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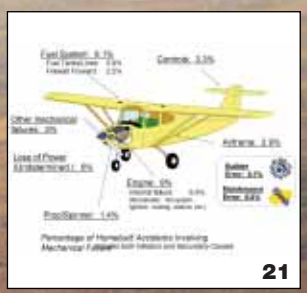
On the cover: Richard Vander Meulen photographed builder Al Mader's Quad City Challenger. Read Dan Johnson's flight report on Page 6.

15

6

51



21

BY BRIAN E. CLARK

Homebuilt aircraft safety and other

unpopular topics.

The outline of our editorial plan for this safety-themed issue was already underway last spring when I received a call from contributor Ron Wanttaja. Ron had just completed a statistical analysis of the NTSB Accident Database for the purpose of answering a question that anyone involved with Experimental-category aircraft has heard before: How safe are homebuilts compared to comparable factory-built aircraft?

Great! We'd finally have some data to confirm that line we repeat with regularity: Once the flight-test period is complete, the accident rate is about the same as for production aircraft.

"Just a second," Ron said. "The news isn't necessarily good."

You can read Ron's full report on Page 21 for his analysis on homebuilt aircraft safety statistics. But here's a quick summary: the overall accident rate for homebuilt aircraft is more than 50% higher than for the rest of the U.S. aircraft fleet.

Why, you might ask, would KITPLANES® Magazine choose to publish these findings? We're supposed to be an enthusiast magazine, right? Here to promote the industry, not publicize its shortcomings. Why would we want to make public information that could cast a negative light on our industry?

The answer? In service to you—the reader.

You may have noticed that beginning with the May 2004 issue, our magazine slogan changed from "The World's Number One Homebuilt Aircraft Magazine" to "The Independent Voice for Homebuilt Aviation." What makes us independent? First, the fact that our most important product is a monthly magazine—we're not a publication tied to an organization of any kind. Second, a willingness to tackle the tough issues that other publications are not compelled to take on.

Homebuilt aircraft safety is one of those issues. Rather than sugarcoat the results, manipulate the statistics or avoid the subject altogether, we want to provide you with accurate, useful information that you can use to make your airplane safer. To achieve that goal, we've put together a three-article package in this issue:

•Ron's "Homebuilt Aircraft: How Safe Are They" presents the problem. Homebuilts are not as safe as some of us assume they are. The reasons, however, are not necessarily what you'd think. Ron's analysis is complete with a detailed look at the causes of the accidents, and he's put together a number of great images that help illustrate the topic

•"An Ounce of Prevention" by Rick Lindstrom (on Page 28) is one of two articles devoted to solutions to the problems presented in Ron's article. Rick examines three EAA programs that should be used by any first-time aircraft builder, regardless of related experience level. EAA's builder workshops, Technical Counselor and Flight Advisor programs can drastically improve the quality of your aircraft, and improved safety results.

•Finally, Ed Wischmeyer presents "The Safe Homebuilt" (Page 33). In putting together this article, we asked Ed to get in touch with some industry experts to get a feel for what can be done to make homebuilt aircraft safer. The results are interesting—sometimes it's not the airplanes that need to be made safer, it's the pilots.

Over the years, the topic of safety has proven unpopular with many readers. Surprised? I am. I know that I'd want any airplane I built to be as safe as possible before I took it into the air. Hopefully our editorial on the subject will bring some of the important issues to the table and help you put together the safest airplane you possibly can.

Financing and Insurance

Two other somewhat unpopular topics include financing and insurance for homebuilt aircraft. Why? Because many builders operate under the assumption that neither is easily available. But if the builder has planned ahead and done the necessary research, that's usually not the case.

That's a big *if*, however. Most builders don't realize the importance of getting financing and insurance research *before* making the decision on what to build.

"Insuring Your Homebuilt Aircraft" (Page 36) and "Financing A Kit Aircraft Project" (Page 46) are both presented from the perspective of a beginner. If you've not yet decided what project to build, read Cory Emberson's articles first. You'll thank her later. If you have started building, read them anyway. While it may be too late to abandon your project entirely, there are small steps you can take to get going in the right direction.

Correction

In the August issue "Engine Beat," we inadvertently changed a character in the web site address for Affordable Turbine Power. It should have said: www.atpcoinc.com.

Since our article ran, ATP has begun operating under the name Innodyn Aviation, and the company's new site is www.innodyn.com. The old one works for now, however.

KITPLANES

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Letters

Inflataplane or Inflatoplane?

First of all, I would like to say that I love your magazine and look forward to its arrival every month. Excellent writing staff, and it contains more than enough info for all of us to dream well beyond our wallets. Too many choices for the Christmas list, birthday list, etc...

The August issue's Kit Stuff cartoon, however, did make me a bit crazy trying to find the Goodyear Inflataplane on the web. If any other readers had a problem, spell Inflatoplane with an "o," and you will get tons of info. Keep up the good work.

Robert d'Ambrosio
Tuckahoe, NY

I'll be honest—I don't make a habit of editing the actual text in Robrucha's cartoons, as they come in fully illustrated and ready for scanning. Perhaps this serves as a lesson—we'll start paying closer attention to the accuracy of text rather than just chuckling at the cartoon. —Ed.

July Issue Content

I enjoy your magazine, as I am in the process of a homebuilt restoration of sorts. I can see the future of general aviation moving toward Experimental aircraft. I can't, however, see devoting so much space to *fly-by-wire* or *critical mach number, transonic flow* and *shock stall* for grassroots aviation.

I am not sure an instrument primer is exactly aimed at the majority of Kitfox and Sky Raider pilots either. I know quite a few kit airplane owners that are instrument qualified, but the majority of their flying is for weekend putting around, just like the rest of us.

Oh well, anybody can complain. On the positive side, I loved the article on the retractable RV, the Oregon Aero seats and others. I *will* buy next month's issue.

Ron Piper
Portland, OR

One of the biggest challenges in putting together KITPLANES® is creating content that appeals to readers across the spectrum. We have guys who fly 350-mph Lancairs at one end of that spectrum and ultralighters who like nothing more than to cruise at 50 mph at the other end. That being the case, not every article will appeal to every reader. We do our best to maintain a balance.

Fly-By-Wire was published because most of the new technology that comes into the GA market is introduced in Experimentals, and most readers are anxious to hear about it. Wind Tunnel is an extremely popular column among readers. Many readers are either amateur or professional designers, and in-depth explorations of aerodynamics are valuable to them. And avionics and instruments are a hugely popular subject among readers. We realize not every homebuilder will install a high-end EFIS system, but many of them will. We try to cover both the low and high ends to appeal to the readership overall. Glad you enjoyed the other articles. —Ed.

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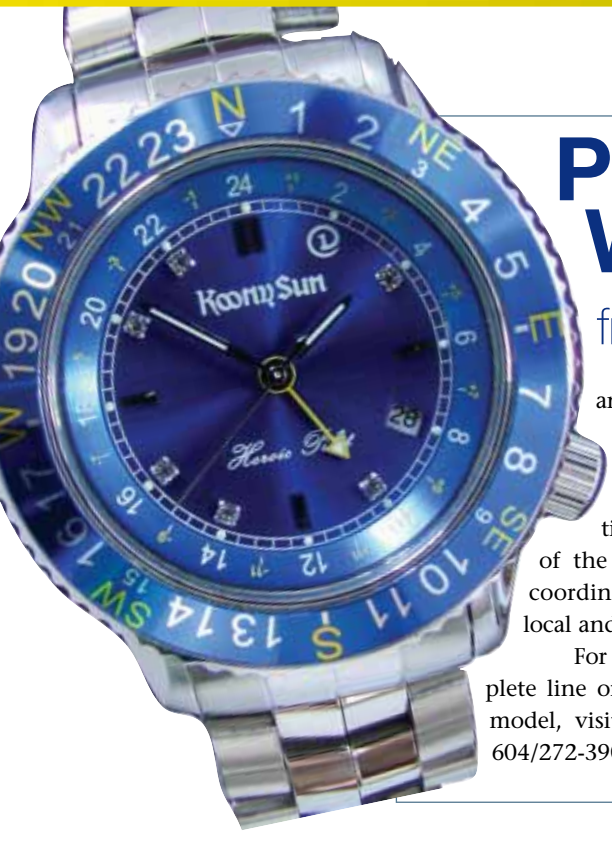

Pro Pilot Watches

from Koony Sun

Koony Sun and Co. announced the creation of a new line of wristwatches designed for pilots and aviation enthusiasts. Each model features multiple dial rings outlining the face of the watch, and the dials can be coordinated to simultaneously read local and Zulu time.

For more information on the complete line of watches and details on each model, visit www.koonysun.com, or call 604/272-3906.

MURPHY ANNOUNCES REDUCED BUILD TIME FOR MOOSE

Despite current trends for aircraft manufacturers to establish assembly factories overseas, Murphy Aircraft has proceeded with establishing its assembly operation at its own factory. This shift in business philosophy was prompted by an unprecendented demand for the Murphy Moose fastbuild kit and the ever increasing cost of doing business overseas due to political instability.

But why does it matter to the consumer? Reduced build times. Advancing the level of manufacturing for numerous parts included in the Moose kit helped to further minimize build times. With the fastbuild assembly staff located alongside the manufacturing staff, ideas for improved manufacturing are easily and quickly acted on. As a result, more than 70 parts have been enhanced to date, making the Moose kit easier and faster to build.

"We realized that we could reduce the assembly times by 200-300 hours for both the fastbuild and standard kit," said company president Darryl Murphy. "This really helps us and is sure to please the customer that wishes to assemble their kit at home."

Murphy currently offers the fastbuild option for two kits—the Moose and the Renegade biplane. For information on any of the company's airplanes, call Murphy at 604/792-5855 or visit www.murphyair.com.

New GlaStar Unveils Builder Assist Program for Sportsman 2+2

Following the successful debut of the Sportsman 2+2 (unveiled earlier this year), New GlaStar announced its latest developments, which include expansion of the factory and the opening of its Customer Assembly Center (CAC) builder assist program. Approximately 12,000 square feet have been added to the kit production facilities, and additional employees have been hired to accommodate accelerated orders for Sportsman, GlaStar and Glasair kits.

The CAC is designed to educate customers about the assembly and maintenance of their aircraft while allowing them to use precision factory jigs and tooling to assemble their airframe and install the firewall-forward components in a reduced amount of time. During the program (currently offered for the Sportsman 2+2 only), customers assemble all structural components in the airframe in only two weeks, leaving little more than fairings, windows, upholstery and paint to complete. In addition, all firewall-aft fuel and control systems are in place, and the wings are completely closed and mated with all fuselage systems.

Customers who opt for a third week at the CAC can expect to complete virtually everything from the firewall forward with the exception of minor items like optional monitoring instruments, final connection of control cables and cowl paint. Once the customer takes the project home, he or she will have an estimated three to six months of part-time work required prior to first flight.

For information on the CAC or any of New GlaStar's kits, call the company at 306/435-8533 (extension 232), or visit www.newglasair.com.

To submit a press release on a homebuilt-related product, e-mail a detailed description and high-resolution photograph to editorial@kitplanes.com. Mailing address is KITPLANES® Magazine, New Products, 239 New Road, Suite B-201, Parsippany, NJ 07054.

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Stratomaster Instruments From Sport Flying Shop

Sport Flying Shop, U.S. dealer for MGL Avionics of South Africa, announced that MGL's Stratomaster line of instruments and engine monitors is available. The Stratomaster line features a number of low-cost, highly functional instruments and avionics pieces designed for use in light aircraft.

The Smart Singles linae includes a range of 2¼-inch digital instruments that are completely solid-state, relying on no traditional mechanical gyro systems. According to the company, this means no limitations during usage with full 360° operability in both pitch and bank. Each instrument weights less than 6 ounces and runs on 12 volts. Functions range from the basics—altimeter, airspeed indicator, VSI—to attitude indicators, engine monitors and fuel computers. Prices range from $125 to $285, depending on function.

The E2 EMS is an engine monitoring system that can be configured for use with just about any engine used in light aircraft today. Clear graphical displays provide data for critical functions, and a six-point fuel level calibration system allows for extremely accurate fuel level readings. For simplified installation, all engine sensors are connected to a remote data acquisition computer, which is then connected with one cable to the display. Price is $595 plus sensors.

The Stratomaster Ultra L adds flight information to the engine monitoring of the E2 EMS and puts it all in a larger display package. All engine functions are available plus altitude, airspeed indicator, VSI, density altitude, true airspeed and more. An Ultra X version is available for up to 8 EGT/CHT channels, and the Ultra RL is available for rotorcraft. The unit costs $1125 plus sensors.

For more information, contact Sport Flying Shop at www.sportflyingshop.com or 310/251-7560.

UltraVair Conversion Manual for *Corvair Engines*

UltraVair Aviation announced the availability of a conversion manual for the GM Corvair engine. The UltraVair engine reduces the six-cylinder Corvair to two cylinders, similar to the manner in which VW engines are converted for ultralight use.

The company's prototype engine produces 37 hp at 3500 rpm with stock pistons, crankshaft and camshaft. It uses single ignition by way of a two-cylinder Fairbanks Morse magneto, and carburetion is provided by twin Mikuni carbs. The engine weighs a total of 80 pounds. According to the company, UltraVair cylinder heads are simple to modify, and both heads can be made out of one stock Corvair head.

The engine is currently being tested on a Legal Eagle ultralight. First flight came on June 12, 2004, with additional test flights immediately following. According to the company, the aircraft has performed better than expected.

For anyone interested in purchasing a copy of the conversion manual, visit www.ultravair.com or write to UltraVair Aviation, P.O. Box 2741, Cedar Rapids, IA 52406. Price is $50 plus $6.50 shipping.

New **Single-Place Beaver** Ultralight Introduced

Capital Air Sports and Aircraft Sales and Parts (ASAP) announced the availability of the Beaver SS, a single-seat ultralight. The original Beaver RX28 ultralight was introduced in 1984 by Spectrum Aircraft, later sold through Beaver RX Enterprises. With more than 2000 of the single- and later two-seat models sold, it remains one of the most popular ultralight designs in history.

ASAP acquired the rights to the Beaver design in the 1990s, upgrading its wings from the internally cable-braced design to a conventional, tube-braced design. The company also replaced the Dacron covering with Ceconite and made the steerable nosewheel and four-point harness standard. Until now, only the two-seat RX550 Plus Beaver was available.

