-forward kits without the pressing need to get parts out the door just the keep the lights on. They can avoid cutting engineering corners or using the deposit on firewall-forward kit #20 to pay for engine #15.

Compact and respectably light, the EJ25, as used in the Maxwell conversion, produces 165 horsepower.

Core Values

Maxwell starts with new Subaru EJ25 engine components purchased locally. Components is the key term here, because this is not a totally off-the-shelf setup. While the old NSI conversion had many special parts and machining/assembly processes, the Maxwell conversion is, by design, much simpler. It starts with the engine block slated for the WRX STi automobile, a deep-breathing, four-cylinder opposed-piston design capable of more than the 300 horsepower it makes in the sports car. (Subaru sports car fanatics are known to turn up the boost and ask for a lot from this engine family.) The aluminum block features a stronger casting with internal risers inside the water jackets; they significantly improve the strength of the block assembly. These cases are one piece from the crankshaft split line to the junction of the cylinder heads—in all, a typically modern, weight-efficient, production-smart design.

However, the STi uses double-overhead cam, four-valve-per-cylinder heads, which are both heavier and overkill for an aircraft conversion expected to operate normally from 4200 to 4800 rpm, well under the nominal redline for the engine. Four-valve heads can have more airflow at high rpm than two-valvers, resulting in more power at the upper end of the rev band, and a double-overhead-cam layout affords more accurate control of the valves at high revs. But the DOHC layout of the STi engine is unnecessary in this application, so instead the Maxwell conversion employs the lighter four-valve, single-cam heads. Belts drive the cams from the firewall end of the engine.

In the bores are forged pistons with the turbo's modest 8:1 compression ratio; the normally aspirated versions of the EJ25 typically use 10:1 pistons. This reduced compression ratio serves two purposes: providing additional detona-

The Maxwell PSRU internals are stacked on the left, and the previous NSI major components are on the right.

Subaru's single-overhead-cam, four-valve-per-cylinder head is tuned for good torque production.

tion margin in an engine expected to work much harder than it does in a car, and making a later turbo model a simpler upgrade. Unlike the previous NSI iterations, the Maxwell-tuned Subaru is almost completely stock parts—no special cams or valves. (NSI was in the habit of mating EJ20 heads to the EJ25 bottom end, with many specialized parts.) As a result, continued maintenance of the engines should be possible with or without Maxwell Propulsion still in the picture.

Most of the induction system is stock—save for the specially designed and locally produced throttle body, which is much simpler than the stocker because it carries no emissions-control gear. The exhaust is aircraft-specific, as it would have to be to avoid the heavy, power-sapping catalytic converters from the car.

Systems Savvy

It's one thing to bolt a car engine onto the front of an aircraft, but another to make it happy there, and Maxwell has continued to develop the Subaru's support systems. To ensure proper cooling, a large radiator stretches across the firewall of the firm's GlaStar Sportsman test mule; cool air is fed from the standard inlets along twin channels outboard of the engine. The Subie is so much narrower than an angle-valve Lycoming that there's ample room for these ducts. This is much like the old NSI setup, and Maxwell is considering

By using a WRX STi turbocharged block, Maxwell bolsters the conversion's bottom-end strength and paves the way for a turbocharged upgrade later.

options as development of the two turbo models (195 hp and 240 hp) progress.

Spark and fuel are delivered electronically. Maxwell uses twin injection and ignition computers (engine control units) paralleled. Only one operates at a time, but failure of one simply means reversion to the other fully featured channel; because they have equal capabilities, you really can't call one primary and one secondary. A third box, the Engine Management System controller, manages both ECUs and the electric propeller. The system remains singular in places. There is one spark plug and fuel injector per cylinder, bone stock Subaru items that have a proven life in cars.

Maxwell has done something clever here. When you are ready to install your kit, send the company the desired harness lengths. You'll receive professional looking, strain-relieved fully tested harnesses in return. Given that many amateur-builder miscues involve wiring, this is a great service.

Between Prop and Engine

Where NSI arguably had the most trouble was with the propeller speed reduction unit (PSRU). Maxwell has completely abandoned the old design and started fresh. The 2.13:1 reduction is achieved through a simple, helical-cut spur gear, the drive shaft at crankshaft level, and the prop-drive (driven) shaft just above it. Yet, the devil remains in the details. Maxwell tested several iterations to check on damaging harmonics between the prop and the engine (and airframe/engine mount). The final iteration starts with a full-size flywheel/starter ring. Eight elastomeric bushings are pressed into an aluminum carrier, which are then bolted to the flywheel. The carrier uses a central pilot bearing extending into the crankshaft bore for alignment. The drive gear rides on the splined end of this carrier shaft where it slides into the overhung PSRU body.

Prop loads are borne by a massive shaft carried fore and aft by roller- and ball-element bearings. And the entire PSRU is bolted to the bell housing of the engine by a thick machined-aluminum plate and anodized spacers. (The starter mounts to the engine plate as well, this time an off-the-shelf item, not a modified part.) Maxwell had examples of the old NSI gearbox on hand to hold and photograph next to the current parts, and the differences are astonishing. If material size and overall "beef" are among the ingredients for a good PSRU, the Maxwell is off to a good start. Rated TBO is 1500 hours with a total weight of 72 pounds.

Maxwell completely redesigned the PSRU carrier from a cast piece to a fully machined and black-anodized aluminum part. Gold flywheel (right) is the starter ring gear (minus teeth) and receiver for the rubber-isolated transfer plate.

The compact Subaru engine exhales through a near-equal-length tubular exhaust, wrapped to keep the cowling cool.

Flying It

Rated for 165 hp at 5500 rpm, the Subaru causes the factory's Sportsman to perform as you'd expect. Startup is turn-the-key simple, and the engine settles into a pleasant idle. Runup is fairly routine except you have to do a quick confirmation of the prop setting. The current system, with an electric pitch-change mechanism in a proprietary hub mated to Whirlwind composite blades, is not automatic. It acts like a fixed-pitch prop that you can adjust in flight.

Initial takeoff performance is reasonably good with near-full-fuel and two aboard (estimated at 2050 pounds all up, against a max gross of 2350), with the engine note turning strident at the takeoff setting of 5200 rpm. With obstacles cleared, you can pull back to 5000 rpm, which quiets some of the din and nets a 700-fpm rate of climb. (For perspective, my own Sportsman, with 215 hp, would be doing twice the climb rate at 100 knots instead of 80 indicated.) Cooling performance is very good, easily maintaining 180° F coolant temp and 215° oil temp at 4900 to 5000 rpm. Fuel flow in the climb started out at 14 gph and was 10.7 gph at the top of the climb to nearly more than 6000 feet (density altitude of 8000 feet). All of this was on a day with moderate (below 70°) ambient temperatures.

Craig Woolman wheels the prototype turbocharged EJ25 into the Maxwell dyno cell. Testing is ongoing for the 195- and 240-hp versions.

We performed cruise checks at altitude. The process of setting up for cruise is simple, though not fully automatic. As you level off, let the airspeed creep up, toggle a bit more pitch into the prop to keep close to the desired engine rpm. Naturally, the airplane accelerates a bit more, so you must repeat the process until, finally, equilibrium sets in. At 4800 engine rpm, the Maxwell Sportsman shows 116 knots indicated, 130 knots true on 9.9 gph. A two-way GPS run verified the speed calculated on the Dynon EFIS. Pull back to a more modest 4250 engine rpm, and you'll see a true airspeed of 122 knots on 7.4 gph.

The Inevitable Comparison

How does that compare with a Lycoming? Given that a 180-hp Sportsman is capable of 137 KTAS on 10 gph

Several iterations of cush drive were tested. The current version, top, uses eight elastomeric bushings to decouple the engine and PRSU vibrations.

(give or take), the Maxwell Subaru is in the ballpark. Current ECU mapping keeps the Subie from going aggressively lean at higher power settings, which gives the Lycoming a slight edge here. If the Subaru sacrifices a few efficiency points, it at least gives back ease of operation—aside from the need to set the prop pitch before takeoff (and once more back in the pattern before landing).

Costs round out the equation, of course, and here the Maxwell is in line with traditional powerplants. A package price of $29,540 gets you the engine, propeller, systems and electronics. Add around $2300 for airframe-specific engine mounts—currently available for the GlaStar and two-seat, side-by-side RVs. Firewall-forward, your costs are going to be close to a new Experimental-class IO-320 Lycoming, constant-speed prop, governor and accessories. In theory, reduced overhaul and ongoing costs tip the bargain in favor of the Subaru.

Perhaps the big story here is simply the revival of this firewall-forward program as an example of a good idea failing to die off, and illustrating how to take on the inarguably intense development process with a level head and good business practices. After all, a great idea, poorly executed, never really overcomes that handicap. ✢

For more information, call 360/474-8118 or visit www.maxwellpropulsion.com. Find a direct link at www.kitplanes.com.

Kannad's line of 406 MHz units includes EPIRBs, shown in back. With self-deploying antennas and buoyancy, they're not suitable for aviation. The ELTs in the front row are for aircraft.

ELTs of Tomorrow, Today

Traditional emergency locator transmitter technology is old, the infrastructure creaky, and parts of it are going away. What's this mean to you?

BY BOB FRITZ

One Artex entry in the 406 MHz race can be traded out for its 121.5 MHz little brother.

Since 1971, when the FAA mandated the use of ELTs, they've been installed on approximately 170,000 aircraft. The results, frankly, have not been great. The Air Force Rescue Coordination Center (AFRCC) processes roughly 6000 transmissions from aircraft ELTs per year. What's more, 400 will be shut off prior to being located, leaving the SAR team nothing to do but go home. Fewer than 100 of the approximately 6000 yearly signals are actual distress calls. But the bell rings and the rescue starts; there's no other option. Those false alarms cost about $3.5 million in federal, state and Civil Air Patrol volunteer resources.

Initially, it was thought that the signal would be picked up by other aircraft. That turned out to be not very effective, because those aircraft overhead must have a radio tuned to 121.5 MHz and, with increasing use of flight following combined with the expense of radios, we in the private pilot community are just not devoting the resources. With that in mind, the Cospas-Sarsat satellites we now rely on were implemented to reduce this dependence upon overflying aircraft. Keep this in mind, as we'll get back to it later.

The stats are not encouraging if you've gone flying with the idea that a 121.5 MHz ELT will be your salvation. Set aside the false alarms and look at the search-and-rescue (SAR) deployments initiated because an aircraft was overdue. In 1988 this occurred 191 times. The distressed aircraft was found 107 times, but in only 11 cases did the ELT aid in the location. Of those 191 deployments there were 16 missions where the ELT did not function, and the length of time to locate the aircraft was greater than 72 hours.

Failure Modes

The cause of the non-functioning ELT has to do with the design of the triggering mechanism. It's a little device known as a ΔV (Delta-Vee) switch. Delta is engineer-speak for change, and V is velocity, so ΔV simply means a change in velocity. What's not in there is the time constraint (T); make a hard landing and the switch should tolerate up to 7.5 G; crash into the brush where you slow at 2.5 G for several seconds and it's supposed to trigger.

Add to this that the switch works in only one direction. If you install the ELT sideways, it won't work at all. In fact, it should be within 10° of the longitudinal axis of the aircraft, and you have to crash such that you exert that ΔVT factor within that 10° or it won't work. Do a 4 G turn, and nothing happens because the force is directed perpendicular to the axis of the switch.

Assuming the switch has made contact, the next factor in this *pas de deux* is simply that the signal is both weak, a measly 0.1 watt, and non-directional; the 0.1 watt radiates off in all directions. The receiving satellite is able to pinpoint the source within only 10 to 15 miles, and yet per the FAA "...not having an ELT signal in an accident reduces chances of survival by 43%." Clearly, the ELTs are not perfect, but they're better than nothing.

Artex G-406.

Photos: Bob Fritz, Courtesy the Manufacturers

ACK Avionics ELT.

Sorting the Solutions

Improvements are being brought to the system, but more importantly, the satellites won't be listening for 121.5 MHz after February 1, 2009. Don't throw away your 121.5 MHz ELT yet. You still need it for three reasons: The FAA rules still require it, ground stations and overflying aircraft will still be online, and the rescue folks need that signal once they get in the vicinity.

The next-generation ELTs will have many improvements. They will send out a signal unique to the owner, which will allow the SAR team to simply call the owner or another contact for verification of the signal. The frequency will also be changed to something unlikely to be confused with a stadium scoreboard's signal leakage, the power level will be such that it can be spotted by a new group of satellites, and GPS will be optional. Enter 406 MHz ELTs.

Problem Solved?

Implementation for non-maritime use in Canada began in 1994, and with 90% of the 406 MHz ELTs registered, some 70% of the false alerts are resolved by radio or phone call. The location of the other 30% was known to within 2 to 3 miles for the non-GPS-equipped unit, and to within 100 yards for those with GPS. With this accuracy and the ability to deploy at first signal, the search times were reduced by an average of 6 hours.

This "new" system started more than 20 years ago when the maritime industries jumped at the chance of having a system to locate them at sea. The United States and Canada, France and the U.S.S.R. cooperated in putting up two groups of satellites specifically for this purpose. One group of satellites is in geosynchronous orbit, and the other is in polar. More on why we need two groups later.


Ameri-King AK-450.

Other than never being in a situation that needs it, the ideal scenario is that you hit the remote switch as you go down, triggering the ELT before impact. Every 50 seconds, the 406 MHz ELT sends out a 0.4-second burst of information that includes the latitude and longitude from the GPS. The geosynchronous satellite picks up that signal and relays it to AFRCC, which makes a phone call. No response or "he went flying" means SAR teams deploy, knowing location within 100 square meters.

Without the GPS option, rescuers saddle up with the knowledge that the signal is somewhere in a 65-square-mile box. But as they head out, the polar orbiting satellites passing over every 15 minutes are able to triangulate the position to within 5 square miles. Now they fly around listening for the 121.5 MHz signal until the plane is found. That's the main reason the FAA is keeping 121.5 MHz, and you should keep it healthy.

The next scenario is that you're using a 121.5 MHz ELT and a handheld personal locator beacon (PLB). This is an ELT for hikers. You have to get out of the aircraft if it's aluminum, open the antenna, and hit the transmit button. If you crash after February 1, 2009, and you can't deploy the PLB, you'll have to hope an overflying aircraft has a radio tuned to 121.5 MHz.

More Capability, Cost

You can buy a 121.5 MHz ELT for less than $200, which uses inexpensive C-size batteries that you'll have to replace at each annual. A 406-MHz unit will take about a $1000 bite, which includes a lithium battery that will last six years. The good news is that prices are predicted to come down to half of that within a year; ACK Avionics plans to have a unit for about $600 by the time you read this.

Price is driven by several factors. If you are replacing your Ameri-King 121.5 with an Ameri-King 406 MHz, it's a simple, minimal-cost swap. Several manufacturers are offering this sort of convertibility, so it is potentially a huge money saver. Be sure to ask.

What you don't want to do is install a second ELT. The 406 MHz devices also broadcast on 121.5 MHz. If your new one and the old one both trigger, the resulting 121.5 MHz signal will be distorted, making the SAR job tougher than need be.

Can You SPOT Me Now?

In a risk-averse society, the proliferation of personal locator beacons (PLBs) is hardly surprising. But now the technology has progressed from the one-dimension PLB, which can only transmit a cry for help. It either stays mute or shouts, "Come get me!" The new tech is embodied in SPOT, a $169.99 PLB with the ability to send non-emergency messages through its satellite system and even provide rudimentary tracking services.

As with other PLBs, SPOT contains an internal GPS receiver to help it resolve your location, plus a transmitter to send messages through SPOT's satellite service. SPOT (the company) is a subsidiary of Globalstar, a sat-phone company, which has 60 low-earth-orbit satellites to provide near-100% coverage in North America. These are geosynchronous satellites, so there is no coverage over the oceans at this point, and you should plan for a different technology if traveling in South Africa. For those of us in the U.S., SPOT's coverage is essentially complete.

The SPOT unit itself is 4.4 x 2.8 x 1.5 inches and weighs less than 8 ounces. It takes two common AA batteries, lithium recommended. The unit is designed to be placed top facing the sky, though we've tested it on its side, and the GPS reception seems OK. In our testbed, the editor's Glastar Sportsman, SPOT was placed behind the pilot, near a window, but beneath and just inboard of an aluminum wing. Based on tracking tests, this location worked fine.

The multiple messages that can be sent back while in flight are what make SPOT unique. Obviously, there's the 911 key, which, assuming the unit has been turned on and is receiving GPS position information, immediately transmits a distress call to the GEOS International Emergency Response Center. Your SPOT unit's ID is correlated with your personal information. It will send the distress message every 5 minutes until canceled. However, the 911 function has to be manually activated; there is no G switch in the unit. Although SPOT won't alert rescuers that you're in an airplane, it's possible to add additional information to the rescue call during the web-based setup process; there you can say that the unit may be (or definitely is) carried in an airplane.

SPOT goes beyond the basic call for help, though. Two other buttons can be programmed to send messages of your choice as email and/or SMS text messages. For example, you could program the Check In/OK button to say, "I've landed safely, be home soon." When you press the button, assuming you have good satellite coverage and Globalstar gets the message, the system will spit out an email and/or text message saying just that. You can define the message via the setup page on SPOT's web site. It's the same deal for the Help button, which has parallel functionality with the Check In/OK button. It will not alert emergency personnel; it just sends a message of your choice.

These functions are covered under the $99/year basic fee. For an additional $49/year, you can have the unit track your movements. Every 10 minutes, the SPOT unit will kick out your latitude and longitude, which can be displayed on a map at the SPOT web site. You can make the information public or have it password-protected on the site. We found the tracking function worked quite well, though there were infrequent dropouts of data; some points were more than 10 minutes apart. Moreover, SPOT does not send out altitude or speed, so it's impossible to know if the hack is in flight or at the airport, if he's moving or not. In this respect, SPOT is not as flexible as the APRS equivalent (see "Found From Space," August 2008), but it also doesn't require you to have an amateur radio license.

For a pure consumer product, SPOT seems to, well, hit the spot. We haven't, thankfully, had to use it in an emergency, but the thought that it is backing up the 121.5 MHz ELT in the tailcone is reassuring.

For more information, visit *www.findmespot.com.*

—Marc Cook

Narco ELT-910.

Installations

If your airplane is finished and you don't want to do all that rework, there's a fine fourth option. You kept your 121.5 MHz ELT, so you're legal. You can augment it with a PLB for less than $400, and now you're covered. Not perfectly, but it's an affordable upgrade that takes care of some of the problem.

PLBs are 406 MHz units that were initially legal only for hikers in Alaska. When the test program demonstrated that the performance was there, PLBs were approved for the rest of us. While this seems an attractive idea on first blush, consider that the problem of a non-traceable false alarm is still there if you rely on your original ELT. Because a PLB will not automatically activate, you have to be out of your metal airplane, deploy the antenna, and flip the switch. Forget setting it off while in an engine-out emergency. You're flying the airplane, remember? Think of it as an insurance policy. Limit yourself to low coverage and you get a lower price.

Testing your 121.5 MHz unit is pretty easy. Wait until the top of the hour, tune your radio to that frequency, push the test button briefly and hear that *wheeeep, wheeeep* sound. Or you could put a simple AM radio tuned to any frequency within 6 inches of the ELT antenna, and you should hear that distinctive noise.

A 406 MHz device transmits a digitally encoded signal of your registration, so there's nothing to hear. You simply look for a flashing LED and buzzing of the unit itself. The buzzing is quite loud, too. At 80 dB a false alarm can be heard through a closed hangar door.

During a test that digitally encoded signal has had two of its digits swapped. The satellite sees this, knows you're testing and ignores you. The 121.5 side of the box is doing what it always has done, so remember to do this at 5 minutes before the hour.

There's a limit to the number of times you can test the unit. The on-board computer will debit you for 30 seconds of use each time, and when you reach one hour, an LED flashes to tell you to install a new battery.

Pointer 3000.

Category and Class

We've already spoken of the three major categories: EPIRB, PLB and ELT. They're all the same basic device in that they transmit a unique call for assistance on the 406 MHz wavelength. Let's summarize them and then look at the subcategories.

- EPIRB (emergency position indicating radio beacon). This is the nautical version, so it has to float and resist water intrusion to a depth of 1 meter, but it won't have the ΔV switch. It's not used on aircraft.
- PLB (personal locator beacon). This version is lightweight for hikers. It transmits your registration, along with a "P" to indicate that SAR should look for a human-sized target, not a boat or aircraft. You have to be out of the aircraft and trigger it manually.
- ELT (emergency locator transmitter). It's for aviation use, so it has the ΔV switch and limited impact and fire resistance.

Within those three categories, there are designators:

- AF (auto fixed). This means it's triggered automatically and is bolted to the airframe.
- AP (auto portable). It's triggered automatically and can be quickly removed for portability.
- P (portable). You have to manually activate it, and you can easily take it with you.
- H (helicopter). This has the omnidirectional G switch, not the ΔV type. It's also AF rated.
- S (survival). This has been tested for fire and is waterproof to a depth of 1 meter.

The designators can be mixed and matched. Flying your helicopter in Alaska? Then AF/H/S is for you.

There's also the issue of programming them. There are four programming protocols: tail number, serial number, aircraft designator and ICAO. The only time you need to worry about this is if you spot one on the Internet that's too good a bargain to pass up. Be sure that it's programmed for either the tail or the serial number.

If you buy it from a reputable dealer, you need not give this another thought as it will be programmed before shipment. But you still need to register it. This requires completion of a simple, one-page form that lists the typical name, phone number, aircraft color and type, and includes instructions on where to send the form. If you sell the airplane later, the new owner will need to fill it out again so that SAR can go looking for him, not you.

What to Buy

In one sense, the decision about what to buy is simple. The FAA requires all multi-seat aircraft to have an ELT. You can continue to use an inexpensive 121.5 MHz unit and hope you get heard. Or you can opt for a more expensive 406 MHz ELT and have assurance that your distress calls are more likely to be heard. The market is still responding to the essential phase-out of 121.5 ELTs and prices for the 406 units are expected to come down as the category fills out with more new product. Today, it's probably a bit early to spend big on a 406, but keep one in mind if you're still in the building process. By the time you're ready to fly, the category might look substantially different. ✈

RESOURCES

ACK Avionics
408/287-8021
www.ackavionics.com

Ameri-King
714/842-8555
www.ameri-king.com

Artex
800/547-8901
www.artex.net

EBC
800/382-0079
www.emergencybeaconcorp.com

Kannad (post a message on the Contact Us page)
www.kannad.com

Merl, Inc.
203/237-8811
www.merlinc.net

Roll Your Own

After static-testing the one-off KK-1 design, *it's time to actually start building one.*

BY KEN SCOTT

Like every homebuilt airplane since Wilbur and Orville's, our KK-1 was taking longer to build than we had envisioned. But now that the static-testing was out of the way—we did not intend to test the fuselage—we pressed on. (In case you're just joining us, the first part of this series appeared in the December 2008 KITPLANES®, and we described the static-testing process in the January issue.) The lessons of the test wing helped immensely, and the flight wing was finished in about three months.

The fuselage begins with a stainless-steel firewall and an aluminum keel. The keel is built from bent sheet aluminum and forms three sides of a box running from the back of the firewall, between the pilot's legs to the forward face of the mainspar. The top of the box gets lower as it moves aft, and the whole thing is open on the bottom of the fuselage.

Behind the seat, the fuselage is a simple cone. A couple of bulkheads of pressed aluminum provide the shape, and single-curvature aluminum skins rivet together to supply the strength. Curving longerons, made from 6061-T6 aluminum angle, run from the firewall to the rear bulkhead.

The control system is very much RV, with a swinging control column under the floorboards that propels pushrods to the ailerons and elevators. Everything is on rod-end bearings—there are no cables, no pulleys—and it runs as smoothly as you could want.

The Engine Arrives

Meanwhile, Mel Ellis, our engine man, had been busy in his shop, and just before the flight wing was finished, he showed up with the completed engine. Using a VW in an airplane presents some geometric challenges. Common aircraft engines use an updraft carburetor mounted underneath the engine, but the VW has its intake ports on top of the cylinders. In the car, the carb is mounted on top and short intake runners take the fuel/air mixture to the cylinders. We wanted the carb on the bottom of the engine so we could use a gravity-feed fuel system and eliminate the need for a boost pump.

The exhaust is another problem. Air-

Krueger contemplates the early stages of the fuselage. Looks like he's on the phone...

How many airplane designers get to actually build what they design? Krueger squeezes rivets.

Starting the nosebowl plug. The disk represents the diameter of the spinner.

plane engines have their exhaust ports on the bottom of the cylinders, so stub pipes can go almost straight down and join an exhaust system that usually exits underneath the fuselage. The VW exhaust ports are aimed in the horizontal plane. Those experienced in VW airplanes counsel using the lightest propeller possible and avoiding prop extensions—thereby reducing stress on the crankshaft. That means the propeller plane is pretty darn close to the front of the engine, and that front exhaust pipe has to make a sharp 90° (or more) bend to avoid interfering with it.

These problems have all been tackled by other VW designs, so parts are available. Ellis used induction runners and tubing from Great Plains to fabricate an

The nosebowl mold, pulled from the plug and reinforced.

induction system that suspended a small Zenith carburetor under the engine. He made a four-into-one exhaust system that joined just aft of the carb.

When he finished assembling the engine, Ellis mounted it on a test stand, bolted on an old wood prop for a load, and fired it up. He was pleased to find it ran well from the start. He delivered it while we were building the flight wing, and on many evenings I found myself staring at it over in the corner, while my hands did familiar jobs on the wing.

Although I was perfectly happy with the basic engine—his craftsmanship was excellent and it matched our requirements quite well—I suspected that keeping the VW happy would be the area where we had the most to learn. I thought we'd find little problem with the aerodynamics, strength or flying qualities of the airplane, but things like getting the mixture right (we worked up a rudimentary mixture control for the Zenith carburetor, which normally doesn't have one), carb ice, heat inside the cowl and throttle lag due to that long, complicated induction system could potentially do something unexpected. I vowed that we would be extremely careful flying behind this engine.

Moving On

With the flight wing behind us, construction accelerated. We made the parts for the forward fuselage just like we made the wing parts, and soon we had the fuselage, between the firewall and the mainspar of the wing at least, assembled. A spare firewall was mounted on a roll-around engine stand and we hung the engine on it. I spent the next months of evenings designing and making engine-cooling baffles. After several tries with cardboard patterns, I had a system that looked good, directing all the cooling air either through the cylinder fins or the oil cooler mounted on top of the engine case. Baffles for the VW seem to be sort of a black art, but I was convinced that this system, based on what I'd learned on several Lycoming installations, would be at least as efficient as any VW system I'd seen at fly-ins.

Cowlings. Tricky little buggers. On

The front of the all-metal cowl determines the shape at the back of the nosebowl.

The nosebowl plug nearing completion. The author's long dormant surfboard-shaping skills came back surprisingly well!

Krueger holds the first part pulled from the mold.

Photos: Kevin Wing, Ken Scott

The finished nosebowl has stood up well in service. Paint? Bah!

most one-off homebuilt airplanes, the usual technique is to hang the engine on the airplane, plastic bag it, cover it with foam, carve the foam to a cowl shape, glass and wax the foam to make a plug, make a fiberglass mold of the plug and then make the fiberglass part.

My building partner Ken Krueger had a better idea and came up with a solution that ended up being one of my favorite parts of the whole project. He used several tapering metal strips that, when curved until their metal edges met, formed a compound-curved surface. Actually, if you look at it closely, it is faceted rather than truly curved, but the difference is so subtle that it's hard to see.

My original thought was to learn enough metal-forming skills to make a metal nosebowl and mate it to the front of the cowl. I'd seen Kent White's amazing work on the Hughes Racer and some exceptional work on a local Bellanca replica, so I knew there were people who could make metal do what I wanted it to do. I'd just have to learn how. A few attempts at making the nosebowl from shaped aluminum showed me that this is not a beginner's project. The compound curves and reverses call for skills that I just didn't have. Rather than hold up the project, I decided to punt and make the nosebowl from (whimper...) fiberglass.

Sand, Sand, Sand

I mounted the cowl on the forward fuselage. The open hole in the front was a floppy oval—it looked like a big basking shark. We defined the shape of the opening on the computer and made a template in eighth-inch aluminum plate. With this fastened into the front of the cowl, I glued a big block of dense foam on the front and proceeded to carve away everything that didn't look like a KK-1 nosebowl.