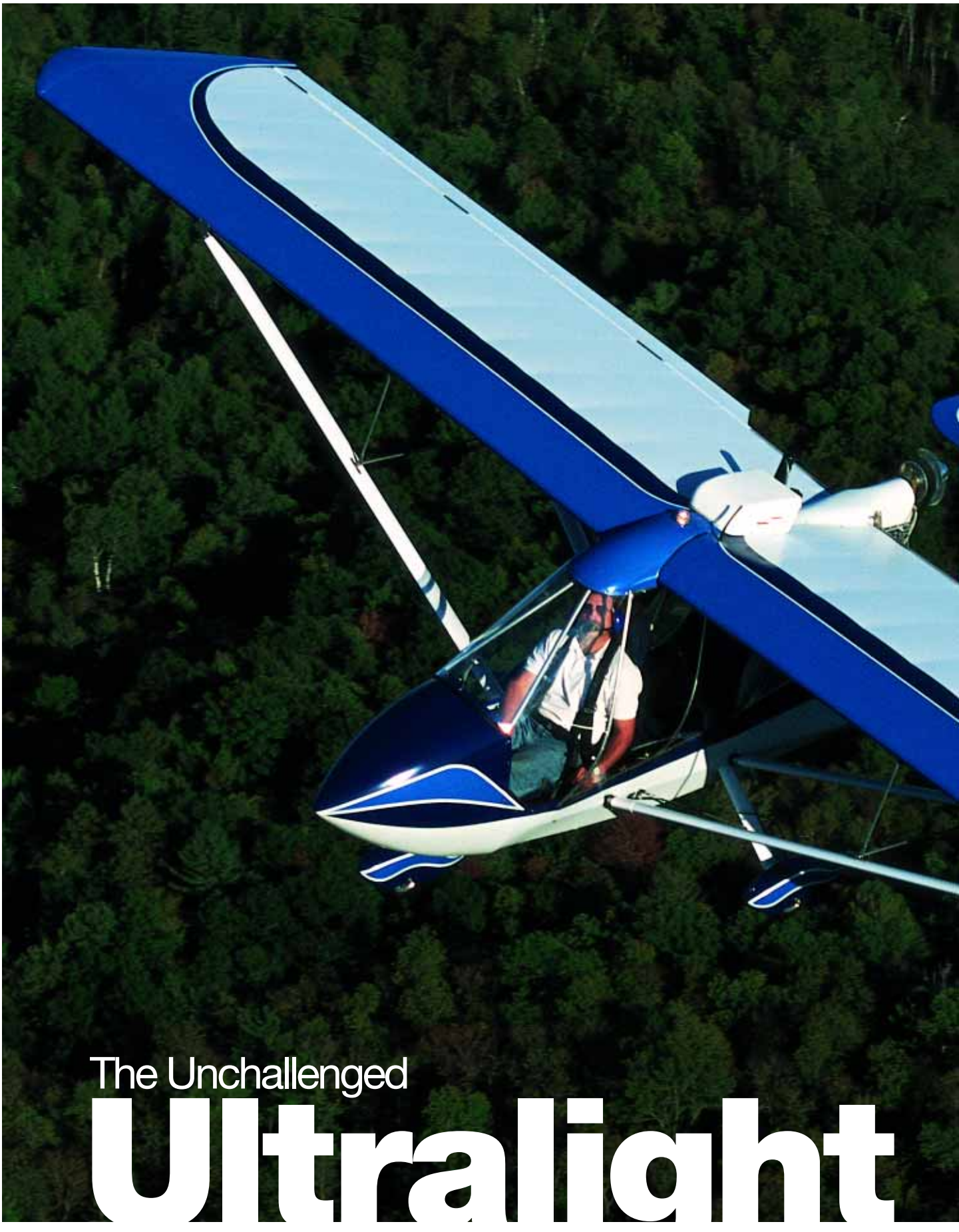
"Since becoming dealers for ASAP, we regularly received calls for a single-seat version of the Beaver," said Chris Patten, Capital marketing director.

According to the company, the well-planned SS construction manual contributes to a low build time—150-200 hours for a first-time builder is typical. The aircraft features a 30-mph stall speed and a high useful load for a single-place ultralight. Empty weight is about 340 pounds, and gross weight is 650 pounds, leaving more than 300 pounds for pilot and fuel.

The kit costs $12,500 and includes a Rotax 447, complete engine instruments, airspeed indicator, primer and paint, adhesive and Ceconite covering material—everything required to fly the aircraft except for fuel, oil and tools.

In separate news, ASAP announced that the Beaver RX550 Plus is now available with an HKS 700 four-stroke engine. The company says the new engine option burns less fuel than comparable two-strokes, giving the airplane twice the range.

For more information on the Beaver SS or the RX550 Plus with HKS, contact ASAP at 250/549-1102 or visit www.ultralight.ca; or contact Capital Air Sports at 866/338-1339 or www.capitalairsports.com.



The Unchallenged Ultralight

Leader

For 21 Years, Quad City's Challenger has proved a good choice.

BY DAN JOHNSON

It's enough to create a serious case of envy among producers vying for the market the Challenger seems to own year after year. Even in 2003, a slow year for all aircraft manufacturers, Quad City Ultralight Aircraft pumped out another 120 kits. Most light-sport aviation companies would consider that an excellent performance. For Quad City, it was a *down* year!

The venerable company from the Quad Cities area of Iowa, near the Illinois border, has put more than 3000 aircraft in the air. Van's Aircraft has done even better, and Quicksilver has more than 10,000 ultralights flying, but the Challenger is clearly one of the industry's leaders. And the company has enjoyed the same leadership since it was founded more than two decades ago.

Despite this success, Quad City maneuvers rather quietly. Last year the company celebrated 20 years of operation, yet many ultralighters and most aviators were unaware of the accomplishment. And this year, Quad City reached another milestone with the 20th anniversary of the two-seaters that have made up the majority of its production.

The Demo Plane Duo

For this review I had a chance to fly two different two-seat Challengers. One was built by Al Mader, a middle school art teacher in Medford, Wisconsin. Though Mader instructs seventh and eighth grade students (a task most pilots wouldn't dare attempt), he had never before built an aircraft. He took his time and got it right.

"With all the head scratching I did," Mader says, "it took me more than 700 hours to build the plane. It wouldn't have to take that long."

Indeed Quad City's fastbuild kit is one of the Challenger's strongest sales arguments. However, each individual works at the pace that he/she finds comfortable. Mader also dolled up his Challenger with several options that added

PHOTOS: RICHARD VANDER MEULEN AND DAN JOHNSON

build time in increments. For example, he has the special leading-edge treatment that places a wide cut of aluminum sheet over the entire wingspan reaching from the underside and wrapping around to 12 inches aft of the leading-edge spar.

"It gets rid of the scalloping that happens between ribs without the metal," he says.

In addition, Mader installed wheelpants, a three-blade Warp Drive propeller, Quad City's fiberglass nosecone, an ELT, the factory Hoerner wingtips, an EIS engine monitor and a parachute system. With all these deluxe options, Mader's Challenger weighs 500 pounds empty—but empty weight can be much less. He's flown lighter versions and feels like so many other ultralight pilots who have experience in lighter and heavier versions of the same model.

"If I did it all over again, I would make the plane as light as possible," Mader admits. "The lighter ones fly better."

Mader received his first taste of ultralights with Don Zank of Zanklites, who also sold him the kit. A 4000-hour pilot in Challengers alone, Zank is one of the country's most experienced dealers for the Iowa producer. He also represents Titan and Loehle aircraft and may become the man behind the Patriot [see the "Dreams of a Patriot" sidebar]. Headquartered in Bloomer, Wisconsin, at the

According to the author, the Challenger boasts a surprisingly roomy cockpit, which is due in part to the fact that the design features tandem seating.

Gateway airport he now owns, Zank works with many area pilots to whom he sells aircraft.

And for years, Zank has been the face of Quad City at Oshkosh AirVenture. Though he handles the other brands, Challengers are still the backbone of his enterprise, and he now runs the company's display at the big summer event. When I flew with him, I saw a pilot in good harmony with his flying machine and one who remains excited about them after all those flight hours—maybe its *because* of all those flight hours.

Successful Company, Successful Design

The truth of Quad City's success may be revealed by this grudgingly complimentary statement by a competing manufacturer: "They [Quad City] build a low-cost ultralight and deliver it swiftly." For more than two decades, the company has been satisfying pilots and challenging its competitors.

Quad City supplies an airworthy machine that brings flying enjoyment

Challenger II Trainer Specifications

WINGSPAN	**31.5 FEET***
WING AREA	**173 SQUARE FEET***
LENGTH	**20.1 FEET**
HEIGHT	**6 FEET**
SEATS	**2, TANDEM**
EMPTY WEIGHT	**320 POUNDS**
GROSS WEIGHT	**800 POUNDS**
USEFUL LOAD	**480 POUNDS**
PAYLOAD	**420 POUNDS**
FUEL CAPACITY	**10 GALLONS**
WING LOADING	**4.6 POUNDS/SQUARE FOOT***
POWER LOADING	**12.1 POUNDS/HP**
POWERPLANT	**52-HP ROTAX 503 DUAL CARB****
MAX SPEED	**100 MPH**
CRUISE SPEED	**70 MPH**
STALL SPEED	**33 MPH**
MAX RATE OF CLIMB	**900 FPM****
TAKEOFF ROLL (BEST FLAPS)	**200 FEET**
LANDING GROUND ROLL	**200 FEET**

**the shorter-winged Challenger II Special has a 26-foot span, 143 square feet of area and wing loading of 5.9 pounds/square foot*
***as tested; standard Challenger engine is 40-hp Rotax 447*

combined with an unusual ease of building—the company does a substantial part of the assembly, saving the builder considerable hours. Quality and flight characteristics notwithstanding, consistently low prices and quick shipments surely are a big part of Quad City's success.

Halfway into its current life span, the design sought to win British certification under the U.K.'s BCAR-S program for microlight aircraft—a demanding task nearly equivalent to earning FAR Part 23 certification. Although a few modest changes were made (Quad City increased the height of the vertical stabilizer), British authorities eventually gave their stamp of approval. Though Americans don't use the Civil Aviation Authority's system, winning British certification will reassure many buyers.

To me, one of the most endearing qualities of the Challenger is its light weight when compared to many ultralights. A two-seat Challenger with basic but sufficient equipment tips the scales at barely more than 300 pounds empty. You can build a single-seat model that weighs almost 20 pounds less than the FAA's 254-pound limit for Part 103 (which, by the way, is not going away with the arrival of the sport-pilot/light-sport aircraft (LSA) proposal).

As Mader came to learn from his building and flying experience, light weight benefits handling and low-speed performance. The slower speed realm of ultralights is an endearing capability, and keeping weight low is one of the best ways to ensure these capabilities.

But while Challengers can be light, they are also surprisingly roomy—partly a benefit of tandem seating. If you want a plane that won't squeeze you, here it is. Especially with doors that curve outward to add dimension, Mader's plane was roomy. In a tandem aircraft, no one rubs elbows with you or blocks your vision to either side.

Challengers are quite maneuverable on the ground. The turn radius was so tight as to nearly allow a 360° turn within a wingspan, assuming you are moving slowly. The inside maingear wheel appeared to scribe a circle only a few feet in diameter. Most pilots appreciate crisp taxiing, and it is certainly handy on a crowded airport ramp.

In-Flight Characteristics

Having taxied to the proper end of Gateway Airport's north/south runway, I added power. Following a brief ground roll, we rotated at barely more than 30 mph indicated, and we were flying.

After a couple takeoff and landings, I was reminded how easily the Challenger goes into the air and just as simply returns to the runway. Controls are cooperative and have no touchiness to them. Advice I'd been given earlier still applied, namely that you can approach at 30-35 mph and you shouldn't let it exceed 50 mph. The plane retains energy quite well in ground effect such that at 60 mph, you'd float excessively before getting it on terra firma.

When I later flew with Zank, he demonstrated one of the deepest, slowest slips I have ever seen in any aircraft. It felt like we were descending vertically yet on releasing the controls, the Challenger simply started flying as though no changes had ever been made.

Despite their easy handling during takeoff and landing, Challengers exhibit an odd adverse yaw quality. When sampling the reaction to aileron-only input with no rudder control application, Zank's Challenger went around an entire circle the wrong way assuming you do not release the control input. Naturally, you wouldn't hold them this way as I did, and when controlled in a conventional manner, the Challenger shows the conventional handling

Dreams of a Patriot

You could call it the Challenger that wasn't. After Quad City owner Dave Goulet developed the aircraft Don Zank would later dub the Patriot, he abandoned its development.

"He simply wasn't interested in pursuing it," says Zank, "So I bought the design and asked if I could pursue it."

Today, Zank has the only one in existence, a situation he'd like to remedy if the funds are forthcoming. After flying a pair of Challengers, going up in Goulet's most recent design was irresistible.

The Patriot may not look like a performer, but that's like saying an RV doesn't look like a performer—both are highly energetic designs with pleasant flight characteristics. In fact, pilots who'd flown both designs (like me) would surely agree the Patriot feels like an ultralight or LSA version of an RV-4.

With its Rotax 912S producing 100 hp, the Patriot gets up and goes like a racehorse out of the gates at sounding gun. The plane will cruise at 120 mph without breaking a sweat. In-flight, the maneuverable design proved to have highly cooperative handling—most pilots will feel comfortable right after rotation.

In Zank's capable hands we executed a beautiful barrel roll and then came in for a surprisingly slow landing with an easy touchdown. With my hands on the controls I wanted to laugh with delight at the airplane's superb handling.

I hope Zank can find the funding to bring the Patriot to market. It's a design that would answer a lot of desires.

—Dan Johnson

characteristics.

Fortunately the good aspects of the Challenger's handling are many. Coordinated control authority is strong, allowing operations even in strong crosswind conditions. Control pressures are light, keeping pilot fatigue to a minimum. In general, the Challenger exhibited good response in all axes, and harmony was quite reasonable. But you must use the controls together, just as your instructor taught you.

It's easy to design crisp handling at higher cruise speeds, but the Challenger particularly shines at slow-speed handling, superior to many other designs. And it is the slow speed ability of ultralights that charms many pilots. Even with the eventual arrival of LSA, it is low-and-slow flying that remains the domain of ultralight aviation, and the Challenger does particularly well in this regime.

However, the low-speed capability doesn't prevent the aircraft from offering speeds with more zip. When you push the nose over, the design moves out smartly. In level flight with higher power settings, I noted airspeed can accelerate beyond 70 mph. At full throttle or with a larger engine, Challengers can hit 100 mph (their V_{NE}).

The light weight of the design also helps in performance areas like takeoff ground roll and reduced-power descents. The idle-thrust sink rate of a lightly built Challenger can be as low as 400 fpm, better than many ultralight designs. Should your engine take a vacation, you'll appreciate the extra time aloft to determine your approach.

Long in the Saddle

After 20 years of market success with many aircraft flying at airfields across the country, Challengers boast an enviably good safety record. You simply don't hear of many problems with the design, and it rarely shows up in serious accident reports.

A good preliminary design with long and slow evolution, careful quality control, understandable builder instructions and corrections to known deficiencies are all desirable goals of any aircraft manufacturer. However, even well-designed aircraft can still have problems. The Challenger's low level of incidents may say more than all the testing or any number of product evaluations. If pilots don't often crash in a plane when measured over a long time, most experts would agree that the engineering must be up to the task.

The panel is small, but there's enough room for basic instrumentation.