This brought about one of the stranger moments of the project for me. Memories can be surprisingly powerful. I don't care to recall much about my high school years—let's just say surfing was the best part of that time in my life. And some of the best times surfing were shared with a neighbor kid who is still my closest friend. Not content with just riding waves and messing up the seats in our parents' cars with surf wax and saltwater, we spent a lot of time building surfboards in my parents' garage, working with foam blanks and fiberglass cloth. Now, 45 years later, I found myself again with a few Masonite templates, a block of high-density foam and a Stanley Surform. Suddenly, even though I was a gritty, sandy mess standing in a hangar 50 miles from the nearest ocean, I could taste saltwater and groan through the headache shock of cold liquid as we paddled out into the black predawn. In the background, I could hear my dad muttering about the smell of resin and the mess in the garage but never telling us to find somewhere else to work. All that was a lifetime ago now, but for a few moments, how I missed it! (I also found that you don't want to wipe your eyes with a wrist covered in foam dust.)

Eventually I had the shape I wanted. I glassed it with three layers of 8-ounce cloth, sanded the result smooth, filled and sanded the little bubbles, and finally waxed it and covered it with mold release. I covered the plug with four layers of 8-ounce cloth and epoxy resin, which turned out to be barely enough to make a good mold. With a few plywood supports glassed to the back it sufficed, and I laid up a three-layer nosebowl inside it, using West Systems epoxy. In the end I'd made a serviceable nosebowl,

They call it homebuilding because you do it in your home—in this case, Krueger's living room.

The one-piece wing just barely fit. It's time to think seriously about moving the project out of the house.

but with a large investment in time and a surprising amount of money. If I'd had the skills, I could have made it in metal for about three bucks in less time.

Way Back: The Aft Fuselage

While I was making a nosebowl out of a big mess of foam and fiberglass, Krueger finished design work on the aft fuselage—the tailcone and aft cabin area. I pressed out the bulkheads around form blocks—a process identical to making wingribs and tail parts. Krueger had developed a way to bend J-stringer right on the edge of skins rather than make separate parts and rivet them on. In four or five evenings, we'd made the parts and riveted together the aft fuselage, which weighed less than 25 pounds, at least the part of it below the main longerons. We stuck the aft fuselage in Krueger's Isuzu Trooper and hauled it to his home, where he joined the cabin section, inserted the longerons and, with help from his wife, Susan, riveted on the top fuselage skins.

At this point we were into early 2005. The fuselage was in Krueger's living room, the wing was in my hangar above my RV-6 (where it stared balefully at me whenever I went flying), and the firewall forward was in my shop. Both of us were getting to the point where we really wanted to put the beast together and fly it, just to see what we had. We turned up the wick under our work sessions and began to tackle the details. We mounted the stabilizers to the tailcone and set the elevator stops. That gave us the dimensions we needed to build the aft elevator pushrod—and a whole lot of other small things, none of them difficult.

Where the Fuel Goes

The 22-gallon fuel tank was the source of one of our few real design "discussions." We wanted it high to permit gravity feed to the engine; keeping it in the fuselage meant there would be no connection to undo when the wing is removed. This component in our airplane does a lot more than just hold fuel. It serves as the rollover protection for the pilot, because it is the only part of the aircraft structure that is higher than the pilot's head. It must support the shoulder belts, too. Normally, these would be anchored on the longerons or somewhere in the aft fuselage, but there is no good opportunity to get there when the tank is in the way. On top of this, the tank skin is also the outside skin of the airplane.

I was not comfortable trying to make this one structure do all of these jobs. I particularly did not want to have the shoulder belts strapped to the forward face of the fuel tank. It seemed to me that if the worst came to pass and the belts were subjected to the force of a body

Simplicity in the Panel

Many airplane builders spend cubic hours designing, dreaming and drooling over their instrument panels. Not us. KK-1 is a cheap, simple airplane, so we planned the absolute minimum instrumentation. To the required airspeed indicator, altimeter, oil pressure, oil temperature, tach and compass, we intended to add carb heat and cylinder-head temp gauges. All of it used, all of it inexpensive.

That was the plan. The reality was that Rob Hickman, who heads Advanced Flight Systems (engine monitors/EFIS systems) and Proprietary Systems (angle of attack indicators), moved in four doors away. His instruments are installed in both Van's RV-10 prototypes, and we'd learned to enjoy the easy-to-read displays, accuracy and recording functions. I shamelessly took advantage of Hickman's inability to avoid me around the neighborhood, and he agreed to provide us with one of his lovely little recording engine monitors, the ACS2002.

One of the best features of the instrument—besides the fact that it watches and displays a wide range of engine parameters—is that it also functions as a data recorder. It records all engine data, airspeed and density altitude every second. When a flight is over, we can download data into a PC and graph performance versus power, temperatures versus airspeed, etc. This relieves the test pilot of recording chores and allows him to concentrate on flying the airplane.

The rest of the KK-1's panel reflects our budget. A Garmin GPS III Pilot is our navigator; a black-and-white screen seems appropriate for an unpainted flivver. The com radio is a hard-mounted JD-200 handheld from Sporty's. Not a gyro in the house!

—K.S.

(probably mine!) slamming forward against the shoulder straps, the tank might rupture. For Krueger, however, getting a single structure to do all these things was satisfying—engineering elegance, as it were. He took the time to walk me through the numbers and forces involved; as usual I came around to his way of thinking and realized that by the time enough force had been exerted on the shoulder harnesses to rupture the tank, I was probably beyond caring anyway.


Krueger's daughter, Amy, says goodbye to the fuselage as it heads for the airport.

The only problem was that, to support these loads, the forward bulkhead of the tank had to be formed from heavy 0.063 aluminum. Bending metal this thick requires a generous radius, which in turn makes fitting parts close enough for prepunched holes to match quite difficult. In fact, we had to flute deeply between holes in the 0.063 flanges, and ordinary fluting pliers would barely make a mark, let alone a flute. We ended up using the end of an 8-foot hydraulic press brake that we carefully adjusted for depth. It was certainly the biggest fluting pliers I'll ever use!

It took only three long evenings to mix several glops of tank sealant and rivet the tank together. A simple aluminum tube serves as a vent line, and a plastic tube run top to bottom on the forward face of the tank became a sight gauge. The flush filler cap is right out of the RV parts bin.

It's Got Legs

The KK-1's nosegear leg was a sturdy, probably excessively so, affair. Fundamentally, it's a bent steel tube. At the upper end it is welded to a cross tube, which fits between the inside faces of the tunnel that runs down the center of the fuselage. Steel flanges on the ends of the cross tubes are riveted to the tunnel sides. The idea is that the cross tube serves as a torsion bar, which will help absorb and damp any forces that the slightly flexible gear leg can't. The whole assembly turned out heavier than we'd originally estimated, so we fitted a light composite Azusa nosewheel and a Lamb tire in the welded aluminum nose fork.

The maingear leg is simply tapered steel rods plugged into a tubular truss bolted to the mainspar. The lower end is bent and threaded to become the axle. The Azusa wheels are crude, but ran true when we learned the trick of assembling them on the axle. We originally planned simple cable-actuated mechanical brakes, and we had actually bought a set. We ran into problems trying to figure out cable routing from the rudder/toe brake pedals to the mainwheels on the wing. After looking at all the pulleys and fairleads we were going to need, we decided it was easier, albeit more expensive, to install hydraulic brakes. We bought a set from Great Plains Aircraft, and Bruce Reynolds used his mill to help us adapt them to our gear leg design. In the end, we'd lightened them substantially and made them fit well.

All Together Now

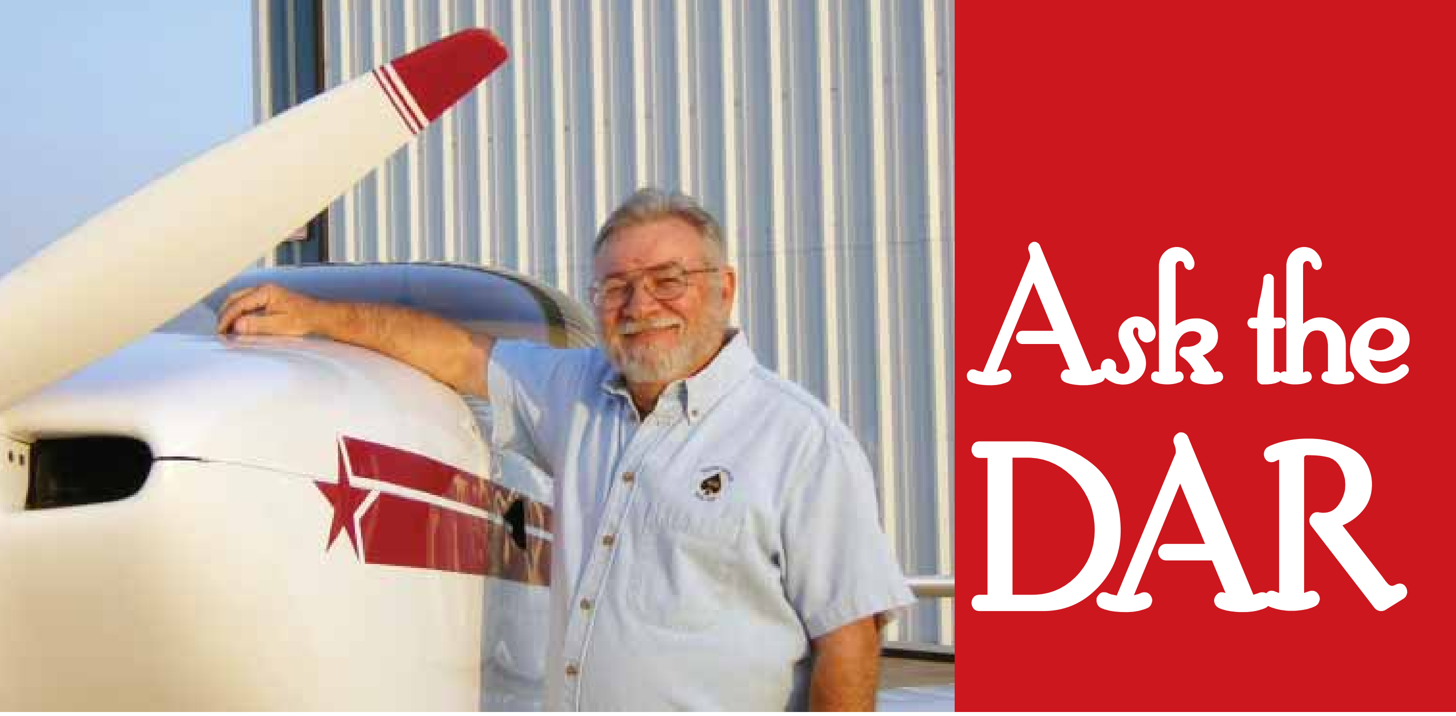
At long last, on Memorial Day 2005, the wings and fuselage met for the first time. We set the wing on the tires and let it rest on Krueger's piano bench. With the airplane taking up most of his living room, there wasn't much piano playing going on anyway. Then we lifted the fuselage, complete with nosegear, over the top of the wing and set it down.

At first, there were a couple of small interferences that blocked the marriage, but 5 minutes with a file solved them. There are four places that must line up between wing and fuselage, the most important being just above the mainspar, where two tangs of 0.063 aluminum bar stick up from the wing and slide between three similar tangs on the fuselage side. At the rear spar, there's a similar one-into-two arrangement. Then there are about 20 nutplates that must match on the rear floors and tunnel.

There is a lot of friction in this arrangement, so it took some judiciously applied muscle to slide everything into place. But when we had tapped everything home, we were excited to find that every single hole lined up. The flaps and ailerons, pushrods, control column and flap lever were already installed in the wing, so within a few minutes we could toss a couch cushion into the cockpit, sit down and make airplane noises while wiggling the control surfaces.

The biggest surprise, however, was how big the project was. You can look at a computer screen all you like, but when the reality is sitting in the living room it is a different story. We could not get over how much larger it seemed in real life. The cockpit was huge, probably the roomiest either of us had ever seen on a single-seat airplane. The fuselage sat tall on the tricycle gear—really tall. Even for guys our size, it was a big step up onto the wing. I realized that our 450-pound empty weight wasn't going to happen... that's less than half what the RV-6 weighs. I knew Krueger was good, but I didn't see how anybody could design an airplane 85% as big as an RV and make it weigh less than half as much! In the back of my mind, something said: 500 pounds, buddy.

At long last, it really looked like an airplane, even if it was trapped between a piano and a French door! Next month we'll wrap this up with final assembly at the airport, test flying and performance measurement. ✈



On major-portion rules and flight advisors.

BY MEL ASBERRY

Question: I am looking at building a Zenith CH 750 LSA kit. As I understand it, the FAA, for the present, is not going to "approve" any new 51% kits. So what would happen if I purchased and built this kit before the FAA gets around to approving kits again and then the FAA/DAR inspector feels I haven't done the majority of the work? Does it become the world's most expensive paperweight? Can I disassemble a component and rebuild it from basic materials?

Answer: If you build the kit as an ELSA, the major portion rule (officially, the FAA does not use the "51%" term) does not apply. Of course as an ELSA, it would have to be built exactly per plans with no modifications or changes. And Zenith would first have to build at least one conforming prototype as an SLSA.

From the wording of your question, I assume that you are talking about building the kit as an Experimental/Amateur-Built. When building an amateur-built that is not on the approved major portion list, you would need to use FAA Form 8000-38. This list compares what the kit manufacturer versus the builder accomplishes and allows check marks for either the kit manufacturer or the builder. After going through the list, if the builder ends up with more check marks than the kit manufacturer, then you are good to go.

If a DAR finds that you haven't met the major portion rule, he must deny the airworthiness certificate. Your recourse would be to have it inspected by the FAA or another DAR, but I seriously doubt that another DAR would consider overturning that decision. He would really be sticking his neck out. Your chances may be better with an FAA inspector. However, many FAA inspectors don't have the time to keep current on amateur-built rules, so it would also be unlikely that they would overturn.

The last part of your question is very interesting. If you disassembled a component and reassembled it, that would not count as fabrication. On the other hand, if you destroy that component and build a new one from raw materials you could certainly get credit for the fabrication. In this case, you are walking a narrow line, so you must provide sufficient proof of what you have done, and the decision is still up to the inspector.

If all else fails, your other option would be to license it as Experimental/Exhibition. The Exhibition classification is not a good alternative, because the restrictions are quite stringent—see FAR part 21.191(d)—and you really want to avoid that classification if you can.

Technical Counselors and Flight Advisors

Several decades ago, the FAA required "in-process" inspections for Experimental/Amateur-Built aircraft. The FAA had little time or expertise to dedicate to these inspections, so the EAA stepped up to the plate and offered to allow its "designees" as they were called at the time, to perform the inspections as long as they were not required to sign anything. The FAA agreed to this, and the newly named EAA technical counselors picked up this duty. While in-process inspections are not a requirement for certification, they are strongly recommended. I prefer to see at least three in-process inspections by EAA technical counselors, A&P mechanics or experienced builders. These inspections should be noted in the builder's log along with the date and name of the inspector.

Flight advisors should actually be contacted before the build process is initiated. Part of their job is to help you select what kind of aircraft would be most practical for your experience and your mission.

After the build and before the first flight of your new WhizBang Special, you should interview with a flight advisor. Together you will review your flight experience and similarities between what you have been flying and the new aircraft to be tested. At this point the advisor will help you determine whether you should conduct the first flight or have someone more experienced do it. Generally we, as flight advisors, recommend you get a pilot who is experienced in your type of aircraft to make that all-important first flight. An experienced test pilot should be so comfortable in the aircraft that flying it is second nature, and if there is any kind of problem, the pilot will be able to concentrate on the problem without compromising control of the aircraft. ✈

Please send your questions for DAR Asberry to editorial@kitplanes.com with "Ask the DAR" in the subject line.

Building a Zenith CH 750 as an Experimental/Amateur-Built requires use of FAA Form 8000-38 to prove to the DAR that you completed the "major portion." This specific design was released after the FAA froze the approval list, but it's similar to the CH 701, which will help DARs with the approval process.

Photos: Mel Asberry, Kevin Wing

Either bias tape or straight tape may be used around a curved area. With a very abrupt curve, a bias tape is sometimes preferable.

FABRIC

A further look at curved surfaces and how to deal with inspection rings, drain gromments and gussets.

BY RON ALEXANDER

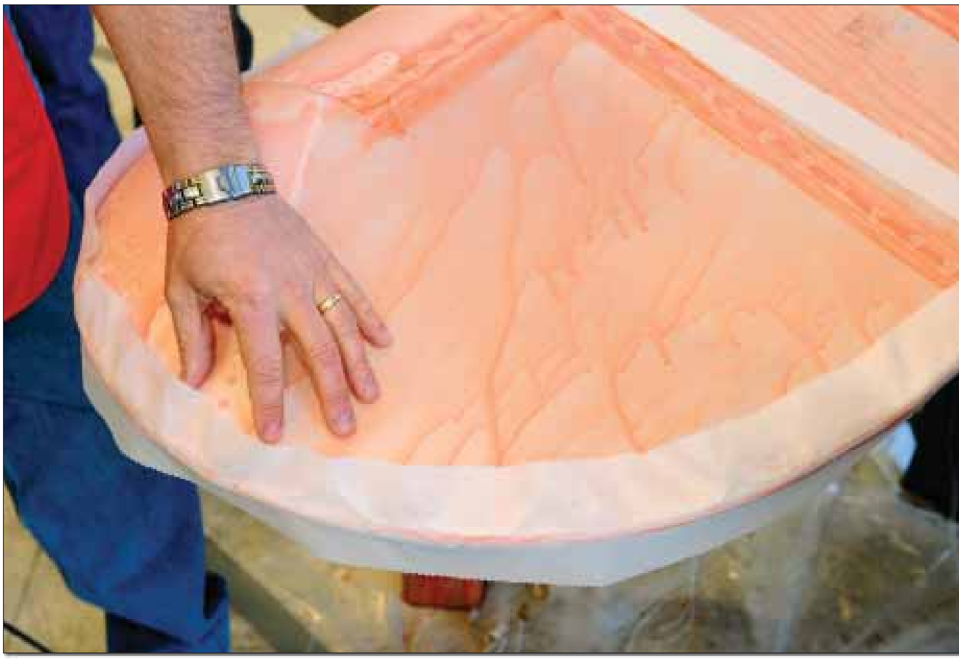
In last month's installment, we began a discussion of finishing tapes and how to apply them. Finishing tapes are required over any fabric seam and over wing-ribs after the fabric has been attached. They should also be placed on leading and trailing edges of surfaces, over the stringers on a fuselage and over any area exposed to wear or that may need additional reinforcement.

Now let's continue the discussion by outlining the methods required to attach inspection rings and drain grommets on a fabric surface.

Taping Curved Areas

Compound curves found on wingtips and tail surfaces are more easily taped using bias-cut tapes. These specially cut tapes will more readily conform to a curved surface than will linear or straight tapes. Remember two important points: A bias-cut tape has a seam about every 70 inches, and the tape will reduce in width about one-third when stretched around a curved area. So when you're selecting the proper width of tape, remember to order a size wider to allow for the shrinkage. You will probably want at least a 4-inch-wide tape on a wingtip bow. That will allow you to begin on the leading edge of the wing and extend the tape around the bow, finishing with the proper width on the bow itself. You can actually overlap the bias tape on top of the leading-edge tape that is in place.

Begin taping a curved area by securing the tape at one end. Be sure to cut the tape to the proper length before applying.



You can work a straight tape around a curved area as shown. The advantage of a linear or straight tape, as opposed to a bias-cut tape, is that there are no seams to deal with during the application.

All of the wrinkles that may occur in the tape can be worked out of the fabric by using the heat from an iron to smooth and form the material.

The first step is to cut the length of tape needed. Don't forget the seams. Start your cut right after a seam. Cut the end that will be overlapped in the shape of a teardrop, as this will provide a more pleasing appearance. After cutting the tape, use a pencil (no pens) and carefully mark a centerline along its entire length. You can again mark the area where you will be applying the tape. Mark about a 3-inch width on the wingtip bow. Precoat this area with Poly-Brush that is thinned with one part of reducer to three parts of Poly-Brush. You will now attach the end of the bias tape cut in the shape of a teardrop over the leading edge

Photos: Richard VanderMeulen, Marc Cook tape that is in place. Apply Poly-Brush to a small area on the leading edge where you will overlap the tapes, and then apply the tape with Poly-Brush, holding it in place with a spring clamp or your fingers. Allow it to dry for a few minutes until it remains in place on its own.

The idea is to cement a small part of the bias tape in place, let it dry, and then come back after about an hour to complete the taping. You now have the tape held in place over about a 3-inch area, allowing you to apply tension to the tape. Next pull the tape around the wingtip, applying it to the entire bow. Use the pencil line to keep the tape centered over the bow. Keep pulling on the tape until all of the wrinkles are gone and the tape is in place. You now have a tape that has spanned a curved area without leaving any puckers or wrinkles.

Linear-cut tapes may also be pulled around curved areas if the curve is fairly shallow. Many people prefer using linear tapes because there are no seams to deal with. To use a linear tape, first attach the tape over a small area and allow it to dry. Then stretch the tape tightly around the curved area over a coat of Poly-Brush. You will probably end up with a few wrinkles and tape edges that are not cemented in place. You can then take an iron, calibrate it to 225° and use it to smooth out the wrinkles.

Again, bias tapes are more easily placed around a tight curve, but linear tapes may be used around normal curves of wingtips, etc. The choice is yours. I would suggest practicing on a curved part if at all possible before going to the actual part you are covering.

Heat Smoothing

This step makes the job look professional. When you are taping (linear or bias tapes) you will probably end up with a few wrinkles and raised edges on the tapes. These can be smoothed down and removed with the application of heat from an iron.

First, calibrate your iron to 225°. A small hobby iron is best for this task. The Poly-Brush used to cement the

After applying the tape, it can be formed to the curve using heat smoothing with an iron set at 225°. Make sure your iron is calibrated, as any hotter will deform the tapes.

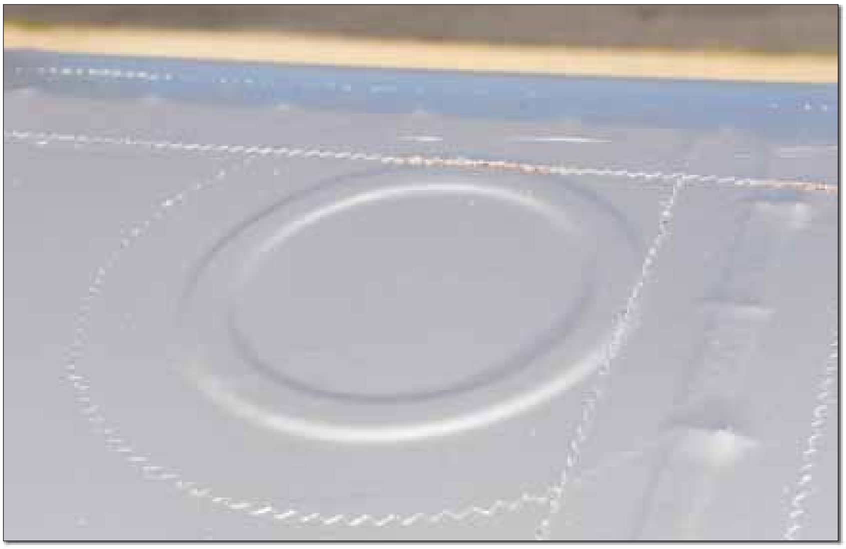
Place a piece of smooth fabric over each inspection ring. Cut to fit using pinking shears. You can trace the outline of this patch using a 1-gallon can as a pattern. Place the can on the fabric and trace around the bottom of the can. The size will be just right to cover the inspection plate.

The finished patch, as shown here, should have a smooth appearance.

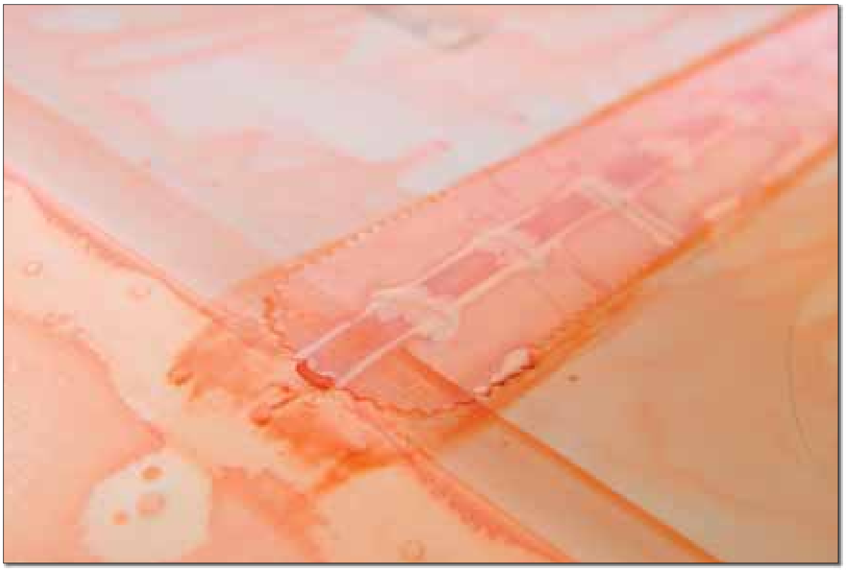
tapes in place will begin to soften at about 200°. (This step can be effectively accomplished only with the vinyl coatings used in the Poly-Fiber process.) This means you can use the iron to actually smooth out any imperfections that exist, particularly along the edges of tape. If you have pinked edges that are not cemented in place, you can use the tip of your iron to literally melt them down. This is much easier than sanding out imperfections.

You must be careful not to heat the iron to above 225°. Anything hotter will shrink and deform your tapes, and you will then have tapes with a snakelike appearance. All wrinkles, bubbles and raised areas can be fixed using the iron as discussed. Go over every tape edge on the fabric surface. Use your fingers to tell when they are smooth enough. When they feel smooth to the touch, they will appear smooth in the final finish. This one step will save many hours of sanding later.

All wrinkles can be worked out using heat smoothing and forming.



An example of a completed patch over an inspection ring. When needed, the fabric may be cut out of the inside of the ring so that an inspection plate can be added.



Tapes may be cut so that they are rounded on one end to make for a more pleasing finished appearance.

Inspection Access Rings

After you have covered your airplane you may have to gain access to certain areas inside the wings or the fuselage. This may be accomplished using plastic inspection rings. These hole reinforcements are cemented in place over every drag-wire junction, wing fitting, cable guide, control bell crank or over any other area that will need to be inspected regularly. Access may also have to be gained into one of these areas during assembly of the airplane. These inspection holes are usually installed on the bottom side of a surface. If you are recovering an airplane, use the old fabric as a guide to locate placement of the inspection rings.

The plastic rings are cemented in place using Poly-Tak fabric cement. Use a small brush to apply a coat of Poly-Tak onto the ring itself and then lay it onto the fabric (flat side down) in the area desired. The fabric cement will dry within a few minutes. Be sure to clean up any cement that works out from under the ring using MEK.

After cementing the ring in place, you will then want to cover it using a piece of fabric. Failure to do this will provide an opportunity for the ring to separate from the base fabric at a later time. This separation is often the result of vibrations and air loads encountered when flying the airplane. A simple piece of fabric cut to fit over the ring will prevent this from occurring.

The first step in cutting a piece to fit over the ring is to smooth the fabric that will be used. You don't want any wrinkles in it. Light weight fabric works best for this purpose. You can use an iron set at 250° and iron out all of the wrinkles on a piece of scrap fabric. Then take one of your 1-gallon cans and carefully set it on top of the piece of fabric. Take a pencil and draw a circle on the fabric using the outline of the can as a guide. This size is just about perfect to cover the inspection ring. You will want the fabric to extend beyond the ring itself. Cut the fabric with a pair of pinking shears. This will ensure you have pinked edges for proper cementing.

Using Poly-Brush that has been thinned appropriately, brush on a coat both inside and outside the inspection ring large enough to wet the fabric overlay. Set the piece of cut fabric over the ring and allow the Poly-Brush to soak through the fabric. Use a brush to work the Poly-Brush through the fabric. After it dries, brush on another coat of Poly-Brush. After this coat has thoroughly dried, you can use your iron to smooth out any imperfections.