The Challenger's fuel tank rests behind the rear seat, which is folded forward in this photo.

Lower speeds and low kinetic energy are strong attributes of ultralight aircraft. The Challenger line, especially the longer-winged models, makes good use of these energies. Since the ultralight is docile at slow speeds, I was able to deliberately miscontrol the airplane in the low 30s—it just wanted to keep flying.

In more conventional verifications, I performed a longitudinal stability series of pushing or pulling the stick and releasing. Some designs will return to level flight faster than the Challenger, but the design was positive in all such checks.

I also tried stalls in all the usual configurations (power off, power on and accelerated). All were mild. When the wing does quit flying, the Challenger seems to pivot at the top, lower its nose a bit and then resume flying as

First-time builder Allen Mader completed his Challenger in 700 hours, but he says that the process could have been quicker.

if the stall never happened.

In an earlier flight test, I tried to spin the Challenger after Zank told me I wouldn't be able to do it. For the most part he was right, though I was able to get a modest partial spin to the right. Virtually confirming his confidence, the Challenger flew itself out of the spin even though I tried to hold it.

A Fair Challenge

In an age when light-sport airplane costs are zooming upward well beyond $50,000, Challenger remains a bargain. Plus you can get one rather quickly should you make the decision to buy. As long as Zank has represented the company, the worst delay he ever experienced was 90 days. Normally 60 days is plenty for delivery, and it can be much faster depending on the model you want and the time of year.

Challengers are available in four configurations:

•Ultralight—and yes, it *can* qualify for Part 103 if you build carefully.

•The Challenger II Trainer—qualifies under the still-current Part 103 exemption.

•The Special single-seater and the Challenger II Special—both must have N-numbers.

The Special models are clipped-wing, higher-speed performers. They also tend to be equipped as more

The author says landings are easy and recommends a final approach at 30-35 mph. The plane retains energy so well that pilots who come in too fast will end up floating excessively before touchdown.

deluxe versions coming standard with features like the flaperon system, faired struts, wheelpants, a larger fuel tank and a complete door kit. Naturally, these extras add weight and cost over the basic models.

The Ultralight model sells from $10,700 to $13,800, depending on which engine you choose. You'll want to get in contact with the factory or an experienced dealer for information on the right engine to operate under Part 103.

The two seat Trainer models run from $12,900 to $16,400, and even these figures are low among two-seat aircraft. With his many options—including a $3000 parachute—Mader reports investing $18,000 for his optioned out Challenger. Even at that expense, you could afford a small fleet of Challengers for the price of one fiberglass model from Europe.

Zank likes to add his own selling points: "All Challengers are effectively quickbuild kits. The factory handles all the more demanding structural work, including installing the controls." Most companies charge a considerable extra fee for their quickbuild option.

"First timers usually take less than 300 hours to complete the assembly including covering and painting," Zank says. Once your Challenger has been completed, it only takes a half hour or so to remove or reinstall the wings for storage or trailering.

The price of quickbuild kits for the Challenger, which include the engine and all covering materials except paint, haven't gone up significantly in the last decade. The reason for

Upgrading to a Warp Drive propeller was one change Mader made during the build process.

Quad City Challenger
CONTINUED

this may be that the design is evolving rather than radically changing. You'll want to compare costs carefully, as most other kit manufacturers publish price lists that exclude the engine just as they charge a premium for quick-build versions.

Mader offers his own advice on the subject. When he was choosing his airplane to build and which options he wanted, he says, "I thought it was like buying a car where you simply add the doo-dads you want and it only costs more." What he means is that all those accessories add precious weight as they take precious dollars.

For pilots on a budget, the Challenger offers a good value, no question. The quartet of models has also satisfied a large number of customers by providing a handling and performance package with a strong safety record. And with dealers across the country, Quad City's Challenger line represents a firmly established brand, so building and maintaining your Challenger should be a straightforward task. It seems as if Quad City Ultralight Aircraft has covered all the bases important to recreational pilots.

Mader opted to install a BRS airframe parachute in his aircraft. To activate the 'chute, the pilot simply pulls the red handle mounted directly above the front seat.

FOR MORE INFORMATION, contact Quad City Ultralights at 309/764-3515 or visit www.quadcitychallenger.com. For Zanklites, call 715/568-2244 or e-mail donzank@zanklites.com.

Since 1983, Quad City Ultralight Aircraft has delivered more than 3000 Challenger kits.

That Fighter Feel:

F4U Corsair vs. RV-4

These two airplanes aren't as different as you might guess.

BY DOUG ROZENDAAL

The Corsair (top) and RV-4 form up for the camera. Which would you rather own?

PHOTOS: DOUG ROZENDAAL

Who hasn't sat on the sidelines at an airshow and wondered what it would be like to climb into a F4-U Corsair and turn 2200 horses out to the pasture at once? Closer to home, most of us have watched an RV-4 zip down the runway and pull up quickly, only to come back and do it again. Many homebuilders have sampled flight in an RV at some point, but few have the opportunity to fly a Corsair. What's it like? What can you compare it to? Could it be possible that a simple homebuilt airplane could capture the feel of one of the most coveted fighters in the sky?

There are more than 3700 RVs flying, but Corsairs are scarce. Of the 12,571 built, less than 100 airframes survive. About 30 are considered airworthy, but fewer than 15 of those ever find air under their tires.

One that flies regularly lives along the Red River in Wahpeton, North Dakota, and shares a hangar with an RV-4. Gerry Beck owns and operates Tri-State Aviation, an aircraft restoration business. When Beck is busy and needs a pilot, I fly his Corsair. My first impression of the Corsair was that it felt just like my RV-4. Beck agreed—he took one ride in my RV-4 and had to have one. Soon enough, he'd bought one. Maybe there is more similarity between these two airplanes than it would seem?

Since few homebuilders get the chance to fly a Corsair, we decided that we'd use some imagination to see if we could provide a taste of what flying a WW-II fighter is like. And what better way to do it than to compare and contrast with an aircraft that's well known to anyone who knows the kit industry—the RV-4.

Training

Tailwheel training in a Citabria or Cessna will serve you well as you prepare to fly a taildragger RV. The FAA has issued waivers to several RV instructors that allow them to conduct training and charge for it in RVs. Insurance is easily available and affordable for RVs, and getting checked out in an RV is a straightforward process.

Training is not such a simple issue for a Corsair. There aren't any dual-control Corsairs, so your first trip is solo. But flying one of the few remaining Corsairs—an airplane worth more than $1 million and a historic national treasure—is not a task to take lightly. To get checked out, you'll need to complete instruction in a North American T-6 trainer and pass a checkride with an examiner who'll issue you an additional aircraft rating in the CHV F4U.

Airframe Comparison

The RV is the epitome of simplicity. Neither the plane's wings nor landing gear folds, and the flaps, whether manual or electric, are simple, straightforward and functional. The design and construction of the RV looks more like it was built in a Wichita factory than a local garage. The systems are simple, the controls are feather light and controlled by push tubes, and the spring steel gear is strong, maintenance free and nearly indestructible.

The Corsair is a big airplane—the propeller measures 13 feet across, and the pilot sits 16 feet behind it. The preflight is straightforward for a round-engine airplane. Radial engines are prone to a phenomenon called hydraulic lock, which occurs when engine oil finds its way into the lower cylinders. Undetected, an attempted start can destroy the $75,000 engine when the offending cylinder comes up on the compression stroke. The trapped oil has no place to go, and something has to give. The cylinder may break, or the connecting rod may bend. To preclude this, it's wise to pull the engine through at least eight propeller blades

The Corsair is a big airplane worth more than $1 million—flying this plane is not a task to be taken lightly.

by hand prior to start-up to ensure no lock exists. This ritual will often result in oil running out of the exhaust pipes. No matter what direction the wind was blowing when the airplane was parked, an unwritten rule says the wind will be from the tail when you pull it through, and the oil will ruin your flight suit.

Under the belly, a door opens to allow inspection of the CO_2 bottle and the hydraulic accumulator. The CO_2 is the only way to get the gear down if the hydraulic system quits. The Corsair's belly will never corrode, because it's bathed in oil by the on-board automatic airframe lubrication system (a.k.a. the engine). Closing this door guarantees you'll get oil on your shoulders and in your hair before it's secured.

The landing gear struts always look flat on a Corsair. This is normal, as the airplane was designed to land on an aircraft carrier. The struts actually serve more as shock absorbers than springs. Above the gear leg is the monkey motion that turns the wheel as the gear is retracted. The Corsair uses a universal joint apparatus mounted on a 45° angle to rotate the wheel as it retracts. The same linkage over-centers to lock the gear up and down. Outboard of the gear is the wing-fold mechanism, which is another engineering marvel.

The Corsair outer-wing panels aft of the spar are fabric covered, and the ailerons are wood. The flaps are anything but normal—they are massive in size and have what seems a ridiculously high deployment angle. When coupled with the airplane's high angle of attack on the ground, they appear near vertical. The flaps are hydraulically controlled, but not interconnected—they balance aerodynamically. The flap preselect control hydraulically sets the position of one flap only. The other is a free agent; when you add power or flying speed, they quickly balance aerodynamically.

The Corsair tailwheel is retractable and free-castering with a lock for takeoff and landing. Taxiing in a crosswind means dragging a brake. The tailwheel lock is important—one Corsair pilot told me having the tailwheel locked is more important than having the gear down for landing,

because in his words, "landing with the gear up will likely do less damage than landing with the tailwheel unlocked!"

Putting It On

You don't get in the RV-4—you put it on. But even for a 6-foot, 220-pounder, it fits. The RV is cozier than the Corsair, but roomier than many other WW-II fighters.

The Corsair resembles a horse (albeit a draft horse), but unlike a horse you mount the Corsair from the right. Handles and steps are hidden in the flap and the fuselage, and finding your way to the top depends on getting started with the right foot. Your first attempt may not be graceful and some assistance might be warranted.

Strapping in, your adrenaline is full rich. Starting below your left elbow you find the tailwheel lock and the wing-fold controls. Ahead of them, where your hand falls naturally, you'll find trim in three axes. Above that is the throttle quadrant; ahead of that are the landing gear, flap and tailhook controls. Typical of WW-II airplanes, the engine and flight instruments are scattered randomly across the panel. The electrical controls and avionics fall on the right side of the cockpit, and at the lower right-hand corner of the windscreen is a small crank that opens and closes the canopy.

Start, Taxi and Runup

The RV-4 starts like a Spamcan. The only question is whether a carburetor or fuel injector is under the hood. RV-4s can be equipped either way, so the procedure depends on the plane. Tailwheel steering makes taxiing straightforward, and the visibility is good by tailwheel standards with only a small area hidden in front of the engine.

Starting the big round engine on the Corsair is as much art as science. Having already pulled the prop through eight blades, let the starter turn at least eight more times before making the mags hot. Air is controlled with the throttle and the fuel by tickling the primer switch. Too much fuel, and you risk a fire or a flooded engine. Too little, and the plane will backfire with an enormous *bang*! Most large, round engines are started with the mixture at idle/cutoff.

Assuming you have mixed the right amount of fuel and air, the engine starts smoothly. You advance the mixture and stop priming. The huge propeller turns slowly as the engine struggles to pick up cylinders. The huge radial idles at about 700 rpm; with the prop turning at about half that speed, it seems as though you can count the blades.

Taxiing the Corsair demands constant attention. The long nose and massive engine can hide a King Air, even at close range. Unless you're on the takeoff roll, you should seldom move farther than a wingspan without S-turning to peek around the beak.

The runup on a supercharged radial engine is done at field barometric pressure—a glance at the manifold pressure gauge before the engine starts will indicate this value. Running up at that manifold pressure will yield a consistent rpm that is compensated for altitude, temperature and barometric pressure. This number will be around 2200 rpm; 100 rpm less is evidence of a dead cylinder. The mag check is typical, as is cycling the prop. With the runup and the checklist complete, it's showtime. By now, your can feel your heart pounding.

The Launch

The power-to-weight ratio of the RV yields an exhilarating ride on takeoff, and the ground handling makes tracking true simple for anyone with basic tailwheel skills. The airplane accelerates like a fighter. Control forces are wonderfully light without being twitchy, and the response is rock solid. In seconds, any sense you might have of moving the lever is gone, and you become one with the airplane.

Your first launch in the Corsair is a daunting task—all the stories about this beast swirl through your head. You remember tales of Corsair pilots with enlarged right legs from pushing on the rudder when the whip was laid to it. Turning onto the runway, you stop and make one last check. LETS GITTT—Lights, Engine gauges, Trim (5°, right rudder), Shutters (cowl flaps and oil cooler door), Gas (on and boost pump on), Instruments, Tailwheel, Transponder, Time.

While there are more than 3700 RVs currently flying, Corsairs are a bit more scarce—only 30 are considered airworthy. One shares a hangar with an RV-4 in Wahpeton, North Dakota.

Smoothly add power, and the airplane starts accelerating. Almost immediately, the tail is light. A healthy (but not unreasonable) foot full of right rudder keeps the nose pointed down the pavement. Soon the runway appears in front the nose, the cowling fasteners make a bore sight, and runway alignment is intuitive.

Soon, that big wing gets ahold of some air, and the long oleos start to extend. Almost imperceptibly, the tires leave the ground and you're flying. Just to be sure, you wait an extra few seconds before retracting the gear; the airspeed shows 120 knots. You pull up the flaps and instinctively you hand-find the trim wheels, which melt the control pressures.

You're up to 150 knots, and the climb rate is accelerating. Nearly 500 feet off the ground you give yourself a treat and move the stick side to side. The ailerons are rock solid and feather light, and you too say to yourself: "This flies just like an RV-4!" You think back to the takeoff—so smooth and so easy. The airplane eats up the power and seems to ask for more.

Airwork

The RV-4 quickly accelerates to a brisk 165-knot cruise speed at altitude. Steep turns are simple, and aerobatics are effortless, even for the uninitiated. After only one demonstration, a roll seems as benign as a turn. Loops from level flight at cruise speeds and power are the norm.

The RV-4's stall has little warning and a nice clean break. Lower the nose and add a touch of power, and the airplane will be climbing again. Little horns start to grow from your head as you search the sky for an unsuspecting Cessna to attack.

Leveling off at altitude in the Corsair, you close the cowl flaps, and the airplane starts to accelerate. Reaching 220 knots, you pull the power back to 28 inches and 1800 rpm. Every speed or power change requires an elevator and rudder trim adjustment; but the trim is so effortless to find and set that it doesn't seem a bother. Steep turns also seem too easy—just put the big nose on the horizon, and ride it around until you feel the bump. Slowing down is just as easy—pull the throttle back and the airspeed follows.

The RV-4, a household name among homebuilders, is cozier than the Corsair but roomier than most other WW-II fighters.

Clean stalls are uneventful: a little warning and then the break. With rudder and power you can stay with it just like a Cherokee. The Corsair's stall manners are better than the RV-4's, though the RV's are not bad either. Stalling the Corsair with the gear and massive flaps deployed, you find yourself settling like a greased anvil, but still it's an honest airplane. Once the sink rate starts, recovering is going to take a bunch of power and altitude. Make a mental note—this is a big airplane...do not let a sink rate get started close to the ground.

"That big prop would just roll you over in a go-around," you remember the hangar flyers saying. Better check that out. At about 90 knots with it all hanging out, 30 inches of power will hold altitude while you get cleaned up,

This shot from behind illustrates why the RV-4 wins the visibility contest.

and the rudder pressure is certainly not Herculean, even if you forgot the 5° of trim. But remember, that's only if you don't develop a sink rate.

Unlike in the RV, looking for targets to attack never enters your mind since you are so absorbed by the airplane.

Back to the Airport

Overcoming the urge to initiate the landing sequence in the RV-4 with a low pass is always a challenge. Letting the nose down with the power on will quickly result in airspeed pushing V_{NE}. Pulling the nose up and the power back will set you up on downwind. It's a great ride.

There is little to do on downwind in the RV-4. Time to GUMP: the Gas is on a good tank with the boost pump on, the Undercarriage is welded down, the Mixture is rich, the Prop is forward, before-landing checklist is complete. Feeding down the flaps creates some drag and lowers the nose to improve visibility. Cessna 172 speeds work well as you progress around the pattern. Just like on takeoff, the RV-4 has excellent landing manners.

Heading back to the airport in the Corsair, you can feel that big Hamilton Standard prop take a bigger bite as you lower the nose. The airspeed needle starts to climb and easily presses 250 knots. Fly down the runway, and haul back at the end. Up and up, banking over you find yourself at 2500 feet AGL. What a tremendous ride!

You go around again, but afraid to enjoy too much you set up for a landing. The gear comes out, the lights turn green, the flaps come down and you sing the same GUMP song as in the RV-4. Bending around on base in a continuous turn (to keep the runway in sight), you feed in the flaps and slow through 120 knots. Slowing to 90 on short final, you check the gear again and squeeze off the power. As the airplane rolls out on centerline, the big nose starts to hide the pavement; not too worry, it didn't go anywhere.

Closing the throttle, you feel those long oleos reach out to grab the ground. The airplane settles down as the struts deflate and the tailwheel touches. You pull back on the stick to make sure it stays. As you slow, the play in the tailwheel allows the airplane to wander a bit, but a couple of rudder jabs keep that

under control as you roll to a stop.

There's an ache in your face, and you realize that you have been gritting your teeth for the last 30 minutes. Now your smile is so big that your muscles hurt. The folks at Van's talk about the RV Grin, but they've not seen one quite like this!

The Verdict

Contrary to what you may have heard in the pilots lounge, both the Corsair and the RV-4 are easy to fly. The Corsair is easy because the pilots that flew them had little total time. The RV-4 is relatively simple because a VFR private pilot can buy insurance for a tailwheel airplane with Bonanza performance.

The Corsair is a mechanical marvel of complex systems that pushed the engineering technology of the time to provide great handling and performance. The RV-4 is a study in simplicity and the exploitation of well documented, long understood construction methods and aerodynamics that yield great performance and handling.

The RV-4 wins big in visibility. The enormous nose on the Corsair hides runways when landing and airplanes when taxiing—how they ever put them on a carrier is amazing. The RV-4 also wins the taxiing battle, but the Corsair wins the landing contest. Those long oleos make bad landings nearly impossible—they absorb everything and do not rebound. The RV-4's spring steel gear can sometimes provide for some fancy dancing on the runway.

There is one clear contrast between the Corsair and RV-4: the RV-4 burns around 8.5 gph and can travel 450 n.m. in 3 hours. By then, you should be looking at a runway and a $75 gas bill. The Corsair, however, burns 85 gph and holds a scant 230 gallons (without drop tanks). In 2 hours, you'll be looking at the same runway and a $500 gas bill.

The RV-4 is obviously no Corsair, and vice versa, but the airplanes have remarkable similarities in the way they feel. I lack the technical vocabulary of a test pilot to describe how RV series designer Dick VanGrunsven has captured the essence of a fighter in his RV-4, but he's done it. It's not just the handling, the speed, the visibility, the acceleration, the power, or even the cozy feel of the cockpit—it's the complete package.

So if you haven't won the lottery and don't have a friend who needs help flying a Corsair, mooch a ride in an RV-4 and fly above the clouds on a beautiful day. You'll almost see the Zeros on the horizon.

Perhaps Gerry Beck, owner of an example of each airplane, says it best: "If they passed a law tomorrow that I could only own one airplane, it would be my RV-4!"

FOR MORE INFORMATION on the RV-4, contact Van's Aircraft at 503/678-6545, or visit www.vansaircraft.com.

Gerry Beck, who owns and operates Tri-State Aviation, agrees with the author that his Corsair flies much like an RV-4, despite the difference in size.

Homebuilt Aircraft:

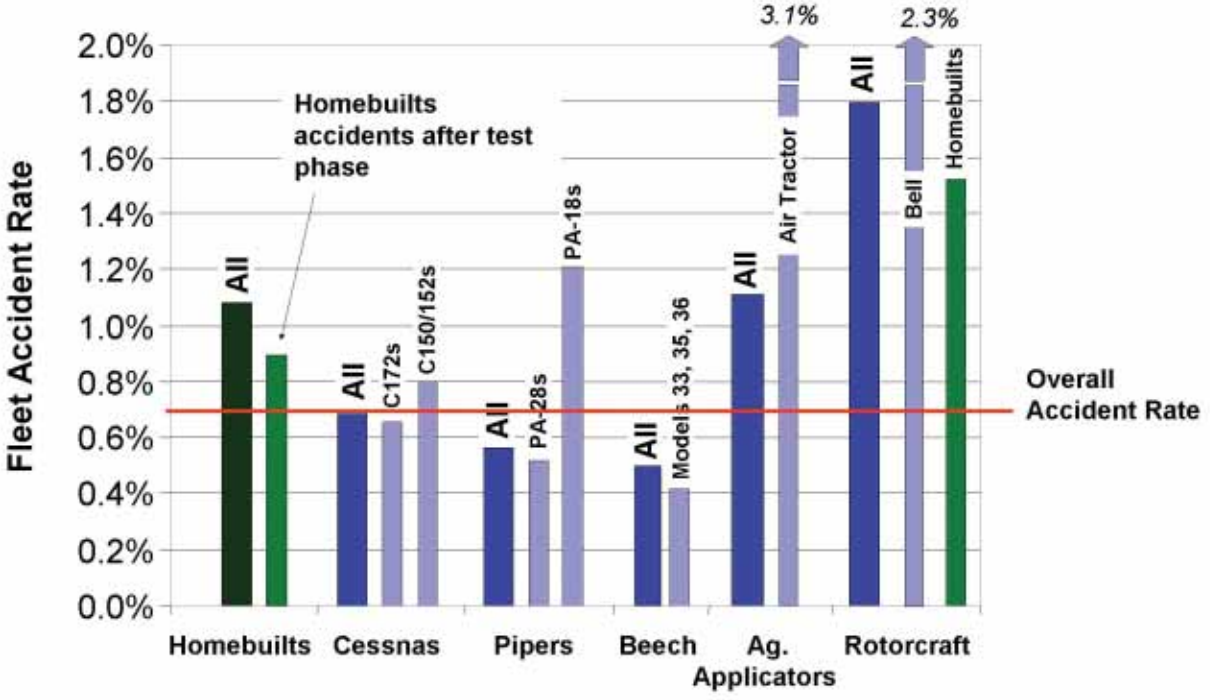


Figure 1.

How Safe Are They?

A statistical analysis of amateur-built aircraft accidents produces some unexpected results.

BY RON WANTTAJA

The reporter from the local TV news held the microphone closer. "Do homemade planes crash more often than normal aircraft?" she asked.

The camera lens glittered behind her shoulder while I stood there and wondered, "Why me?"

All I'd done was bring my Fly Baby to an event at the local air museum. The reporter's station loved to run "breaking news" items about the slightest fender-bender and ran all homebuilt-airplane accidents as the top story. Heck, this was probably the first time the reporter had ever seen an *intact* homebuilt airplane.

I wracked my brain for any safety-related statistics I'd heard over the years; a few fragments surfaced. "Once we complete our test period, our accident rate is about the same as production aircraft," I started. "Most of our accidents during the test period relate to problems with the fuel system. Once the test period is completed, our accident rate in weather-related accidents is lower, although we tend to have a few more crashes in other categories."

The news report that night, with the quotes from several of us homebuilt owners, wasn't too bad. They even ended with a mention of the EAA Technical Counselor and Flight Advisor programs.

But it left me with a sense of dissatisfaction. Maybe I remembered correctly, but how accurate *were* the statistics that I quoted to the reporter?

Are the accident rates about the same? How frequently do accidents occur during the test period? What are the causes compared to those of production aircraft accidents?

I'm the kind of guy who walks away from "Wet Paint" signs with tacky

ILLUSTRATIONS: RON WANTTAJA

fingers. Damp enamel or aircraft statistics, I have to prove it for myself.

Fortunately, the information needed for studying homebuilt accidents is just a few mouse-clicks away. It turns out that two out of the three things I told the reporter were wrong!

Let's see what the real answers are.

Data Sources

This analysis was based on the accidents occurring in 1998, 1999 and 2000. Downloading the NTSB Accident Databases for these years provided the primary source of data for analysis. These files were obtained from the self-extracting archives located at www.ntsb.gov/avdata/Access95/.

It should also be noted that these statistics reflect only *reported* accidents. I've known cases where broken homebuilts were stuffed back into garages or hangars before the FAA could find out about it; they aren't reflected in my figures.

Determining the total number of aircraft on the FAA registry during the same period required copies of the FAA Aircraft Registration database. While historical versions of these databases are not available online, I had previously obtained the July 1997 and December 2000 sets. They were used to calculate the average fleet sizes during the 1998-2000 period.

Overall Accident Rates

For the first application of these data, let's compare the accident rates between homebuilts and all U.S.-registered aircraft. We'll define *fleet accident rate* as the average number of annual accidents involving a particular type of aircraft divided by the average number of that type on the FAA rolls. Each *fleet* may include an overall class of aircraft (such as homebuilts) or specific aircraft (like Cessna 172s). Again, all averages are for the 1998-2000 time period. **Figure 1** illustrates fleet accident rates for homebuilts and certified aircraft.

The result? The homebuilt accident rate is more than 50% higher than the overall rate. About 1.05% of all homebuilts crash in a typical year versus about 0.68% of the overall U.S. aircraft fleet.

About 20% of those homebuilt accidents involved aircraft that hadn't yet completed their first 40 hours. If these are not included, the homebuilt rate drops to around 0.85%—about 25% higher than overall.

Determining the Fleet Average Annual Flight Time

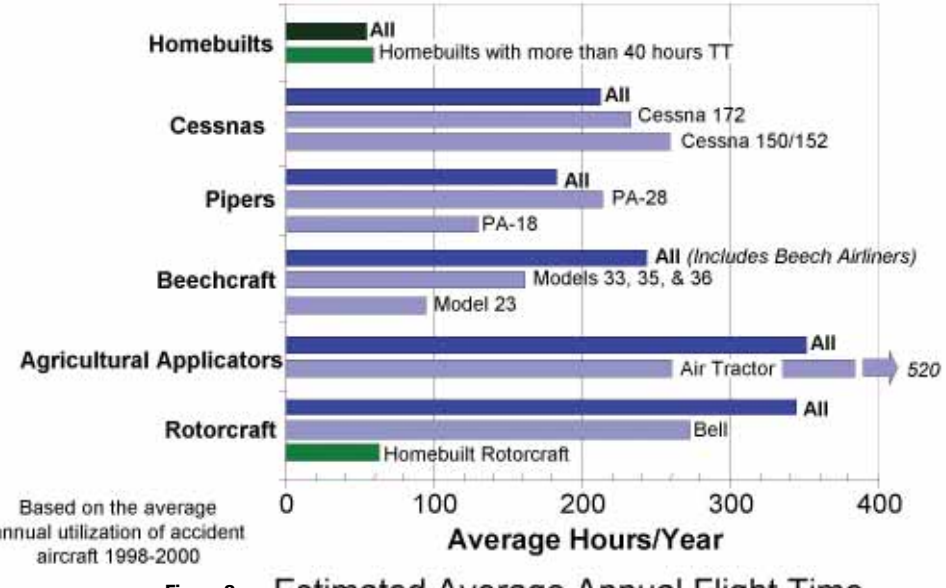


Figure 2. Estimated Average Annual Flight Time

The fleet accident rate doesn't take into account the amount of flight time accrued on each type of aircraft. The rate for homebuilts is about equal to that of agricultural airplanes, but ag planes fly *a lot*. For a true comparison, we need to correlate the average annual accidents with the total number of hours flown by the entire fleet during a typical year.

While this sort of information isn't directly available, the accident reports themselves present an opportunity for further clarification. The reports include the aircraft's total flight time, its year of construction and the date of the crash, which can be used to determine an accident airplane's average annual flight time. The results for all accident aircraft of the same type can then be averaged to produce an average annual flight time for all aircraft of that type.

Whether or not this method is absolutely accurate, the *relative* relationships should be about the same. By using the same process on all types of aircraft, the relationship between homebuilts and production aircraft flight time should be the same, no matter what the absolute numbers are.

The results are rather stunning: Homebuilts fly only 20% as much as the average U.S.-registered aircraft. Using the method described above, homebuilts fly an average of 55 hours per year versus 270 hours per year for the overall fleet.

Of course, the overall figures include air carrier, charter and agricultural operations. If we include only single-engine, fixed-wing, non-agricultural aircraft, this reduces the annual rate to about 160 hours per year. Also, the homebuilt numbers include those planes still in their test periods. If we eliminate the planes with fewer than 40 hours, the average annual flight time for homebuilts rises to about 60 hours per year.

Figure 2 compares the homebuilt rate with that of common general aviation aircraft. **Figure 3** breaks down the results for common homebuilt aircraft types.

Accidents Per 100,000 Hours

We have the number of accidents, we have the number of aircraft and we have an estimate for the average annu-

al flight time for these aircraft. We now have everything we need to calculate the number of accidents per 100,000 flight hours—the standard method of comparison.

How do homebuilts compare? Pretty doggone awful, because they have a higher fleet accident rate and much lower annual flight time. The overall homebuilt accident rate per 100,000 flight hours is *almost eight times higher* than that of all U.S.-registered aircraft!

Then again, the overall U.S. rate includes air carrier and commercial operations. Single-engine, fixed-wing, non-agricultural operations have a rate about 50% higher than the overall accident rate. These operations are probably the closest equivalent to that of a typical homebuilt, but the homebuilt rate is still five times higher.

Checking the Causes

These statistics are useful to insurance companies to predict the overall trends, but they do not apply to individuals. Just because one out of every 100 homebuilts crash per year, doesn't mean *you* have a one-in-100 chance of crashing.