When you have completed the airplane you may want to cut the fabric out of a few of these inspection rings. Cut out only those where access is needed for assembly of the airplane. Leave the others uncut. Those that remain can be opened at a later date if the need arises. Once the fabric inside the inspection ring is removed, it will be covered with a metal inspection plate. These plates are made to fit over the plastic inspection ring and are easily removed to provide access to the area.

Another tip: When you are painting your airplane be sure to paint a number of metal inspection plates the final finish color. You will then have them available to place on the inspection rings when needed at a later time.

Fabric or other reinforcing material may be cut to the size and shape needed. Be sure to follow fabric system guidelines when applying.

Drain Grommets

Every fabric-covered airplane must have a way for moisture to escape. Condensation can introduce moisture, or rain or water from washing your airplane may leak into a wing or fuselage. These areas need to be able to breathe and allow moisture to escape. This is accomplished using drain grommets. These small grommets are cemented in place on the underneath side of surfaces. Any place where you think water may collect should have a grommet. Most wings, for example, will have a drain grommet located next to the outboard side of each rib at the trailing edge. Some people will place a grommet on each side of a rib. Obviously, you will want to place drain grommets on the underside of a fuselage to allow water to drain.

Drain grommets are cemented in place using Poly-Tak just like the inspection rings. They are then covered with a piece of fabric. They will vibrate loose if not covered with fabric. You can use a roll of fabric and draw a pencil mark on the fabric to be cut using the inside of the roll of fabric as a guide. This will provide the ideal size piece of fabric to cover a drain grommet. After you have completed the final finish, you can use a pencil soldering iron and melt the fabric

Cut a fabric patch to the specific shape that will be covered. Be sure it fits smoothly, and then put it in place using the same procedure you would use for a finishing tape.

Grommets are preferred to reinforce drain holes, but some builders elect to go without. This hole was made with a pointed-tip soldering iron.

out of the drain hole, which will allow water to drain out.

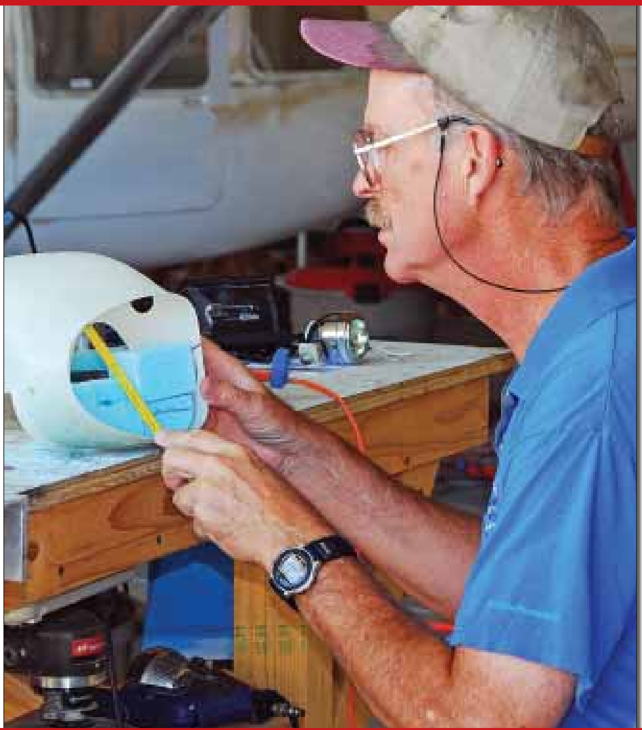
Three types of drain grommets are used: plastic, aluminum and seaplane grommets. I prefer to use aluminum grommets because they are thin and cover easily with a piece of fabric. Seaplane grommets feature a small vented hood that will help them siphon water out. They are normally reserved for use on seaplanes.

Fabric Gussets

There may be areas of the fabric that need to be reinforced where a finishing tape is not satisfactory. The area may be oddly shaped or too large to accommodate a tape. When this occurs you will want to cut a piece of fabric to the exact size and shape needed, and then apply it to the area using Poly-Brush. An example would be over a wingstrut fitting that is protruding through the fabric. The fabric area around the protrusion should be reinforced. This can be accomplished using a fabric patch cut to the proper shape and size. Be sure that you iron out all of the wrinkles on the fabric you will be using to cut out the patch. Use of light weight fabric is also recommended for these gussets or patches, trimmed using pinking shears.

After completing the steps outlined, we are now ready to begin spraying on our chemical coats. Next month we will review the fabric covering steps and then begin the spraying process. ✈

To Launch A LIGHT SPORT



Mounting the beautifully machined engine was surprisingly easy, and on balance things on the Jabiru J250 are going well.

BY BOB FRITZ

Last month I promised no monsters would intrude upon the serenity of building. A couple of minor gremlins waltzed through, but they were sent scurrying as nothing more than trivial annoyances. Maybe my expectations have changed?

So there the Jabiru sits. Horizontal tail planes are in place, and it's on three wheels with one sawhorse under the tail and three 5-gallon gas cans suspended from the nosewheel mount as a counterbalance.

This airplane is not supposed to be a taildragger, so let's get the nosewheel on the ground by adding a bit of a counterweight. There's a dandy piece of aluminum under the shelf, so we'll use it.

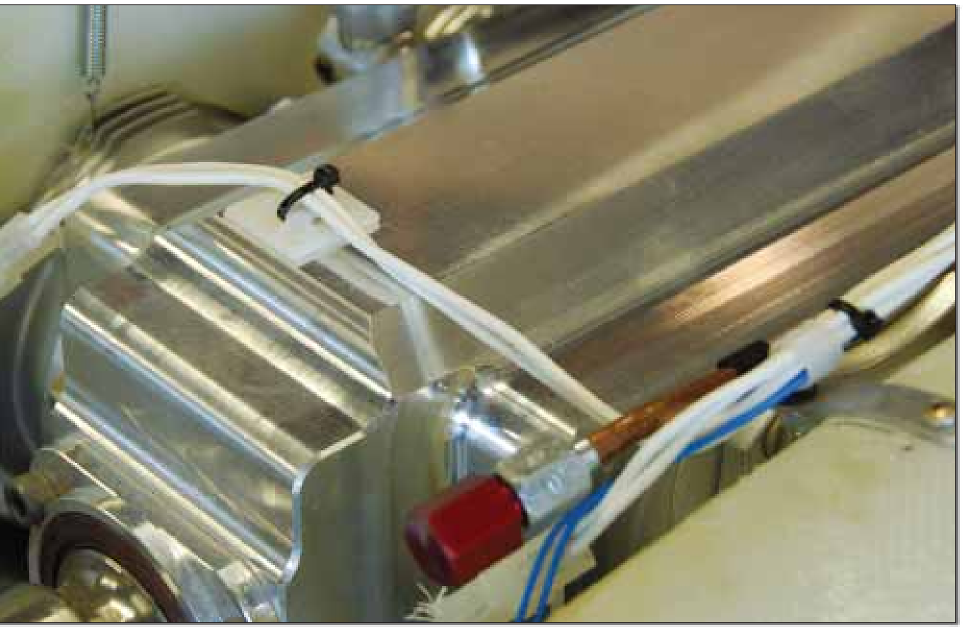
This was one of the reasons I bought this airplane; it has the most drop-dead beautiful engine you could ask for. The crankcase is two pieces machined from solid aluminum, which are bolted together and then given a completely unneeded pass with a fly-cutter. The result is a beautiful pattern of crescents along the upper surface, making the parting line between the cases almost, but not quite, invisible. Artwork.

The cylinder fins are also machined, not cast. The advantage here is not just beauty; it helps the cooling. Cast fins have to be tapered so the mold will release the part. That makes them thicker at the base than at the outer edge, so the fin has a higher volume/surface area ratio.

Let me explain: Heat up a thin hunk of metal to the same temperature as a thick hunk. Which one cools off first? Yep, the thin one, because the heat contained in the material is close to the surface.

"Hey wadeaminut!" you're saying. "This engine has a reputation for running a bit hot." As the Aussies would say, "S'truth, mate." I think I know why, and I'll be explaining the reasoning plus, I hope, offering a solution later.

But no matter what, this fin design



The engine is CNC-machined from two solid blocks of aluminum. There is a split line right down the top that is almost invisible.

On the left is the voltage regulator; the airbox is in the middle. You can see why it's important to mount at least the airbox before you hang the engine.

helps the cooling and looks great. The only thing needed is a transparent cowl…seems a shame to hide it.

Hanging the engine turned out to be easy. The factory instructions came through and suggested putting the mount onto the engine and then lifting the mount/engine into place. That's a heck of a good technique.

The engine/mount interface is cushioned in a sandwich of beefy rubber bushings topped with nicely machined aluminum caps, covered with self-centering spacers and pierced through with genuine AN bolts. If it were a lunch menu item, I could have eaten it, it looked so good.

Drilling for the Mount

Before that all goes together, though, you need to drill the holes in the firewall. Oops! Applying the stainless-steel shield covered up the eighth-inch holes that Jabiru had drilled in the wood. You can see them from the cabin side, and it sure would be nice to be able to check their location before enlarging and drilling through the stainless steel. Forget trying to use the mount from the inside; even if you could put it up there, there's no purpose, as it would be reversed!

All I could do is measure the bolt pattern on the mount, compare it to the holes that I could see, hope it was correct, and run a drill through from the cabin side. It worked! They were dead on target, so I enlarged them and did a fit-up of the mount by itself to assure that all the bolts fit smoothly.

What I should have done, and you should if you're building a Jabiru, is to check the position of the firewall holes before you put that stainless-steel firewall plate in place. The holes in the wood are about an eighth-inch in diameter, so put some bolts through the wood from the cabin side and then hold the engine mount up to them. The engine mount uses larger bolts, so you might need some help to hold all of it in place while you check that everything is properly centered.

I was lucky and in hindsight I probably should have played it safe by making a transfer punch. You home machinists out there can easily make one on a lathe. Cut a steel shaft such that it's a smooth fit through the engine mount, and then cut a nice point on one end. Drill through one of the existing wood holes and then through the stainless steel. Now hang the mount from that first hole and position it to level. One person holds the mount in place, and the other puts a punch mark on the firewall. Drill that second hole out to the size of your bolt, and hang the mount from the bolt. With the mount now stable, you can punch all the remaining holes in one go.

Using a transfer punch is preferable

Six exhaust pipes fit into one muffler, and it's amazingly easy to assemble.

Photos: Bob Fritz

to just using a drill through the mount if for no other reason than it's tough to keep the mount in position while pushing hard enough to start a ⅜-inch drill in stainless steel. Jabiru did it exactly right, and I didn't have to resort to the transfer punch.

But Before That….

Throughout this series, I have related how important it is to think ahead. Right here is a good instance of the truth of that advice. I'm going to have to mount the airbox on the firewall, and it's going to be a lot easier to drill the stainless without the engine in place. The instructions did say to do this, so I can't claim prescience.

It's a simple job, but an interesting component because the airbox itself is so well made. It left me puzzled about the quality systems at Jabiru. Why are the parts so inconsistent? The wingtips are atrocious, and the composite airbox is perfect? Whoever builds that part ought to be let loose on the rest of the airplane, I say.

Have the mount held in place with a couple of bolts so you can position the airbox. While you're at it, now is a good time to lay out where you want the starter solenoid and the voltage regulator. I put the regulator up there with the mount in place and found that I had to reposition it later. There's enough room for positioning these items, so be sure to just space them away from one another.

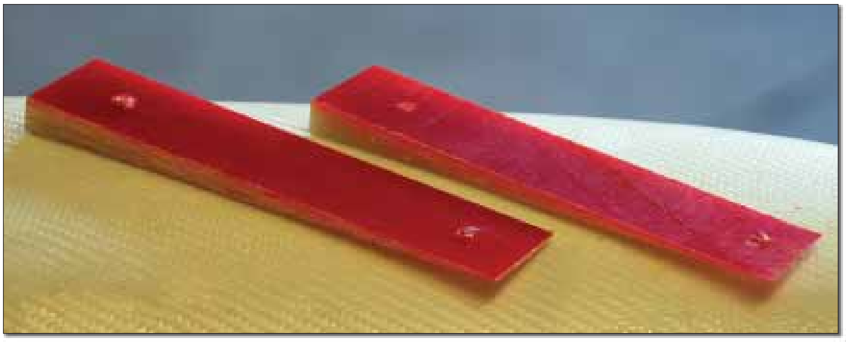
Having assured myself that the mount would fit the firewall, I could now reassemble the mount to the engine and hang the whole thing out there. I've loaded fuel in nuclear reactors and designed cutting-edge equipment for Silicon Valley, but this was just plain fun that made those experiences seem inconsequential.

My buddy Buzz had brought his engine hoist over, so we attached the mount to the engine and lifted it all up into place. Easy. Except the crankshaft is pointing up at about 3°! "Let it sit/settle/sag," said Buzz. I did, but it didn't. A preliminary fit of the cowl showed that something was askew.

The cylinder fins are also machined.

The air intake box before mounting. It contains an easily replaced filter.

After letting it sit for a couple of weeks, I decided to remove those shims between the engine and mount and remeasured it all. A quick fit of the uncut cowl showed that the crank would now exit roughly in the center of the cowl. I'm going to have to assume that the aft end is off-center though. If it is not I can plan on adding a big fin to the rudder. Remember P-factor? That's the asymmetric loading on the prop as the angle of attack increases. The prop is a big gyroscope, so if an unbalanced force is applied to one side of the disc, the reaction is 90° away; in this case it causes a yaw. Also, keep in mind the corkscrew airflow around the fuselage at low airspeeds and high prop thrust,



It wasn't until the author read the third edition of the instructions and was well past this step that he discovered what these are for. They fit between the fuselage and the gear leg and angle the legs slightly backward.

such as during takeoff. It hits the side of the rudder, so a bit of opposite angling of the engine can help.

Did I get it right? Shortly after deciding to remove the shims I received a third set of instructions in a PDF format. There are no shims. Those lads Down Under are getting this part straightened out, but only the first flight will tell if it's really perfect. Fortunately, it's easy to adjust in this design.