While an automobile driver is still at the mercy of the other drivers on the road, the fate of an aircraft is almost completely in the hands of people directly associated with it: its manufacturer, its maintainer and its pilot. If these individuals can avoid the situations leading to accidents, that aircraft is much less likely to crash.

With homebuilt aircraft, the manufacturer, maintainer and pilot are often the same person. By understanding the causes of homebuilt accidents, a builder will have a better chance to avoid becoming a statistic.

Finding the Initiators

For each homebuilt listed in the NTSB database, I studied the available narratives to determine the *initiator* for each accident. Initiator is my term for the event that triggered the emergency situation. While the NTSB's *probable cause* formed a major part of my initiator determination, I sometimes drew a different conclusion.

Take, for instance, a typical engine-failure accident. If the pilot overshot during his or her forced landing, the NTSB often assigned probable cause to "...the failure of the pilot to maintain proper glide path." The engine failure itself was usually listed as secondary.

In contrast, I would assign the engine failure itself as the initiator of the accident. This has the effect of reducing the number of *pilot error* accidents, but helps highlight cases where mechanical problems were the first event in the accident chain.

Rather than merely examine homebuilt accidents on their own, let's perform an identical analysis on a subset of production aircraft during the same time period. Let's start with one of the most common general aviation aircraft: the Cessna 172. Because the 172 is often used as a primary trainer, we'll omit all accidents that are flagged in the NTSB database as training flights.

Still, the 150-hp, fixed-gear 172 isn't really a fair comparison with the overall homebuilt fleet. To even the playing field, let's include Cessna 210 accidents as well. This gives us about a 4:1 mix of simple and complex aircraft.

STATISTICAL INACCURACIES

Any statistical analysis must deal with inaccuracies in the data, and the data used for the homebuilt accident analysis are no exception.

For one thing, not all aircraft accidents are reported by the NTSB. If there are no injuries and the aircraft damage is minor, it is considered an *incident* and is therefore not investigated by the NTSB. The reportability standards are included in NTSB Part 830.

However, the fact that there are rules for reporting accidents doesn't necessarily mean the rules are followed. No one really wants the embarrassment. Unlike most production aircraft pilots, homebuilders are accustomed to moving pieces of aircraft from one place to another—whether it's from a home shop to an airport, or a fallow field to a closed hangar.

For instance, when one of the local EAA chapters held a picnic at an airpark, a chapter member lost the engine of his homebuilt on takeoff; he wiped the gear off when he deliberately groundlooped to avoid going down an embankment at the end of the runway. With no one hurt, chapter members hauled the wreckage into a hangar and made themselves scarce before the police arrived.

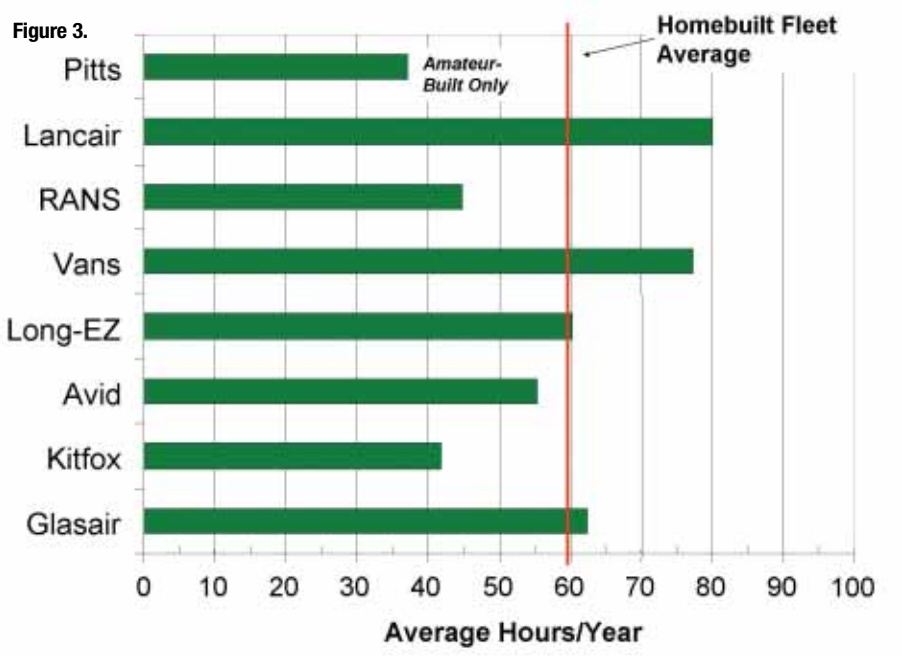
Homebuilders are better equipped to avoid having the FAA or NTSB find out about their "mishaps" as long as no one is badly hurt. Consequently, the total number of accidents (and thus the accident rate) may be higher than the main article presents. Balancing this is the uncertainty over the true size of the overall homebuilt aircraft fleet. When computing the total homebuilt fleet size from the FAA registration databases, I counted only those aircraft listed as certified under the Experimental/Amateur-built category.

However, there are 20-30% more homebuilts in the FAA registration database that do not have an entry in the certification field. Some of these aircraft are operational, so the total homebuilt fleet size is somewhat higher than the official numbers would reflect. If the fleet size is higher, the actual accident rates are lower.

The NTSB accident database includes two-seat ultralight trainers that are not registered with the FAA. I did not include non-N-numbered aircraft in the overall statistical calculations, although I did include them in the analysis of the causes.

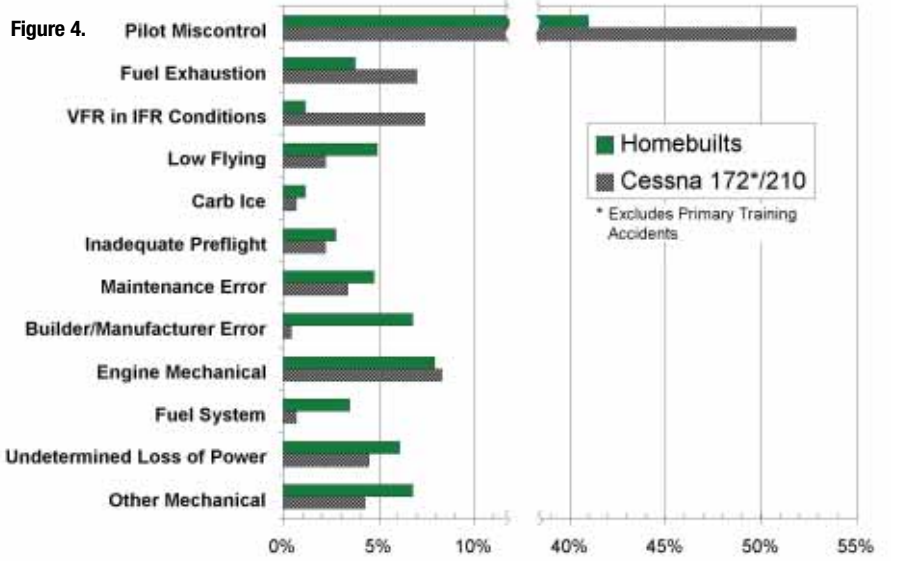
—Ron Wanttaja

Figure 3.



Estimated Average Annual Flight Time for Common Homebuilts

Figure 4.



Accident Initiators – Homebuilts vs. Cessna 172s & 210s

Pilot Miscontrol and Decision Making

A comparison of the results is shown in **Figure 4**. Not surprisingly, the most common initiator of aircraft accidents is pilot error. What's interesting is the difference in the rate between homebuilts and our Cessna 172/210 in the *pilot miscontrol* category. This category covers accidents that resulted from the pilot either losing control of the aircraft (such as an inadvertent stall or ground-loop) or misjudging the flight path.

The homebuilt rate is about 10% less than our Cessna 172/210 sample set. Obviously, we're better at maintaining control of our aircraft, despite the fact that many of the homebuilt fleet are taildraggers. This may be primarily due to a higher experience level; the accident reports showed Cessna 172/210 pilots averaging about 500 hours total time; homebuilt pilots averaged almost 400 hours more.

Next we'll compare the accidents caused by attempts to fly VFR in IFR conditions and those involving deliberate low flying. Homebuilders have fewer accidents in the first category but seem to engage in more buzzing.

All told, about 55% of all homebuilt accidents involve mistakes in either control of the aircraft or in the pilot's judgment, compared to about 72% for our Cessna 172/210 sample set.

Mechanical Failures

Sadly, the difference is made up with a higher percentage of homebuilt accidents caused by mechanical failure—more than 50% higher, in fact.

Figure 5 shows the percentage of homebuilt accidents that involve mechanical problems. These include both the accident initiators as well as those instances where the failure was a secondary cause.

The single most common mechanical failure involves problems with the powerplant; 9% of homebuilt accidents feature failures of the engine. Most are triggered by internal events: valve failures, seized cylinders, failures of rods and bearings, etc. The rest involve the exhaust, ignition, cooling, oil and redrive systems.

Fuel system problems come in second, reported in about 6% of homebuilt accidents. These are split fairly evenly between difficulties with the fuel tanks and lines in the main airframe, and fuel system components forward of the firewall.

Another 6% of accidents actually may not be mechanical in nature; those are attributed to a "Loss of power for undetermined reasons." These may be due to errors by the pilot or mechanical failure, but the NTSB found no evidence either way.

Builder/Maintenance Error

Probably the most alarming find in this analysis was the frequency of accidents involving errors by either the

aircraft builder or the person maintaining it. Almost one in every six homebuilt accidents involved mistakes by the builder or maintainer; in more than 10% of homebuilt accidents, such errors were the direct cause of the accident.

The systems affected by builder errors and the types of mistakes made are shown in **Figure 6**. Two-thirds of the errors involved either the engine or fuel system; 20% of the errors affected the control system; and about 12% involved the airframe.

What kind of mistakes did the builders make? Almost 40% of the cases featured improper installation of an off-the-shelf component. These include items like fuel valves or propellers. About a quarter of the time, the builder made some sort of change to the design that didn't pan out, such as omitting installation of a fuel boost pump. Almost 20% of the cases involved poor workmanship, such as a bad composite layup, a faulty Nicopress fitting or the failure to follow the construction instructions.

Builders improperly performed initial setups or adjustments in 15% of the builder-error cases, including items like control rigging or rotor tracking. Finally, about 5% resulted from the use of materials or parts inadequate for the task.

(It should be noted that these assessments are my own, based on reading the NTSB narratives. Other analysts may characterize the data differently.)

The numbers for maintenance errors are generally about the same: The engine and the fuel system are affected even more frequently, and more workmanship/procedure problems occurred. But nearly 30% of the maintenance errors are attributed to inadequate inspection; either existing problems were not detected, or scheduled inspections were neglected.

First Flight and Test Period Accidents

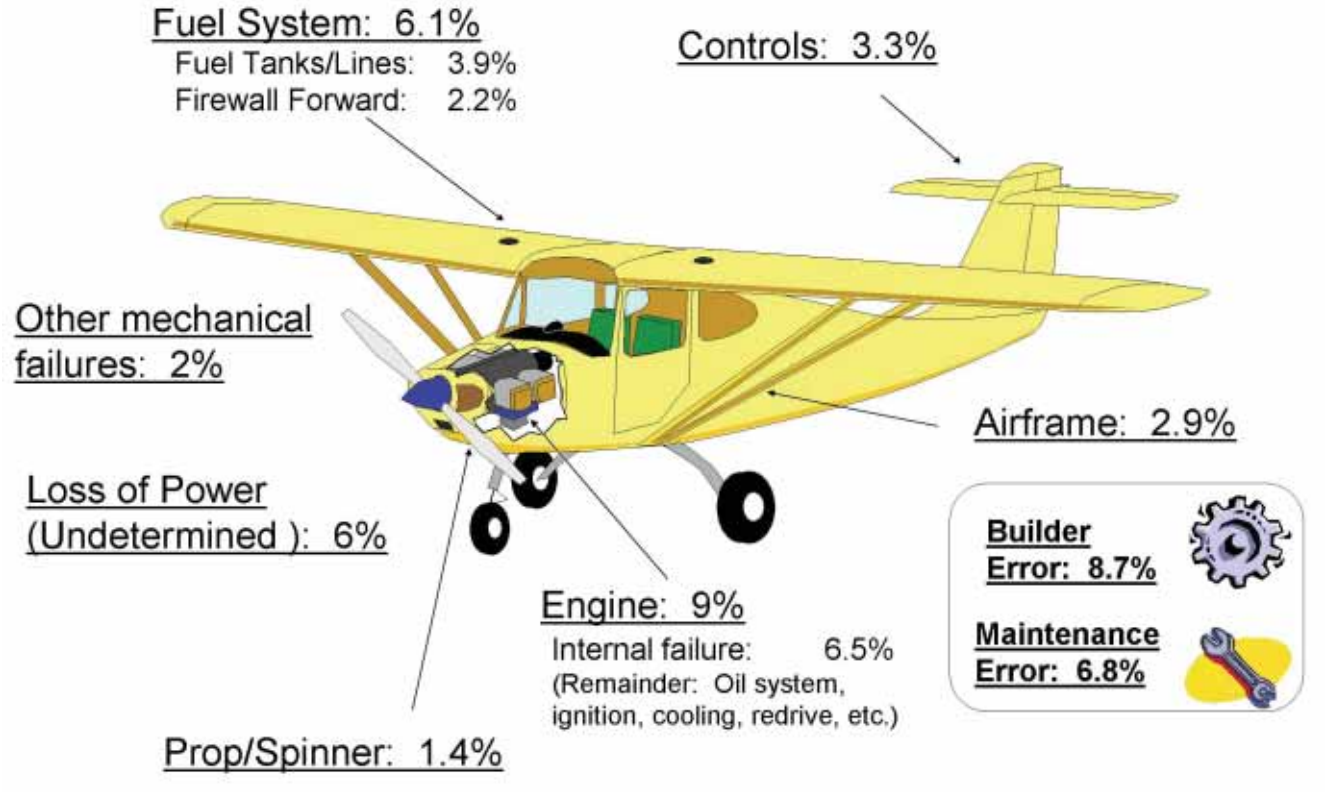
One of the big questions people have is how often accidents occur on the first flight or during the test period of a homebuilt aircraft.

About 80% of the nearly 700 homebuilt accident reports during the 1998-2000 timeframe included the number of hours on the aircraft at the time of the accident.

However, the use of reported hours as an indicator is not strictly reliable for determining whether a plane was on its first flight. If the investigator merely wrote down the reading of the recording tachometer or Hobbs meter, all the ground-running and taxi testing will be included.

For my analysis, accident aircraft are considered to be on their first flight if the investigator's narrative describes it as such, or if the aircraft total time is 2 hours or less.

Determining whether the aircraft is still in its test phase is more difficult, because the FAA assigns different durations depending upon the aircraft, engine and propeller combination. Forty hours is most common, but 25- or even 10-hour periods have been granted by the FAA. To simplify matters, we'll assume that any aircraft with 40



Percentage of Homebuilt Accidents Involving Mechanical Failure...Includes both Initiators and Secondary Causes

Figure 5.

hours or less is still in its test phase.