Muffler Snakes

Here's where I get to the 90% complete, 90% to go point by fitting the exhaust. I was mentally prepared to spend a lot of time trying to get it all to fit. Six exhaust stacks going into a single muffler would seem a job akin to stuffing mad snakes into a garbage bag. But it turned out to be really easy! Loosening just one pair of bolts on an exhaust pipe was all it took to get all six pipes into the muffler. Jabiru seems to have this thing for working in metal. It's pretty, it fits, and it's a pleasure to work with.

The muffler is held in place with four springs, not six. At first I thought they'd omitted one on each pipe, but a closer look revealed that somebody at the fac-

The author's friend Buzz brought his engine hoist over to make short work of positioning the engine with the mount attached.

tory was really thinking. These are not particularly high-tension springs. Still, you'll be tempted to grab the free end with Vise-Grips. In a word, don't. A spring is a carefully heat-treated device that's extremely sensitive to crack propagation. If you put a small scratch in it, it is likely to break. There are soft-jaw pliers specifically for this purpose, but lacking them, you can use a small screwdriver inserted through the spring loop to pull the spring into position.

Having done that I still put a safety wire through the center of each spring. It was then tied off to each mounting point with a bit of slack. If the spring were to break, the pieces are retained, and the pipe is held in position.

The safety wire through the middle will keep the pieces together if the spring breaks.

Speaking Strine

Winston Churchill once commented that, "England and America are separated only by a common language." The truth of that was evident when I told a neighbor that I was "offering up" the "muff" as I wanted "carby heat" when descending. S'truth, mate!

I was also going over the latest set of instructions and have to say that Jabiru has done a good job of it. There's still a bit of Strine scattered about, but this project would have been a lot easier if I'd had this version at the start. For instance, there are two fiberglass wedges in the kit. Each is about an inch wide, 4 inches long and tapers from a quarter-inch down to zero. I've looked at these innumerable times, but only on reading this new set of instructions did I learn where they go.

The bad news is that as I write this, the new instructions are still incomplete; they only go as far as fitting the ailerons. But Jabiru is fixing the documentation problem. Keep up the good work!

Build the Record as You Build

I'll wrap up with a generic tip: Keep good records. With the recent problems caused by builders receiving more than just a little help, you should be fairly meticulous in your record keeping. Paper is so passé that I dragged an old 486 computer and a cheap flat-panel monitor out of the closet and made a quick, stand-up desk in the shop. I'd won a copy of Kitlog Pro at a club raffle, so logging has been done on it throughout this build.

Kitlog is software designed for kit aircraft builders that allows you to rattle on as you care to as you create your masterpiece. Three photos can be added to each data entry, and your time is nicely added up as well. You could use a lot of other methods, but I've found this to be rather easy and would recommend it (You can find out more about this software at *www.kitlog.com*.)

Having said that, I'd best go to work so I have something to log for next month's installment. ✢

For more information on the Jabiru J250, call 559/431-1701, or visit www.jabirupacific.com. Find a direct link at www.kitplanes.com.

Levering the spring onto the ring this way will avoid putting any nicks in the spring wire.

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SPORTPLANES™
MARKETPLACE

Good design and multi-engine aircraft performance.

In the past few months, we have been exploring the lateral and directional stability and control of airplanes. This month, we turn our attention to a lateral/directional issue that is specific to multi-engine airplanes: maintaining control with one or more engines inoperative. One engine inoperative (OEI) operations are an important factor in the design of multi-engine airplanes. Not only must the airplane have sufficient performance to safely maintain flight after an engine failure, the pilot must also be able to maintain control.

There is an old pilot's joke that says that the function of the second engine on a light twin after an engine failure is to carry the airplane to the scene of the accident. This morbid assessment is a bit of an exaggeration, but it does point out that while having two engines gives one a chance of flying away from an engine failure, single-engine flight in a twin is not easy and requires significant pilot skill (and training) to be safe.

For a conventional twin with wing-mounted engines, the critical parameter is the engine-out minimum control speed (V_{MC}). This is the minimum airspeed at which full rudder will keep the airplane from yawing with one engine inoperative and full power on the live engine. V_{MC} is critical in low-airspeed situations where the good engine is called upon to produce maximum power. Typically these are the initial climb after takeoff and a missed approach with an engine out. A common light-twin accident sequence is an engine failure shortly after takeoff, followed by loss of control when the pilot allows the airspeed to fall below V_{MC} while attempting to continue to climb.

The AirCam, among the very few multi-engine Experimentals, has excellent single-engine handling characteristics in part because the engines are laterally close together.

The thrust of a wing-mounted engine produces a yawing moment on the airplane. The engine pulls forward on the wing, causing the airplane to yaw away from the engine. When both engines are operating, the yawing moment of the left engine cancels the yawing moment of the right engine.

When one engine fails, several things happen. First, the thrust of the dead engine disappears along with the yawing moment it produces; the airplane experiences a net yawing moment toward the dead engine. Two other factors can worsen this effect. The first is the drag of the propeller on the dead engine (or the windmilling drag of an inoperative jet engine). Immediately after the engine failure, the blades of the propeller produce significant drag because the airflow is hitting them from the front and separating behind them. If the propeller is windmilling, it can also produce a lot of drag as the blades lift backward and the propeller tries to drive the dead engine. Until the propeller is stopped and feathered, the drag of the dead prop reduces the ability of the airplane to maintain airspeed or to climb. This also drags the dead-engine wing backward, increasing the yawing moment toward the dead engine.

When the engine stops running, the propeller stops accelerating air aft, and the slipstream behind the propeller

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disappears. The effective airspeed of the portion of the wing that was in the slipstream decreases, causing a loss of lift. This may be exacerbated by separated or disturbed airflow coming off of the propeller blades if the prop is not feathered. The loss of lift will cause the airplane to roll toward the dead engine. This roll will be accelerated by the natural dihedral effect of the airplane if the pilot fails to keep the airplane from yawing.

The yawing moment produced by the live engine is a function of the thrust of the engine. The counteracting yawing moment produced by the rudder is a function of rudder deflection and airspeed. As airspeed decreases, the yawing moment produced by a given rudder deflection decreases, but the thrust of the engine does not decrease with airspeed. At some speed, the yawing moment produced by the rudder at full deflection will just balance the yawing moment produced by the thrust of the live engine. This airspeed is the V_{MC}. If the airspeed gets below this critical speed, the airplane will yaw toward the dead engine in spite of full opposite rudder.

A pilot of a twin that suffers an engine failure right after takeoff is faced with a rapidly deteriorating situation. Thrust has been cut in half, and drag has increased. Without prompt action to lower the nose and establish a shallower flight path, airspeed will continue to decay.

At the same time, the airplane has developed a large yawing moment and some rolling moment toward the dead engine. In addition to dealing with decaying airspeed, the pilot must keep the airplane straight with the rudder.

The pilot must keep the airplane under control laterally, keep the airspeed from decaying below V_{MC} and, at the same time, identify and secure the dead engine, feather the prop on that engine and clean up the airplane to maximize the (usually sluggish) single-engine rate of climb. Failure to complete even one of these tasks properly and quickly can lead to an accident.

For a pilot, proficiency is the best defense against this type of accident. But manufacturers can also help pilots by designing twins to have safer engine-out characteristics. The single most important thing the designer of a twin can do to increase safety is to get V_{MC} down. Ideally, it should be below stall speed, but on many airplanes it is not. On some twins, it is actually above the twin-engine best angle of climb speed. This is particularly dangerous because it tempts the pilot to deliberately climb at an airspeed below V_{MC} to use the best twin-engine climb performance of the airplane. This will typically happen during a maximum effort short-field takeoff. If an engine fails while the airplane is climbing below V_{MC} the only option the pilot has is to drop the nose and reduce power on the live engine quickly to prevent loss of control. Design factors will affect how a multi-engine airplane performs when an engine is lost.

Engine Placement

The distance between the engines and the centerline of the airplane is one of the most powerful determinants of minimum control speed. The yawing moment produced by the operating engine is the product of the engine thrust multiplied by the lateral distance between the engine thrust line and the center of gravity of the airplane. The further outboard the engines, the greater the yawing moment caused by each engine. To minimize V_{MC} the engines should be as far inboard as is practical.

While V_{MC} considerations tend to force the engines inboard, there are several other factors pushing them outboard, and the designer must consider all of these. The most important factor is clearance between the propeller and the fuselage. Obviously, a propeller blade tip striking the fuselage would be a bad thing. Engines are typically mounted on soft, vibration-absorbing rubber mounts, which allow the engine to move around a surprising amount. The static clearance between the propeller blade tips and the side of the fuselage should be large enough so that engine motion cannot bring the blades into contact with the fuselage.

Noise and vibration inside the cabin are also a consideration. The majority of the noise emitted by a propeller radiates from the blade tips in or near the plane of the prop. If the clearance between the blade tips and the fuselage side is too small, the noise and vibration level in the cabin will be high.

Having the engines too far inboard on the airplane can also increase drag. If the propeller slipstream scrubs along the fuselage side, it will increase skin friction drag. Also, the channel flow between the fuselage and engine nacelle can cause significant drag.

Finally, moving the engines outboard can reduce the weight of the wing structure. The weight of the engine acting on the wing produces a moment that opposes the upward bending of the wing. The further outboard the engine, the greater this bending moment relief. The wing weight advantage gained by moving the engines outboard will be partially offset by the need to increase the size of the fin and rudder to oppose the increase yawing moment produced by the engine.

The designer must balance all of these considerations when choosing the lateral position of the engines. Usually, the tip clearance and acoustic considerations set the minimum acceptable distance between the prop tips and the cabin wall, and this determines the engine position. The load relief provided by moving the engines outboard on a twin is rarely worth the V_{MC} penalty it causes.

There have been a few attempts to improve engine-out characteristics by moving the engines very close together. These concepts all shared a few aspects. First, the position of the engines and the design of the fuselage (or fuselages) are chosen so that the propeller disks clear the fuselage by being in front of it or over it. The engines can then be moved inboard until the clearance between the propellers tips is at a minimum.

One of the more bizarre experiments along this line involved making a Siamese twin out of two Piper Tri-Pacers joined by a short stub wing. On this machine, the prop disks actually overlapped. A propshaft spacer was used to move one prop forward of the other. More recently, a twin-engine pusher ultralight with overlapping propellers has appeared.

Photo: Courtesy Lockwood Aircraft

Overlapping the propeller disks introduces various unpleasant aerodynamic interactions between the propellers and is probably not a good idea. However, moving the propellers inboard until the propeller tips just clear each other does work quite well as long as the rest of the configuration is well designed. Two modern examples of this approach are Burt Rutan's Boomerang, which has the engines mounted in the noses of twin fuselages, and the AirCam, which has pusher engines mounted close together on a parasol wing. I have had the pleasure of a brief demonstration flight in the AirCam, and it is quite easy to control even with one engine out. This performance is all the more remarkable because the propellers are fixed pitch, so the dead-engine prop cannot be feathered.

affect minimum control speed.

The maximum deflection of the rudder also has an effect. Up to a point, increasing rudder deflection increases the side force generated by the fin and the rudder. The increase is linear with deflection up to a deflection of about 30°. At higher deflections, the flow over the rudder starts to separate at the hinge line, and increasing deflection beyond this point will increase drag without producing a useful increase in rudder power. A row of vortex generators mounted just upstream of the rudder hinge line can help this situation. The vortex generators re-energize the boundary layer and delay separation. This increases the side force generated by the deflected rudder, and lets the rudder go to higher deflections without stalling. Vortex generators on the fin are a feature of several popular retrofit kits designed to improve the engine-out characteristics of twin-engine airplane.

The single most important thing the designer of a twin-engine aircraft can do to increase safety is get the V_{MC} down.

Fin and Rudder

The yawing moment produced by the live engine is opposed by the aerodynamic moment produced by the fin and rudder. The total aerodynamic yaw control power available is a function of the fin area, the tail arm, the area of the rudder and the available rudder deflection.

The bigger the fin and rudder, the more yawing moment they can generate. Twins typically have vertical tails that are proportionately larger than singles to handle engine-out situations.

The side force produced by the deflected rudder acts on the aft end of the fuselage. The yawing moment is the product of this side force multiplied by the tail arm. Increasing tail arm increases the yaw power of a given fin and rudder.

Once the lateral position of the engines has been set, the size of the vertical tail and the length of the tail arm are the primary parameters the designer can use to

Another trick that was popular at one time is to use a twin-tail configuration with two fins mounted at the tips of the horizontal tail. The advantage of this configuration for engine-out flight is that the fins are in the propeller slipstreams, while a single centerline fin is not. In the event of an engine failure, the fin and rudder behind the live engine have a higher effective airspeed due to the prop wash, increasing rudder power. The disadvantage is that in normal flight, both fins are in the prop wash, which increases drag. The twin-tail configuration was popular for a while, appearing on most Lockheed twins, the Beech 18 and the four-engine B-24 Liberator. In recent times, designers have returned to the single centerline fin in the interest of simplicity. ✈

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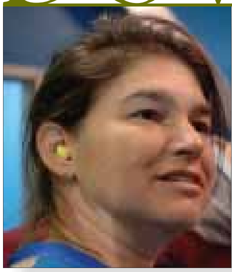


Pretty and fast! The coming-out party begins.

Satisfactorily completing the fly-off period seemed to take forever, but now 9AB is ready to go.

Yes, I know that the break-in and fly-off on our RV-10 seemed to take awhile, but allow me to pick up where my last column left off by letting you in on this little known homebuilder secret: If you have anything other than stock equipment on your aircraft (and most homebuilt kits are modified somewhere), then the thorough shakedown flights do take time. Ol' Silverback, as I was beginning to call our RV-10, has a different cowling, different main wheelpants, and an Airflow Performance fuel-injection system with an updraft sump using Van's filtered airbox, to name a few of the mods. We'd also had a couple of snafus and setbacks. There was an itinerant voltage regulator, seized bearings in the nosewheel, cranky software and a magnetometer failure—all fixable with new hardware, revised plans and a little more testing. That took us through May of 2008. But at least we were flying.

Now for Paint

As much as we wanted to complete the FAA-mandated 40-hour test-flight fly-off quickly and get down to the fun part of flying our family around, with a south Florida summer in front of us, we were concerned that the beast was unprotected from the horrors of corrosion, and some serious paint was the best prescription we could find.

Now the only thing my husband, the RV-10's builder, hates worse than fiberglass is paint. The solution: shop it out. We'd negotiated with Craig Barnett, owner of Scheme Designers, and he'd come up with a wonderful paint scheme for the airplane. The horizontal lines with tapering trim really softened the bulbous cockpit and enhanced the sleek look of the sloping Sam James cowl and 14-inch spinner. Barnett convinced us to paint the spinner, too, to elongate the look of the airplane. There are still a few curved lines, out on the tips of the vertical stabilizer and wings, to keep the aesthetes in the family happy.

It was a couple of months of back and forth figuring out that paint scheme, but we did it while the airplane was under construction so that there would be no pressure. Finding a paint shop in the summer that could take our machine and render the scheme live? That seemed like it was going to be nigh on impossible without at least a four- to six-month waiting period.

Then Joe Dinolfo at Hawkpainting at the Vandenburg Airport in Tampa, Florida, suddenly had an opening. We'd had Dinolfo paint our Cessna 210 years ago, and that proved to be a durable application. We asked him if he'd worked with Scheme Designers before, and he said he had. We visited to see what he was doing, and chatted about paint colors. He talked us into a bright white, with a minimum of metallic (just in the trim), so that we could stick to our budget. The scheme was simplified slightly, again thinking cost, and also serviceability. We then struck a deal, and before we knew it, the airplane was at Vandenburg Airport, in pieces.

Dinolfo touched up a few smiley rivets and smoothed a couple of spots where fiberglass and metal abutted, but generally his job was to prime and paint to spec, which he and his crew did. A month and a half later, the airplane was back with us, reassembled and, frankly, as lovely as I'd seen it. I have to acquiesce and admit that for this airplane, stripes work.

Amy Laboda *has taught students how to fly in California, Texas, New York and Florida. She's towed gliders, flown ultralights, wrestled with aerobatics and even dabbled in skydiving. She holds an Airline Transport Pilot rating, multiengine and single-engine flight instructor ratings, as well as glider and rotorcraft (gyroplane) ratings. She's helped with the build up of her Kitfox IV and RV-10.*

Photos: Amy Laboda

July passed, and I was sure we were near the end of our fly-off journey. If only it had been that easy. The first post-paint flight I took revealed that somewhere in the paint or reassembly process the airplane had picked up a list to the left. It wasn't the fuel balance or the dual elevator trimtabs out of alignment. It took six more flights, each after adjusting a flap, an aileron or wingtip, to bring things back to level. By then, the fly-off restrictions were past, and still the airplane didn't feel ready for a long trip.

Duty Calls

Didn't matter. A trip came along and grabbed us anyway. An illness in the family necessitated a run from our Florida base to Ohio. We balked at the price of airline tickets, and looked at the hangar. Could 9AB do it? Well, not right away. We needed to update the GPS and EFIS software, and then run it in to make sure that it worked. (It did.) Then we needed to add a little carpeting, and tweak the electrics one more time. Door seals needed to be installed to try and trim the noise a little. (That worked.) After years of building and months of testing, it was one week to finish up. Then it was time.

Seven a.m. The girls were tucked in the rear seats, sleepy and ready for the noise and vibration to lull them back into slumber land for the morning trek north. My husband and I began to step up on the wings, right and left, together and… BAM! The tail hit the concrete! We were in total disbelief. We'd weighed things, and balanced out the center of gravity, and after the swearing stopped my husband admitted he'd heard from other RV-10 pilots that sometimes, if you have it loaded in back, you might want to put someone in front before the pilot steps up (or load the pilot from the front). How embarrassing! The kids climbed down from the airplane, totally bewildered, and sat on the concrete. We pulled the airplane back into the hangar.

The damage to the tailcone was minimal and quickly repaired. The paint was no longer perfect, but that was only visible to those who inspected closely. Our egos, though bruised, would recover. We carefully reloaded (with me in the right seat first), fired up and rolled to the runway for our first cross-country trip.

And They're Off!

The initial power application, ground roll and liftoff were exhilarating, and even with the nose trim dialed down an extra notch and the airspeed dialed up to 120 knots to facilitate cooling on the humid August morning, the airplane climbed at 750 feet per minute. It was different from the Phase I test flights. Those were solo in the airplane, and all business. This was proving that the airplane was the dream machine we were hoping it would be, capable of moving the four of us, fast and comfortably, across the country.

We were at 8500 feet in no time, and leveled off to see the airspeed tape spool up to 155 knots indicated. That trued out to nearly 180 knots, and resulted in 170 knots across the ground at 65% cruise power setting, with the mixture 200° rich of peak, and an average fuel burn of 15 gph.

We are still figuring out the plenum cooling, and have not matched the injectors yet. As such, the engine isn't happy at lean-of-peak mixture settings, which would automatically lower CHTs, and the temps we're seeing now are not yet in the range we feel comfortable running. We'll get there.

The TruTrak DigiFlight autopilot was a cinch to program, and helped us by keeping our workload down. The Grand Rapids Technologies dual EFIS did not disappoint. In fact, the EFIS, as the flight wore on, became a source of infinite information, and even entertainment. A twist of this knob, a push of that softbutton, and reams of flight details, from logs of where the airplane had already been (dates, places and flight times right there ready for downloading) appeared on the screen. Cool. Another knob twist and button push from the engine page and all kinds of performance information was displayed, including our miles per gallon (around 11 nmpg average; call it almost 13 statute miles per gallon to make the comparison to automobiles more realistic).

Securing a summertime slot at a paint shop allowed the plane to be ready for a cross-country sooner than expected.

It wasn't long, even with a fuel stop, before we were talking with Indianapolis Approach and beginning our descent into Batavia's airport. All in all, the flight took 5 hours, and that included the brief stop for fuel en route. Nine Alpha Bravo was pretty and, even loaded up, proved fast and economical, too.

I had a hard time believing we'd averaged 170 knots ground speed in cruise for 5 hours, but the flight home proved the RV could do it with consistency. We were chock to chock (again, with a brief fuel stop) 5 hours en route, burning at an average of 10.8 nmpg at altitudes from 7500 to 9500 MSL. Ultimately we put $700 in avgas in the tanks to move our family of four almost 1500 miles round trip, in 10 hours, with four landings/climb-outs included. We could not have done it via the airlines for less money, or in less time, if the trip to and from the airport, with parking, TSA and wait time were included.

Best of all, though, we could not have done it more comfortably. That bulbous cabin? It is roomy inside, with plenty of space for the girls, who have grown to full size, and their pillows, blankets, laptops, books and DVDs. The airflow through the cockpit is excellent in every regime except for taxi, and then it is at least passable.

It takes awhile for a machine to grow on me, and then to steal my affection. I'm tough that way, holding judgment until I'm confident the airplane can deliver what it promised. There are still plenty of little chores left to do, from finishing the interior to continuing to tweak the avionics, plenum and engine cooling systems. Even so, it sure is a sweetheart.

Maintain thy airspeed, lest the ground rise up and smite thee.

There was a serious discussion on the Pilots of America newsboard (*www.pilotsofamerica.com*) about calibrating your airspeed indicator. Some claimed that it was a straight-line function of pressure versus airspeed, some claimed it was a completely nonlinear and difficult equation, and those of us who have done the math know it is a relatively simple task to go from pressure to airspeed.

Let's back up just a minute and see if we can figure out what drives the airspeed indicator, the defining document(s) that tell us how to convert from pitot pressure to airspeed indication, and how we might rig up a simple calibration tool of our own.

Calibration at 70 mph indicated airspeed is right on (factoring in the fact that this photo was taken at a density altitude of 3000 feet MSL).

What Is an ASI?

First, the airspeed indicator (ASI) is nothing more than a differential pressure gauge. You put ram air pressure from the pitot tube on one port and ambient (static) pressure on the other, and the airspeed needle measures the pressure differential. Yes, this differential is a function of altitude, and there is an old rule of thumb about 2% per thousand feet. That is, at sea level, sitting still, you have roughly 15 psi of pressure on the pitot tube and 15 psi on the static port, and the airspeed reads zero. After you start your takeoff roll and climb out, and the airspeed reads 100 mph, the static port (assuming a *very* shallow climb near the ground) is still at 15 psi, but the pitot pressure has increased to about 15.17 psi. Climbing at constant indicated airspeed, when you reach pattern altitude at 1000 AGL/MSL your airspeed indicator may read 100 mph, but your actual airspeed—the so-called true airspeed—is 2% more, or 102 mph. At 1000 AGL/MSL your static pressure may have dropped to 14 psi, but your pitot pressure has dropped an equal amount to 14.17 psi, so there is a constant 0.17 psi differential presented to the ASI.

The problem then resolves itself to finding a way of generating a precise amount of low-pressure air. We could use a precision pressure gauge and a source of compressed air, but that method is (a) expensive and (b) begs the question as to whether the precision gauge or the airspeed indicator is out of calibration. We could use a column of mercury, but that stuff is expensive and it's toxic. Or we could use plastic tubing, a yardstick and a water column. Guess which way I am going.

The first table (Table 1, next page) gives the relationship between airspeed (mph), airspeed (knots), water column (inches) and air pressure (psi). The second table (Table 2) does the same thing, but the independent variable is water column in inches and the rest of the dependent variables as shown above. The equation for all this nonsense is relatively simple and gives results to within 1% from 50 mph to 250 mph. Airspeed (mph) is equal

Jim Weir *began acquiring Aero'Lectrics expertise in 1959, fixing Narco Superhomers in exchange for flight hours. A commercial pilot, CFI and A&P/IA, Jim has owned and restored four single-engine Cessnas. These days, he runs RST Engineering and teaches electronics at Sierra College. Ask him questions at rec.aviation.homebuilt or visit his site at www.rst-engr.com/kitplanes.*

Photos: Jim Weir

to the square root of (inches of water times 1526.5). Or to put it in better mathematical form, A = $\sqrt{(i \times 1526.5)}$ where A is airspeed in mph, and *i* is water column difference in inches.

The source for all of this information? A fairly simple Mil-Spec document called AN 05-10-24 that specifies the water column in steps of 10 mph from 50 to well over 250 mph. The data and equations in this article were derived directly from this document.

Build It

The mechanics of rigging up the water column are simple, and materials include a 6-foot length of clear plastic tubing bent into a U shape (tubing inside diameter to match the airspeed pitot port fitting), a wood yardstick, a few tie-wraps to hold the tubing to the yardstick and some water. Refinements to the parts list are red food coloring in the water to make the water column easier to read, a drop or two of dishwashing liquid into the water to make the meniscus (the little lens-shaped area at the top of the water in the tube) a little flatter and a turkey baster to put the water into the tube. If you spend more than $5 on the whole shebang, you don't scrounge very well. And, as noted in a prior article on the subject (KITPLANES®, July 1989) the ultimate California wine snob will use Gamay Beaujolais instead of water with the normal 1.2345% wine correction factor.

Operation? Trivially simple. Fill the plastic tubing about a quarter of the way up from the bottom (say, 6 inches or thereabouts), and attach one of the free ends of the tubing to the airspeed indicator fitting. *Be careful*. If any water gets into the airspeed indicator, you might just as well start pricing a new one. Using either of the tables shown, begin filling the open end of the plastic tube with water and noting the reading on the ASI. Simplicity itself.

Can you use this device in the aircraft without removing the ASI? Certainly. Just take every precaution to keep water out of the ASI. If I were using this device on a regular basis, I'd stuff the ASI end of the tubing with lightly packed cotton so that the air pressure will get through. But if the calibration stick got upended, I'd at least have a fighting chance to pull the tubing off of the ASI fitting before any water got into the mechanism.

Too much fun. I think a little treatise on digital logic might be in order next month. Specifically, I'm going to show you how to use the 4000 series of (cheap) CMOS digital logic to implement simple and useful things for your airplane. Until then, just remember that this snow isn't going to be on the ground forever, and we have a whole summer of flying ahead of us. ✈

Table 1.

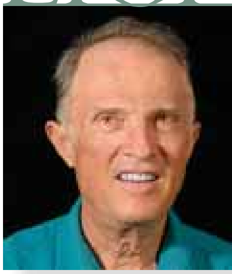
AIRSPEED VERSUS WATER COLUMN

Airspeed MPH	Airspeed Knots	Water Column in inches	Pressure PSI
50	43.45	1.64	0.059
60	52.14	2.36	0.085
70	60.83	3.21	0.116
80	69.52	4.19	0.151
90	78.21	5.31	0.192
100	86.90	6.55	0.237
110	95.59	7.93	0.286
120	104.28	9.43	0.341
130	112.97	11.07	0.400
140	121.66	12.84	0.464
150	130.35	14.74	0.532
160	139.04	16.77	0.606
170	147.73	18.93	0.684
180	156.42	21.23	0.767
190	165.11	23.65	0.854
200	173.80	26.20	0.947
210	182.49	28.89	1.044
220	191.18	31.71	1.145
230	199.87	34.65	1.252
240	208.56	37.73	1.363
250	217.25	40.94	1.479

Table 2.

WATER COLUMN VERSUS AIRSPEED

Water Column in inches	Airspeed mph	Airspeed knots	Pressure PSI
1	39.1	34.0	0.036
2	55.3	48.0	0.072
3	67.7	58.8	0.108
4	78.1	67.9	0.145
5	87.4	75.9	0.181
6	95.7	83.2	0.217
7	103.4	89.8	0.253
8	110.5	96.0	0.289
9	117.2	101.9	0.325
10	123.6	107.4	0.361
11	129.6	112.6	0.397
12	135.3	117.6	0.434
14	146.2	127.0	0.506
16	156.3	135.8	0.578
18	165.8	144.0	0.650
20	174.7	151.8	0.723
25	195.4	169.8	0.903
30	214.0	186.0	1.084
35	231.1	200.9	1.264
40	247.1	214.7	1.445
45	262.1	227.8	1.626



Flight-testing the Remos GX LSA.

At AirVenture last summer, Remos introduced its new all-composite GX Special (factory-built) Light Sport airplane. The GX replaces the Remos G-3, which we noted in this column in January '08.

Major features of the GX are a completely new all-carbon-fiber wing that folds quickly, a pair of sticks and throttles, 110-knot cruise speed and a provision for a Magnum ballistic airframe parachute.

Also introduced at Oshkosh was the company's newly appointed chief engineer, Christian Majunke. Before he arrived, Remos had designed the all-composite wing for the GX, which replaces the fabric-covered wing on the G-3.