Of the nearly 700 homebuilt accidents in the analysis period, 33 of them (almost 6%) occurred on the first flight. About 21% of the total accidents occurred during the aircraft test phase, which also includes the first flight accidents.

How Often Does it Happen?

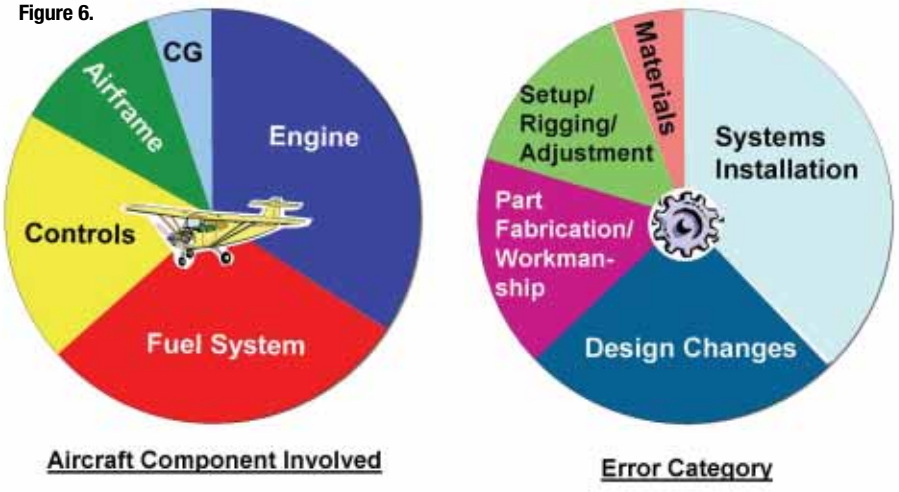
It's helpful to know what percentage of the homebuilt accidents involve aircraft on their first flight, but what people *really* want to know is how often a first flight ends with a crash.

About 4100 new homebuilts were added to the FAA rolls during the January 1998-December 2000 timeframe covered by the accident database. With 33 identified first-flight accidents in the same period, it appears that less than 1% of new homebuilts crash on their first flight.

This rate is actually pretty close to the overall annual homebuilt accident rate, but don't be fooled: Remember the overall rate is for an *entire year* of operation. Not just one flight.

All told, about 3% of new homebuilts crash sometime during their test phase.

Figure 6.



Homebuilt Accidents Involving Builder Error

Initiator Differences

What are the causes of crashes during the first flight and test period? **Figure 7** compares the accident initiators with those for the overall homebuilt fleet.

As the figure illustrates, builder and maintenance errors cause accidents during the first flight almost twice as often as other initiators. The figure drops slightly for the overall test period, but it's still about 65% higher.

Figure 8 compares the systems where the errors were made. Almost half of the builder-error-induced accidents during the test phase involve the engine, compared to about a third for the overall fleet. The same types of mistakes (faulty installations, not following the instructions) are being made in about the same percentages.

The big message from Figure 8: Don't depend on the test period to drive out the errors made during construction. Control and airframe structural mistakes are more likely to surface after the aircraft has flown for a while, and fuel system issues will bite anytime.

Longer-Term Trends

When the percentage of accidents compared to the aircraft total time is plotted, a curious phenomenon is noted. The effect of the first flight and test period is expected, but as seen in **Figure 9,** there's a second spike in accidents between 50-90 hours total time.

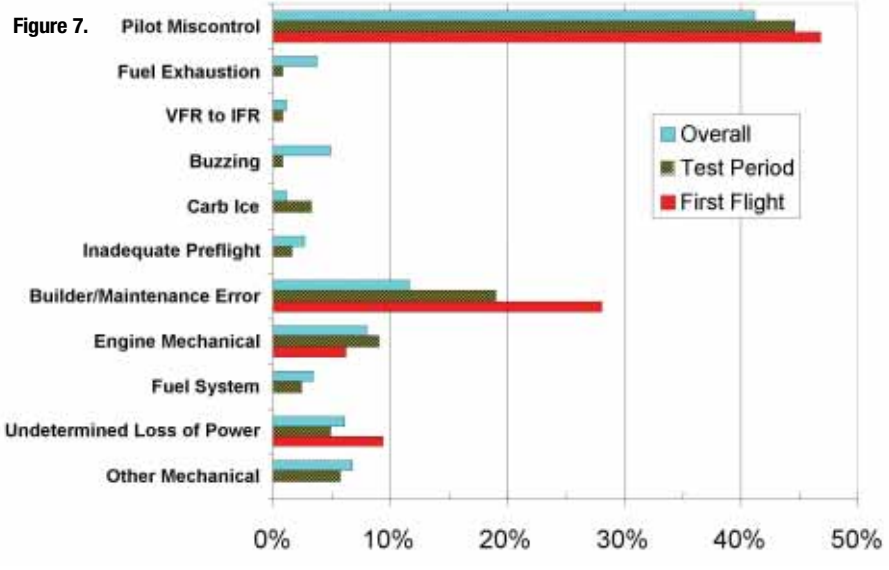
Once free of the test area limitations, owners apparently succumb to the perils of cross-country flight. For instance, the occurrence of "VFR flight in IFR conditions" accidents is more than twice that of the overall rate.

The other contributor to the spike is maintenance error. During the 40-90 hour period, the rate is almost 40% higher than the overall homebuilt rate, and almost three times higher than the maintenance error rate during the test phase. It appears that the wear-and-tear of the test phase is not being detected and/or repaired properly.

Reducing Your Risk

Alright, so what was erroneous about my statement to that TV reporter?

Figure 7.



Homebuilt Aircraft Accident Initiators

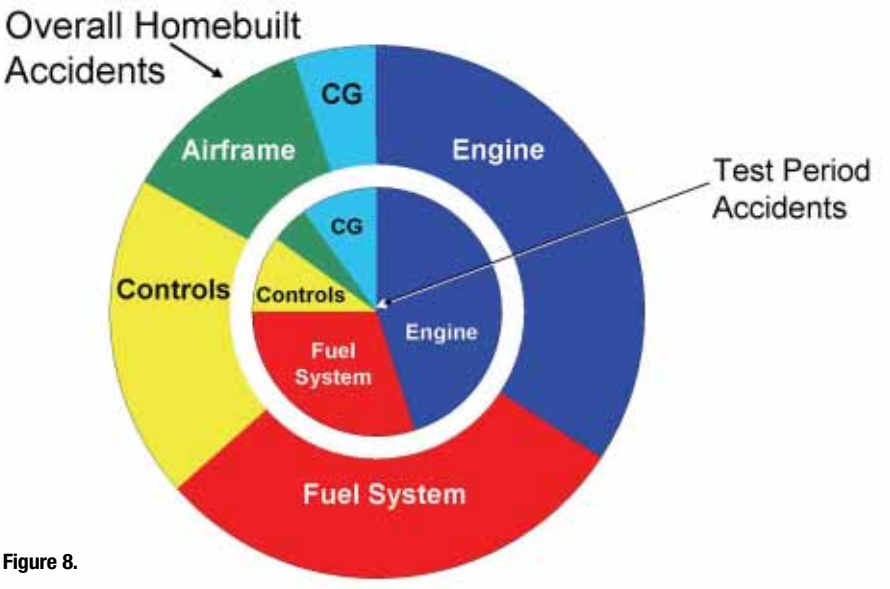


Figure 8.

Test-Period Accidents Involoving Builder Error

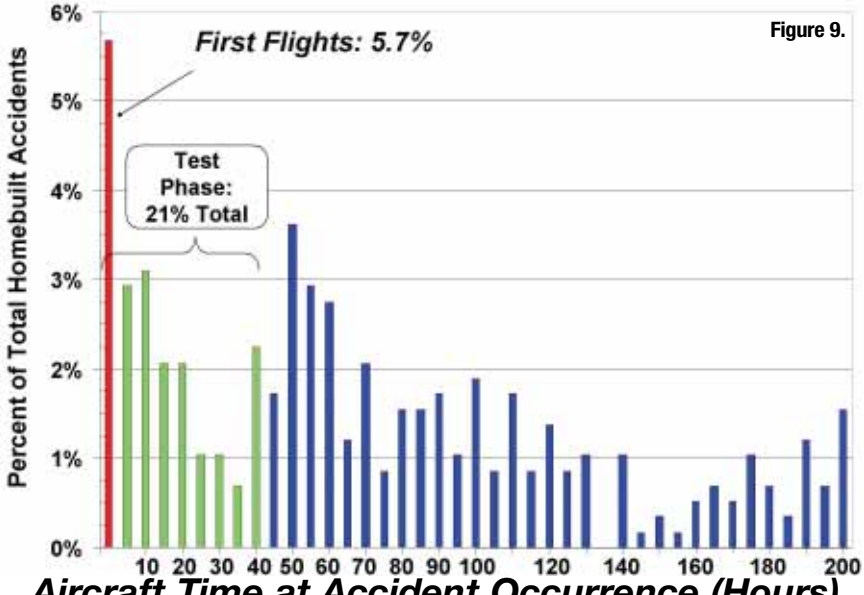


Figure 9.

First, I was incorrect when I claimed that post-test-period homebuilts had the same accident rate as production aircraft—our rate is actually 25% higher.

And second, I claimed that most accidents result from fuel system problems. Pilot error leads, of course, with engine mechanical failures a close second. Fuel system difficulties are further down the list. However, our engine mechanical failure percentage is close to the Cessna 172/210 baseline, while our fuel-system accident rate is three times higher.

There is no single reason for homebuilding's higher accident rates. But mechanical failure is definitely one factor. Considering that our airplanes are built by amateurs and often maintained by amateurs, accidents should therefore be expected.

But they do not occur at random. There are steps you can take to reduce your own risk.

First, sign up for the EAA Technical Counselor program (see article on Page 28), and invite other builders to examine and inspect your work during construction. Building an airplane is a complicated endeavor. More than 10% of all homebuilt accidents and almost 30% of the first-flight accidents can be traced to builder mistakes. It's important to have a more-experienced set of eyes check your work.

Also, a quarter of the builder-error accidents are related to modifications or changes from the baseline design. Get advice before deviating from the plans.

Second, remember that maintaining an aircraft—any aircraft—is also a challenging task. Almost as many homebuilts crash due to maintenance mistakes as from faulty construction. Almost a third of the time, it's because of problems that should have been detected during routine inspections and corrected afterwards. If you have the Repairman Certificate for your airplane, invite other homebuilders to look over your plane once in a while. If you don't have the certificate, don't just hand the keys to the A&P for the annual—participate in the inspection, and use your own judgment.

On a related note, just because your airplane is nearly new at the first condition inspection doesn't mean you can relax. The spike of accidents for airplanes just out of their test phase is probably due in part to maintenance issues that aren't being detected and corrected.

Finally, when something breaks on your airplane, it doesn't mean you have to crash. While we maintain control better than our Cessna-driving counterparts, mechanical failures cause more frequent challenges to our flying skills. EAA's Flight Advisor program (see article on Page 28) is designed to get new builders ready for their test period. Those past the test stage should stay alert, review their own plane's systems and get recurring training.

Reducing the homebuilt accident rate comes down to the basics: Know your aircraft systems, ask for help when needed, and know how to handle yourself—and the aircraft—should the unthinkable occur.

FOR MORE INFORMATION, visit the NTSB's aviation accident database at www.ntsb.gov/ntsb/query.asp.

An Ounce of Prevention

Three EAA programs take a proactive approach toward safety.

BY RICK LINDSTROM

Hey, y'all! Watch this!" This ominous phrase crackled from the Unicom monitor, and the onlookers diverted their attention to the mere speck of an airplane that was getting louder every second.

The sleek composite sport plane streaked down final over the pine trees at the small Georgia airport. The pilot leveled off about 50 feet above the runway at cruise airspeed, with the airspeed indicator needle as far up the scale as it had ever been. He'd been tempted to make the high-speed pass even lower, but he hadn't much time yet in his new baby. Why take unnecessary risks?

As the numbers on the departure end on the runway flashed underneath in a blur, the pilot hauled back on the stick, and the slick airplane shot upward in a steepening climb. The G-load was almost unbearable, and his vision started to gray. But he wasn't too concerned, for he knew this airplane was one of the finest ever completed by an almost fanatical builder who gave an incredible level of dedication to detail, equipment and aerobatic modifications. The pilot knew he could wring the absolute most from this engine and airframe.

By the time the accelerated stall had come and gone and the beautiful little airplane was in an uncontrolled high-speed tumble toward the trees, the pilot began to comprehend that he was suddenly in very deep trouble. Mercifully, his increasing terror only lasted a few moments as the composite airframe slammed through the trees and disintegrated. As the dust settled and the air cleared, there was very little that was recognizable as an airplane—or a pilot for that matter.

True story.

I didn't know the pilot personally, but I was very familiar with this airplane. I called the builder after reading the NTSB accident report, expecting to get his input on the tragedy. Surprisingly, he hadn't yet heard; I felt sick having to explain the purpose of my call.

This accident has haunted me ever since, and it's taken a few years to come to grips with the reason. There are so many lessons to be learned here that I offer this particular crash as the cold splash of reality that periodically mars the otherwise joyous activity we call sport aviation.

If you're new to sport aviation, sign up for EAA's Introduction to Aircraft Building. Taught by Dave Juckem (standing), the course gives students the opportunity to explore composite, sheet metal and tube-and-fabric building in a hands-on environment.

Contributing Factors

Let's examine the factors that contributed to this accident. Even the word *accident* hardly seems adequate, as the pilot actually worked hard to achieve this tragic outcome, although not entirely consciously.

This airplane wasn't designed to be an unlimited aerobatic performer. Although the stock airframe allowed for mild aerobatics, the builder wanted to increase the roll rate and lighten the stick forces, so spades were installed on lengthened ailerons. The engine had full inverted oil and fuel systems, and five-point aerobatic harnesses were installed. The builder spent many hours flying the airplane while testing these mods and had learned firsthand how each new tweak affected the airframe's performance.

But the accident pilot had none of this direct experience. He was the third owner of this airplane and had no direct contact with the builder; he knew nothing of the processes behind the various modifications. He did know that the large ailerons, spades, inverted systems and stout harnesses visually indicated a capable aerobat, but not to what extent. Unfortunately, his brief experience as a test pilot cost him his life.

The builder had sought out an ex-military fighter pilot to assist with his flight-test program while introducing airframe modifications, and they flew a

conservative profile while nibbling at the edges of the envelope. Always at altitude, always with parachutes. The accident pilot just knew that the airplane was solidly built from a kit from a respected manufacturer. He had no reason to suspect that the airplane didn't fly entirely the way it looked like it should. But if he had just thought about what he was attempting while recalling what he learned in primary ground school, he certainly wouldn't have attempted such an abrupt pull-up so close to the ground.

After many flight hours, the builder realized that as beautiful and well-appointed as this airplane was, no amount of reasonable modification could change its intended mission profile of a slick, cross-country airplane capable of mild aerobatics. Expecting it to be something it wasn't was delusional. So he moved on to his next project—an unlimited aerobatic performer with good speed and adequate cruise stability. The pilot who crashed didn't take the time to become familiar with this airplane and made a lot of assumptions about capability, ultimately pushing it way beyond the limits of predictable flight characteristics.

It's tempting to dismiss the actions of the late pilot in question and write them off to stupidity, but the truth is that we've all done dumb stuff where airplanes are concerned. Human beings are fallible, especially when they operate without a backup, as is so often the case when flying light aircraft.

When you throw in the fact that every homebuilt airplane is slightly different than the same model built by someone else, you introduce variables that the factory production lines never encounter. Unless it's been bent, a 172 pretty much flies like a 172.

Given these facts, many would incorrectly assume that all kit aircraft are doomed from the moment they first roll out to the runway. But this is not the case, and statistics indicate that the accident rate for homebuilts has steadily decreased as the number of hours flown increases. Some of this is attributable to the maturing of the kit aircraft industry and its designs as well as better powerplant technology and instrumentation, but much is due to the proactive efforts of EAA in tackling this sometimes thorny issue head-on.

A Call for Backup

Rather than put on the happy face and deny that homebuilt accidents are only an anomaly, EAA has developed a three-pronged approach to assist builders in flying contentedly into the sunset once construction is completed. If you're bright enough (and most of us are) to have flown as PIC more than once without hurting yourself or the airplane, you'll recognize the intrinsic and lasting value of these programs.

The full approach first became available about a decade ago—EAA's SportAir Workshops, Technical Counselor and Flight Advisor programs combine to support and educate the builder from the initial planning and selection of a project through flight test and ongoing operation and maintenance.

SportAir Workshops

With so many kit choices available and so many opinions out there, finding the right project isn't easy. If you're new to sport aviation and surrounded by friends who all claim to be building the absolute best airplane available, it's downright daunting. Add that nagging little voice (or spouse) that's questioning your sanity for considering building at all, and it's tempting to just go back to watching *Jerry Springer* instead.

But for a paltry $25, you can attend any entry-level EAA SportAir Workshop held around the country and get an overview of what's actually involved in building your own airplane. *What's Involved in Kit Building?* is a two-hour seminar that explores the realities of homebuilding and touches on planning for, selecting, building and completing your project, followed by flight testing and operation. These seminars generally start at 5:15 on a Saturday evening and even include pizza.

If you haven't been scared off by then, your next step may be to sign up for the two-day *Introduction to Aircraft Building*, where would-be builders are introduced to the FAA regs concerning homebuilding, a brief history of different construction types, tools and workshop space requirements, and the recommended steps in deciding whether building or restoring is for you.

After lunch, the fun really begins. It's time to roll up your sleeves and jump in to working with composite construction, which includes doing your own fiberglass layup. Class discussion will answer most of your questions about working with this increasingly popular method of airframe building, including benefits and caveats.

The second day starts with fab-

The moment of truth—Juckem evaluates a student's composite layup, undoubtedly offering valuable tips and tricks for the real deal.

SportAir Workshop instructor Dick Koehler conducts an in-depth discussion with prospective builders on avionics and electrical wiring.

PHOTOS: COURTESY EAA

ric-covering instruction using the Stits Poly-Fiber method. Students actually cover a rudder and can give rib stitching a whirl as well. In the afternoon, metal construction is introduced. Students learn the basics in laying out metal components, drilling, deburring and riveting; they'll also quickly conclude whether this construction discipline is for them.

The class concludes with a presentation on aircraft hardware, and project selection is revisited now that the students have earned a hands-on, informed perspective on what's involved in the construction process. The cost for this class is $249, but EAA members receive a $40 discount.

Once a student has a good idea what construction method is most appealing, there is a wide selection of one- and two-day follow-on classes that explore building methods in detail. Covering much sought-after skills, these in-depth classes include: Electrical Wiring, Fabric Covering, Composite Construction, Finishing and Spray Painting, Gas Welding, TIG Welding, Sheet Metal Basics, RV Assembly and Test-Flying Your Project.

The costs per class vary somewhat, depending on the cost of the materials used. You should budget between $100 and $150 per day to cover class costs. Of course, travel and expenses are on you. But given the depth of knowledge possessed by the instructors, the small class sizes and the relevance of the information, the EAA SportAir Workshops are a great way to avoid making an uninformed multi-thousand dollar mistake (as many have) when first jumping into aircraft building.

Richard Finch, who instructs EAA's course on gas welding, assists another would-be builder in the art of oxy-acetylene welding.

EAA Technical Counselors

Imagine having a local expert that stopped by on occasion, looking in on what you were doing with your project and freely giving his/her sage advice. For the first-time builder, having such a relationship would be invaluable, especially when the expert had the experience of building a project similar to yours. How much would such a relationship be worth to you? How much would you pay an expert for personal, on-site consultation like this?

If you're an EAA member, this program is free. Oh, it might cost you a cup of coffee or a doughnut (or two) during the visit, but the Technical Counselor program is kind of a buddy system that connects an experienced builder with an inexperienced one to provide much-needed assistance and advice when the inevitable questions arise. About half of the TCs in the program are A&Ps, and each TC has built or restored an average of two airplanes. They're not allowed to sign aircraft logbooks or building logs or help modify a design—their primary goal is to help the builder adhere to the plans and ensure that the finished project will be safe and airworthy.

The program began in 1965, and there are roughly 1200 Technical Counselors available nationwide; chances are good that one is close by. "We recommend at least three visits during the building process," says Charlie Becker, Executive Director of Aviation Information Services at EAA. "Frankly, you can't have visits like this too early or too often." Becker stresses that having that second set of eyes look for things that have eluded the builder often avoids having the wrong nut or misinstalled part turn into a tragedy. And *saves* happen a lot more often than you would think.

EAA's Flight Advisor program picks up where the Technical Advisor program leaves off—when the project is finally ready to begin flight testing. Here, Chris Heitman (left) who after consulting with Flight Advisor, Jerry Thorpe, decided to have Rich Vichich (right) conduct the first flight of Heitman's RV-9A.

"Most builders have an emotional attachment to their project," Becker says. "The Tech Counselors are impartial third parties that are only interested in seeing the project built and flown successfully." He suggests that builders schedule the first TC visit before that wing or other structure is closed, as the whole concept becomes invalid once it's too late to make corrections.

Although it's tempting to credit the EAA mothership with the ongoing success of this program, Becker says that it's all possible because of "EAA members volunteering to help other EAA members; we just put 'em together."

Well, EAA does a bit more than that. A visit to the members section of the EAA web site (www.eaa.org) will provide all sorts of information on how to get involved with this innovative program. Once your project is up and running, it's time to take advantage of the program that addresses the last phase of a successful build.

EAA Flight Advisors

Introduced in 1994, the Flight Advisor program picks up where the Technical Advisor program leaves off—when the project is finally ready to begin flight testing.

"We have a tremendous amount of freedom where homebuilding is concerned," Becker says. "And whenever there's a problem, the first response from the FAA is more regulation. That's not the answer—education is. And it's working."

As in the other EAA builder assist programs, Flight Advisors are volunteers who are experienced in flight testing aircraft. Their expertise may come from antiques, warbirds, restorations or even the military, but all must have significant experience in their area of expertise. Although they do no test-flying of the project themselves and can't prohibit a builder/pilot from flying, they do help the pilot through an honest evaluation of the plane (and themselves) before embarking on a test-flight program.

"For a complete and proper flight test, you'll need every one of those 40 hours," Becker says. "Every kit is unique in its own way. And every single one needs to be properly tested by the one who'll fly it." EAA provides detailed guidelines and support for the 550 or so

EAA Safety Programs

CONTINUED

volunteers who typically perform about 1800 flight-test consultations per year. "Inserting a neutral third party into the flight-test regime has made a tremendous improvement," Becker says.

To ensure that the Flight Advisor program is on target, the EAA regularly scours the NTSB accident reports looking for past program participants; their names rarely show up among the statistics.

Your Project Can Benefit

With the soup-to-nuts approach of these three EAA-sponsored programs, builders no longer need to feel abandoned after the big boxes arrive. Kit manufacturers can only provide kit-specific information and don't often delve into areas outside of their expertise. EAA has filled the void with an elegant solution that allows the novice and experienced to rub shoulders while pursuing a common dream.

Many homebuilt accidents can be traced to system failures, such as fuel delivery or electrical. Kit manufacturers have limited control in these areas, and they must depend on the builders to get it right on their own. This is where these three EAA programs are most valuable in providing expertise in areas where others simply can't.

It has been said that a smart man learns from his mistakes, and a wise man learns from the mistakes of others. I can only conclude that a brilliant man, upon deciding to build, would immediately join EAA to take full advantage of this cornucopia of knowledge and experience made freely available.

And I can't help but think about that ill-fated pilot in Georgia, whose outcome would've been much happier had he fully understood the limits of the homebuilt he was flying that day. A little bit of knowledge, indeed, can be a dangerous thing.

FOR MORE INFORMATION on EAA's SportAir Workshops, visit www.sportair.com, or call 800/967-5746. For information on the other two programs, visit the member section at www.eaa.org.

The Safe Homebuilt

Take these tips into consideration when it comes to safe homebuilding and piloting.

BY ED WISCHMEYER

So what are the primary factors that make a homebuilt safe? Good question. We'd all agree that the most important safety element is the pilot, of course, but if it were the same pilot flying, which airplane would be the safest? Would it be the one with the most pronounced stall buffet? The one with the certified engine and prop? Maybe it would be the airplane with a glass cockpit and avionics for weather avoidance, traffic detection and terrain awareness? Perhaps the plane with the ballistic recovery parachute and the reinforced landing gear? How 'bout the one that was most comfortable and least fatiguing? Or the one with the best visibility? Or the one that was easiest for other pilots to see? Or the one that used certified, TSO'd components wherever possible?

To get a handle on homebuilt aircraft safety, we talked with a number of prominent folks in the field, including Dick VanGrunsven of Van's Aircraft, Ed Downs of Skystar, Joe Norris, who was the first person to be designated by the FAA as an amateur-built Designated Airworthiness Representative (DAR), and Jim Lauerman, Avemco's executive vice president and chief underwriting officer. Here's a teaser—of all the factors listed above, *none* were mentioned by the four people interviewed.

Piloting, Inspecting and Selecting

Ed Downs, president of the SkyStar Aircraft Corp.'s Sport Plane Division, has a background that includes substantial work in the certified aircraft arena as well as NASA research. He also presents safety information at CFI refresher clinics.

Downs' initial response was to gravitate toward FAA and NTSB statistics. Takeoff accidents and maneuvering accidents (traffic pattern, buzzing, low-altitude aerobatics) are more frequent in homebuilts than in factory-built aircraft, and departure stalls cause the highest loss of life. Combined, those are 20-30% of homebuilt accidents. But notice that they're pilot-induced phenomena.

Second on Downs' list, after the pilot, is proper inspection of the aircraft. He says that in the Kitfox community, accidents occur because of failure to inspect properly and to install correctly—cotter pins, lock wire, nuts missing, almost tight enough oil filters.

On homebuilt aircraft annual condition inspections, those performed by the owner may sometimes reflect tendencies to be less than professional and to take things for granted, rather than to really inspect. The consequences of this may just be a forced landing, not a wing falling off, but it could be that serious in some situations. Downs is concerned about pencil-whipped annuals that don't follow a kit manufacturer's checklist or other complete, appropriate checklist. This is even more significant with a non-certified engine, such as an automotive conversion.

Third on Downs' list is that the airplane be properly selected by the owner. He points out that Experimentals are unregulated, and you may have only the manufacturer's claims on safety, handling and stability. You don't necessarily know if the prototype was flight tested in all c.g. ranges. Many buyers will look only at price and speed without thinking about accident statistics or how many of the type are actually flying. Some homebuilts have more low-altitude maneuvering accidents than others, but is that because profoundly dumb pilots are flying them or because of the aircraft's characteristics?

Downs relates that he's overheard many opine the myth that amateur-built means higher performance and higher technology, and therefore better. That's wrong, he says. At airshows, he sometimes finds it frightening to hear what potential buyers are saying. Some homebuilts are *point designs*, highly optimized for just one parameter, such as cruise speed; the consequences of that optimization may mean degraded and unconveyed shortcomings in other areas. But buyers too often don't know, or don't want to know.

Downs also shared some wisdom that stems from 30-year-old NASA research. Have you ever heard a little voice saying, "I wonder if that's okay?" NASA found out that by the time you have that thought, whatever event you're thinking about has already occurred and you should be working on recovery now.

So aside from the pilot, what are the top items on Downs' list for a safe homebuilt? One that is well inspected and properly selected.

A Little Research

Joe Norris has lots of letters after his name including A&P, IA, CFI (for airplanes and helicopters), EAA Tech Counselor and EAA Flight Advisor. As mentioned, Norris also holds the designation as the first amateur-built DAR, meaning that he can license amateur-built aircraft for flight.

So what's the most important element for homebuilt aircraft safety on Norris' list? Education—for building, test flying and purchasing an airplane built by someone else. Norris notes that there is a ton of information for builders to find out how to do just about anything properly and safely—everything from standard techniques and practices to building hints and information on how to find a Tech Counselor or Flight Advisor. Norris strongly suggests joining EAA as the first step for any prospective builder or buyer, and he's quick to point out that this was his opinion long before he starting working for the EAA, where his primary job responsibility is helping members find information they need.

Reducing Unknowns and Non-Conformity

At last year's Oshkosh AirVenture, there were more Van's aircraft present than from any other kit vendor. In fact, there were more Van's aircraft present than second through ninth place combined. Dick VanGrunsven is the founder of the company, and his designs reflect his goals and ideals.

VanGrunsven acknowledges that homebuilt aircraft safety is a complex topic and that the pilot is clearly the most important safety factor. He sees two answers to the question of how to build a better homebuilt.

"One of the things that really separates homebuilts from other planes is that they're not standard," VanGrunsven says. "You may have a well-developed airplane, but the airplanes that appear in the field do not necessarily mimic the factory prototype. Certificated airplanes have to."

For example, a homebuilt might have changes, deliberate or not, that affect the flying qualities or provide unknown engine operating characteristics. A prime example is the fuel system. VanGrunsven says that some builders use different fuel selector valves or different plumbing.

"Something they [the builder] felt was better didn't turn out that way," he says. Fuel gauges on factory-built airplanes aren't necessarily foolproof, but a homebuilt aircraft's fuel gauges may be worse. A builder can overlook that and know how to interpret the fuel gauge readings for his/her own aircraft, but if he/she never placards the airplane, that's a risk to any other pilot who flies it. This may sound like a worst-case scenario, but VanGrunsven says he's seen homebuilts where the fuel tank sender float has hit the bottom of the tank without the fuel gauge indicating empty.