Majunke's first job, he said, was to optimize the aircraft, which included fine-tuning the design of the GX control system. He joined the flight-test team after the aerodynamic design was frozen. He flew performance tests in Germany and in the United States. Wing structural testing had been completed when Majunke arrived, but he participated in testing the GX's vertical and horizontal tail.

The Remos GX features an all-composite wing designed for 4 G and ground-tested to 8 G.

Good Vibrations

Two of the most dangerous experimental flight-test activities are multi-turn spins and flutter testing. In fact, test pilots who specialize in this type of work are often employed for only these tests, and they tend to be bachelors who are willing to wear a parachute and use it if necessary.

Flutter usually happens to control surfaces without warning and may result in loss of the surface—and sometimes the structure to which it is attached—in a fraction of a second. Failure of the original Tacoma Narrows Bridge (in Washington state) and the twisting of a stop sign in a high wind are two well-known examples of low-frequency flutter. The cause is known as aeroelastics, where at some airspeed, something sets a movable or flexible part in motion, and it vibrates at its resonant frequency. If there is insufficient damping, the initial buzz may increase in amplitude until the part or the hinge fails. In the case of elevator flutter, it might take the horizontal stabilizer with it.

To preclude flutter, airplane designers make supporting surfaces such as wings and fixed tail parts stiff, and they add weights to the control surfaces so that the controls nearly balance on their hinges. Aircraft-design software also helps engineers avoid high-airspeed flutter, but two kinds of testing (ground and flight) are needed to verify the design at airspeeds higher than V_{NE}.

Ground vibration testing (GVT) is required in Germany, and it is conducted on the entire airframe as it sits stationary at the test site. The test airframe's wheels may be placed on inflatable pads to minimize the damping effect of sitting on the landing gear.

Ground vibration testing looks for resonances that could lead to flutter and airframe failure. The technique is to attach speaker-like pulsers and sensors to various parts at prescribed locations, drive the pulsers with variable-frequency oscillators and then look for resonant frequencies. The hope is that the normal

Dave Martin

served as editor of this magazine for 17 years and began aviation journalism evaluating ultralights in the early '80s. A former CFI (airplanes, gliders, instruments), he's flown more than 160 aircraft types plus 60 ultralights (including a single-seat, no-basket hot air balloon). Now living at a residential airpark in Oregon, he flies his Spacewalker II homebuilt as a Sport Pilot.

Photos: Dave Martin, Courtesy Remos

flight envelope will yield no resonances that could amplify and cause structural failure due to flutter. Good structural stiffness results in rapid damping of the vibrations rather than amplification of them at a resonant frequency.

A specialist in interpreting GVT results analyzes the data and usually determines a maximum safe airspeed that will avoid the flutter regime. If flutter appears likely in any part of the normal flight envelope, new design, probably including extra stiffening, will be prescribed. In the case of the Remos GX, GVT analysis determined a possible problem with the flaps. The solution was to modify the flap hinge slightly to stiffen the flaps when they are retracted.

Ground vibration testing takes considerable time to set up, but the tests themselves are quick. Majunke said that setup for the GX required about three days, but the tests were completed in 2 hours. In Germany, four groups are authorized to perform GVT, Majunke said: EADS and DLR (the German equivalent of NASA minus the space programs)—both involved in big-airplane projects—are primary players. An independent GVT expert, Professor Norbert Niedbal, performed the Remos tests, which determined that the GX is theoretically safe to an airspeed of 400 kph (214 knots), well beyond V_{NE}.

Chief engineer Christian Majunke talks about testing the new Remos GX, which replaces the Remos G-3 LSA.

Experimental Test Flying

Flight-testing to V_D (maximum design velocity) comes after the GVT analysis; V_D is 10% beyond V_{NE}, which is 249 kph (133 knots) for the Remos GX. Flight testing was to 288 kph (154 knots). Testing for flutter is begun at high altitude for safety purposes. A common procedure is to dive in smooth air to a predetermined airspeed and pull up before the pilot purposefully raps the stick to induce a vibration. That way, if something flutters, the airplane is already decelerating because the nose is high. These tests take time, as the test sequence may call for increasing the airspeed by only 2 knots or so on each successive dive and pull-up. "The airplane performed very well at this top speed," Majunke said. "Of course there was no flutter, but also no vibrations."

GX development took about two years, and testing was embedded in that process. At first, the composite wing was much too heavy and more rigid than it needed to be. "A wing that can support 12 to 15 G is much too heavy," Majunke said. "It gives up performance and payload. So the wing was redesigned for an ultimate of 8 G at 1320 pounds [maximum gross weight for an LSA], which means that much load would have to be applied to break it. The design load [the limit the pilot is required to observe] is 4 G."

Majunke found flying performance data to be the most fun part of the project. "You're flying on the edge of the envelope and expanding it," he said. As of late July '08, he had accumulated nearly 50 hours of flight-test time.

Production Testing

Majunke also flies production test flights on customers' new airplanes, and he had flown 10 new Remos G-3s as of last July. He described the process.

The test time required in the production test phase on average depends on the avionics, Majunke said. If the avionics package is quite simple and everything checks out, 20 minutes to half an hour will be enough. "I had one aircraft that was absolutely perfect, and I was disappointed that the single test flight was over and I was back on the ground in 20 minutes. Of course, the ground crew was happy." But with multiple glass screens and actual IFR capability, the production test pilot needs to do an ILS approach, so the minimum will be about an hour of flying time.

For testing positive-G capability, the wing is inverted and loaded according to a distribution plan.

Before the flight phase of a production test, the pilot checks weight measurement and c.g. calculation and does a normal thorough preflight check. "I then look at many details, because the production test pilot is the first person to fly the new airplane," Majunke said. As you would expect, control systems, engine installation and servicing are checked especially thoroughly.

"You look twice at the engine and three times at the rescue system," Majunke said. "Then it's time to check that every system operates well. Lights. Seat belts. Everything else. You fire up the engine and make it warm enough to take full power. You count numbers: oil pressure, rpm, coolant and other systems. A very careful takeoff follows, and the airplane is kept over the home field initially. Once I gain confidence, I may apply up to 2.5 to 3 G to make sure everything is in place.

"Then you're checking performance. How much is the airspeed at a given rpm? I check that at four different rpm plus full power, where the rpm is noted," he said. For airplanes with the full avionics package, Majunke flies to the nearest airport with an ILS and makes an approach while checking the avionics and instruments. "Coming home, I may fly full throttle over the hangar and pull up." The ground crew gets the idea: Another Remos is nearly ready for delivery to a customer. ✢

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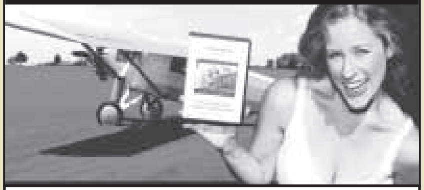

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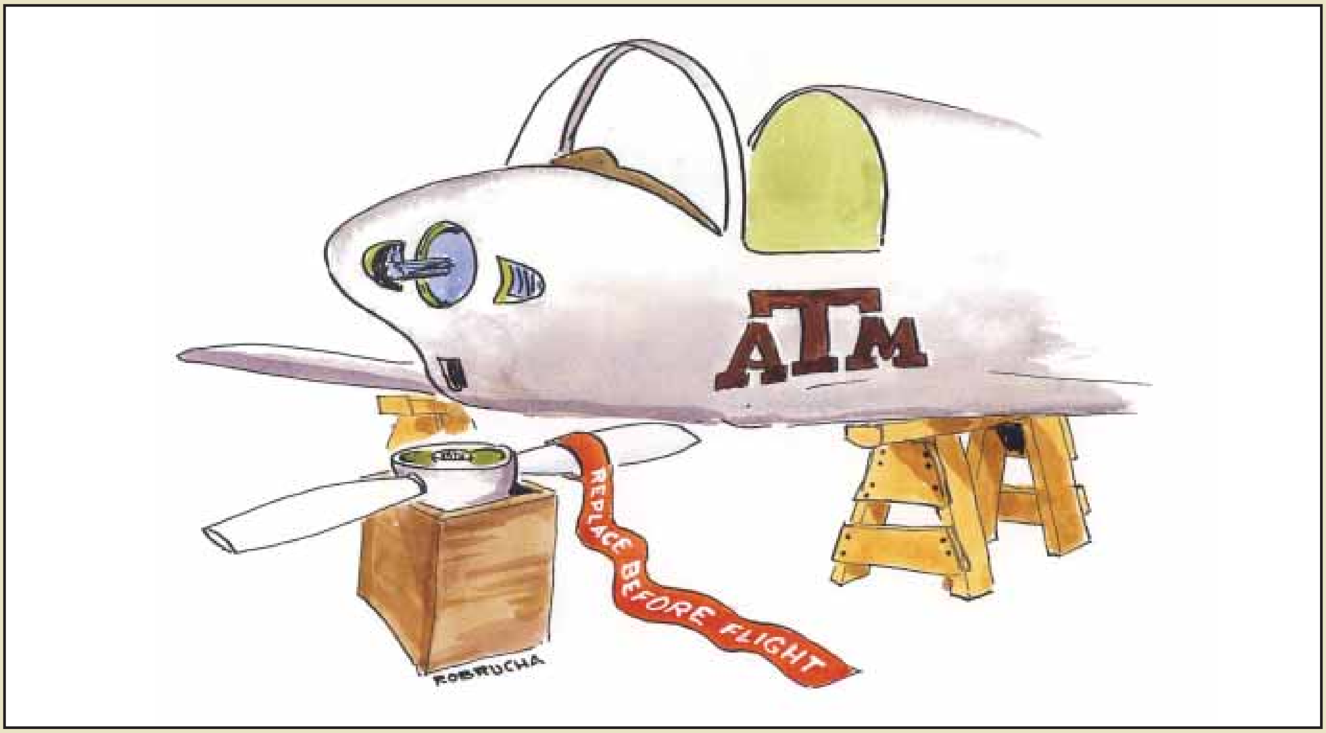

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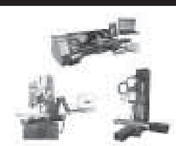

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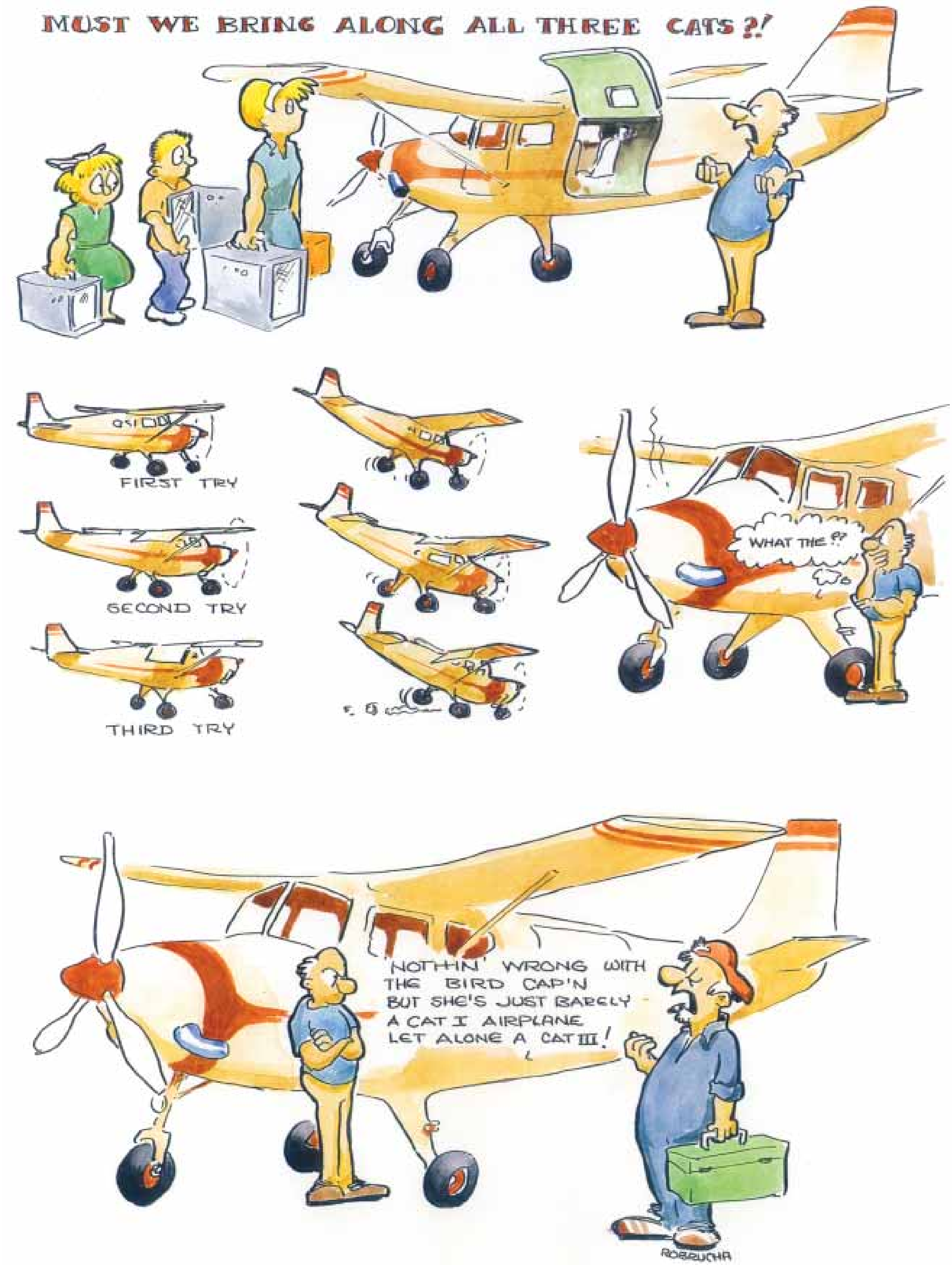

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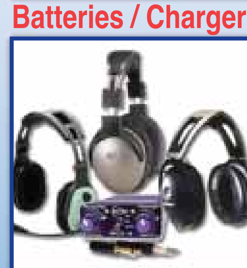
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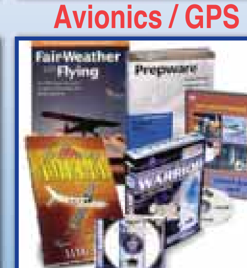

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