VanGrunsven used John Denver's fatal Long-EZ accident as an example. "A lot of times, folks will arrange controls in ways that are not intuitive," he said. "The flip side is making sure that all the systems are easy to operate, well calibrated and well placarded, so anyone can operate the airplane and will have a better chance of not screwing something up."

He offers the same caution for engine installations, too. "You can do anything you want—aftermarket carburetor, supercharger, high-compression pistons, any kind of automobile engine—and this is like fuel systems. These could involve a lot of unknowns. These aren't necessarily hazardous, but you have the opportunity for variables to enter into it. It could have been done by somebody who truly was an amateur, and there is a chance of partial or complete power loss."

VanGrunsven points out that some buyers may not be objective in their purchase. "Another area—maybe a little sensitive—it's entirely wrong to assume that everything is right because the airplane has been inspected. The FAA primarily signs off that the paperwork is in order. The conscientious inspector will make a best effort, but they can't attest to the correctness of the airplane. A buyer just cannot assume anything in that regard. And if you're unfamiliar with the building or licensing process, you may assume. You only know that [things are correct] if you go completely through the airplane yourself."

As an example of a good attitude, VanGrunsven tells of one builder who held a party and invited everybody to try to find something wrong with his finished but not-yet-flown airplane. "A builder has to put his ego on hold and open himself wide open to any sort of scrutiny that may get past himself and the official inspector," he says.

VanGrunsven's list for a safer homebuilt? Reducing the unknowns, and reducing non-standardization.

Handling Characteristics and Testing

Although we asked the question of what makes a homebuilt *safe* instead of what makes a homebuilt *insurable*, it's no surprise that this line was blurred. As the vice president in charge of homebuilt insurance at Avemco, Jim Lauerman cites two primary gauges for homebuilt safety.

The first is wing loading. Wing loading is calculated by taking the maximum gross weight of the airplane and dividing that number by the number of square feet of wing area. For homebuilt airplanes, wing loadings can vary from 10 pounds per square foot for a Kitfox, to 15 pounds per square foot for an RV-7, to 33 pounds per square foot for a Lancair IV-P. Wing loading is often used in preliminary design calculations to predict landing speeds. In Lauerman's experience, wing loading is directly proportional

to severity of loss.

The second criterion Lauerman uses is how well tested a design is. For example, the Van's Aircraft RV-6 is a well known and well tested design. If a new design comes from a manufacturer with a good track record, such as Van's new RV-10, that manufacturer's track record counts, too.

Beyond those two primary criteria, there are issues of low-speed handling qualities and longitudinal stability. It also helps if the plane was designed by *real* engineers. Lauerman says that you can look at the distance from the c.g. to the tail and the size of the tail, and just from that you'll be able to tell something about the aircraft's handling.

Also important as a predictor of safety is how well the plane conforms to the manufacturer's original design, especially for critical items like the fuel system.

Drifting more into insurability than safety, Lauerman considers a *three-legged stool* of aircraft, pilot and operating environment, which includes runway length and the availability of crosswind runways. If one is marginal, the other two had better be solid.

Avemco provides discounts to customers who have taken the King Schools video on risk management, but Lauerman observes that external pressures are seldom a factor in homebuilt accidents. Of more significance is whether, when selecting the aircraft, the pilot understands what they have gotten themselves into.

Concluding Thoughts

Although our four experts expressed their thoughts in different ways and emphasized different aspects of safety, they all concluded that the single most important element in homebuilt safety is the human element—pilot, buyer, builder, inspector. The pilot needs to fly the airplane safely, the buyer should choose the airplane wisely, the builder must reduce unknowns, and the inspector needs to put ego aside and aggressively search for mistakes.

For most homebuilders then, what's the single most important element in homebuilt safety? It's you!

A Beginner's Guide, Part I—

Insuring a Kit Aircraft Project

Planning ahead is the key to making your search for aircraft insurance manageable.

BY CORY EMBERSON

With about 50,000 homebuilts registered in the U.S., Experimental aircraft constitute about 10% of the total general aviation market—but they seem to comprise 95% of the hangar talk on the subject of insurability. The topic of insurance seems to follow the often-repeated characterization of airline pilotage: mind-numbing boredom interrupted by hair-raising adrenaline rushes. The latter occurs when you need insurance that you don't have.

As pilots, everything we do works better when we plan ahead. During primary training, our instructors worked pretty hard to instill that skill in us—every solo training flight was plotted on the sectional with the time and fuel calculated to a fare-thee-well. If you're considering building your own set of wings, *plan* is the operative word. The time to investigate insurance is well before you place a deposit on the kit of your choice. And because the insurance market is always changing, a good relationship with an agency or company familiar with homebuilts is essential.

"Before you plunk your money down, call a specialist in insurance for homebuilt aircraft," says James Lauerman, an ATP-rated pilot and executive vice president and chief underwriting officer at Avemco Insurance Company of Frederick, Maryland.

Key items to research: Is coverage available? What type should you get? How much coverage will you get and how much will it cost? What experience does the broker or underwriter have in insuring homebuilt aircraft?

Selecting a Company, Getting a Quote

Lauerman says that insurance companies are often unpopular with pilots. While the marketing strategy for kit manufacturers includes the dream of building and flying your own aircraft, the insurance industry provides a cold and heavy dose of reality. A good insurance company, he adds, will dovetail the two realities and discourage a builder's ego from writing a check that his skills and experience can't cash.

When selecting a company to buy aircraft insurance from, you have two basic choices—a direct insurer or an agent. Avemco is a direct insurer, which means that it deals directly with its customers without using agents and develops its own underwriting standards. It has been in business since 1961 and has been insuring homebuilt aircraft for close to 20 years. The application process is simple—call Avemco directly and speak to an insurance counselor, who will make the decision on insuring your aircraft.

With the exception of Avemco, all other aviation insurance must be purchased through an agent (or broker). The EAA Aircraft Insurance Plan is administered by Falcon Insurance Agency of Kerrville, Texas, which has been in the aviation insurance business since 1979. Falcon Vice President Bob Mackey notes that as an independent agent, Falcon can select the most appropriate market and underwriter for your particular situation. He recommends presenting as much pertinent information to your agent as you can when getting a quote, including any additional training you've received recently, such as the FAA Wings program or ground schools.

Mackey notes that the aviation insurance industry is small, with approximately eight companies that write aircraft insurance—a number that varies as the market changes. He estimates that there are about 200 insurance agents in the U.S. who are familiar with aviation insurance. The majority of the aviation insurance companies will only quote a particular airplane and owner once, to the first agent they hear from. If you ask a second agent to quote your plane, the second agent's request will be blocked. Why?

"Airplane insurance companies, unlike car insurance companies, are not required to file their rates," Mackey says, "so they can change at any time based on the information presented to

them. This actually guards against the company generating different numbers for the same person and plane when receiving different (or inaccurate) information from different agents."

He says that insurance underwriters may vary their quotes based on the agent that contacts them and the information they are given. "If the agent has a good reputation for always being professional and trustworthy, the underwriter is more likely to provide him with a better quote," Mackey says. He adds that it is essential to perform due diligence on the agent before making your selection.

Danny Bullard, senior vice president at United States Aviation Underwriters, Inc. (USAU), is a pilot who has flown more than a dozen different antique, homebuilt and certified aircraft. While USAU has been in business for 76 years, it has insured homebuilts for only five; Bullard says they are not a major player in that insurance segment. He estimates that they insure approximately 100 homebuilt aircraft a year, less than 1% of their total business.

Bullard says that the insured's best friend can be a good broker who can forward all of the pertinent information to the underwriter. He noted that if a builder has a question about a broker, he or she should call the United States Aircraft Insurance Group (USAIG) office in their territory (USAIG is managed and underwritten by USAU). The office can't recommend one over another, however. His advice before making any insurance decisions: do your homework, talk to people, call EAA and network with other builders online.

Insurance Types

The type of insurance you should buy depends on many things. If you are financing your kit (or buying a completed kit), the lender will determine the type and limits of the insurance. In purchasing homebuilt aircraft insurance from most companies, there are two distinct segments: (1) construction coverage, which extends until the airplane takes flight, and (2) in-flight insurance, which (at Avemco) begins once the first 10 hours and 10 takeoffs and landings are in the books. In each of those two periods, two types of insurance are available: hull insurance and third-party liability insurance.

Hull insurance covers the value of the kit or the airplane (once it's complete) itself. During the construction phase, hull insurance protects against events such as fire, tornado or hangar collapse (homeowners insurance will *not* cover the project while it's under construction, even if you're building the kit in your own garage). If a neighboring tenant somehow sets the row of hangars on fire, construction insurance would come into play as well. During the in-flight phase, hull insurance insures the value of replacing or repairing the airplane in case of an accident.

How much hull insurance do you need? Lauerman says that unlike automobile insurance, which is based on the book value of the car, insurance for homebuilt aircraft is on a "stated value" basis. The owner should insure the aircraft for what he or she could sell it for on the open market. The minimum coverage should insure the hard cost of the kit; this will be required by the lender if you're financing your kit.

Mackey offers a strong caution to those who try to reduce their premiums by underinsuring the hull coverage: *Don't!* The "stated value" of hull insurance means that in the event of a loss, the insurance company may declare an underinsured plane a total loss because the combination of the repair costs and the salvage value are greater than the insured value of the plane.

Third-party liability insurance is pretty inexpensive during the construction phase (Lauerman says coverage starts as low as $80 per year), but it's valuable in protecting the builder if a visitor to the hangar is injured by any part of the kit, for example. During the in-flight phase, liability insurance will protect the builder's assets after the project is flying. At Avemco, liability insurance is required for in-flight policies—there's no such thing as a hull-insurance-only in-flight policy.

Lauerman emphasizes that liability insurance should be considered a must in every phase of the kit's life (though many builders skip it during construction), as it's the cheapest insurance out there for the benefits received. "At the very least," Lauerman says, "liability insurance will entitle you to use our attorneys and will help protect your home and other assets."

Larry Storlie, desk underwriter at London Aviation Underwriters (LAU), notes that the kit is not officially an aircraft until the FAA "sprinkles its holy water on it" and issues the airworthiness certificate. When your plane is ready for taxi testing, stay in touch with your agent and be sure you have the appropriate coverage at the right time. When the aircraft moves under its own power (not being pulled out of the hangar), it becomes an aircraft and is then covered under the aircraft policy (at LAU). The construction insurance will then be cancelled and prorated.

Policies for homebuilt aircraft will contain exclusions, most notably the inability to use the aircraft for commercial purposes (which is prohibited by FARs anyway). Primary training (or training of any kind) is often excluded, and engine modifications, such as converted automotive engines, are nearly impossible to insure. Turbine engines for high-performance homebuilts fall

Insurance
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into that category as the risk exposure is more than most insurance companies want to contemplate. Lauerman stresses carefully studying your policy's exclusions so you're not left hanging when you're most in need.

Mackey says that Falcon will spell out factors such as approved pilots or use of the plane; for instance, Falcon will not insure student pilots. He stresses the importance of discussing these choices with your agent so you don't waste money, or worse, find yourself uninsured or underinsured. Mackey adds that it is crucial to read and understand your policy and to correct any errors as soon as possible. If you need to make a claim, the actual contents of that legal contract will determine what happens—not what you intended to include in the policy.

The Right Plane, The Right Pilot

So how does the insurance company decide whether to accept or reject your application? Insurability is the key factor in writing a policy for homebuilts in two areas: the aircraft and the pilot. Each policy is unique, with the characteristics of the plane and the pilot falling in a specific place on a decision matrix.

Bullard is at the center of the underwriting world and says that the guiding principle of the underwriter is to look at one risk at a time. He examines the merits and the risks individually and doesn't use any hard and fast formulas. The ability to understand the pilot/aircraft mix is essential, and underwriting is usually drawn in shades of gray. "Sometimes the best solution is to decline the application," Bullard admits.

Mackey says that a good insurance company wants to pay claims, and that it avoids paying claims by doing good underwriting in the first place. If the company needs to pay a claim, paying it quickly and accurately is a "possible chance for the insurance company to shine."

Insurability of aircraft is easy to quantify, Lauerman says. For full insurability, "20% of the available models comprise 80% of the available units we will insure." That means the companies that (1) have been around for a long time, (2) are in good financial health, (3) have demonstrated a good track record of high-quality designs, and (4) have a significant number of aircraft flying. Lauerman urges prospective builders to perform thorough due diligence of a kit manufacturer before writing a check for that deposit.

Underwriters will approach a new design with caution. A new design from an established designer, however, is not as much of a risk. If a kit has a quickbuild version or if the company has a lengthy, reputable history, that may increase insurability. A design with many examples completed and flying will greatly increase the underwriter's comfort, as will manufacturer support for the kit.

High-performance designs with high wing loading (more than 15-20 pounds per square foot) are tougher to insure simply because of the higher degree of skill require to fly them proficiently. Factory training provided by such companies as Lancair and New

Glasair is a major benefit in attaining full insurability. More sedate designs such as Kitfox or the Zenith Aircraft designs may not have the sheer sex appeal of the fast glass designs, but affordable insurance is much easier to obtain.

Another major factor in insurability is how easy the kit is to build and—more importantly—repair. Repairability of a design is extremely important, as is the availability of parts from suppliers. Composite aircraft are generally the toughest and most expensive to repair. Lauerman suggests that prospective builders join EAA and take advantage of the builder assist programs and the builder workshops. While you may go into the decision-making process confident that you want to build a slick fiberglass plane, you may find after a workshop that you're sensitive to fiberglass or that you just prefer working with sheet metal or tube and fabric.

A major problem in attaining insurance is modification of the kit, especially when the mod results in significant variation from the original design. Also, altering items such as the propeller or fuel lines may render the plane uninsurable unless it is recertified by the FAA. Sometimes, Lauerman says, "the builder finds himself in unknown areas, and instead becomes an aeronautical engineer."

But it's not just the airplane that's important—it's that pilot/aircraft mix, remember? The aircraft type generally drives the insurability of the pilot—a private pilot with 200 total hours may be perfectly insurable for a Kitfox but may not be insurable for a Glasair II TD or a Lancair IV-P. If a pilot's hours do not include any tailwheel time, he or she will be required to log a certain number of tailwheel hours with an instructor before qualifying for insurance for a taildragger. The total solo PIC time will likely be pushed upwards in order to be insurable in a high-performance plane like a Lancair or Glasair.

Mackey says he hates to see people spend money on a kit and not be able to insure it. He recommends that a potential builder spend some time working with a volunteer EAA Flight Advisor who is familiar with the aircraft you are considering. He or she

Insurance

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can help you choose the right plane for your budget, experience, skills and the type of airport you normally use. A 1500-foot turf strip will call for a different type of plane than an active Class B airport. Some insurance companies won't insure any plane based at a turf strip; others won't insure a plane if the home airport's elevation is greater than the runway length. And, if there is a serious mismatch between the airplane and airport, coverage may not be available at all.

Mackey adds that flying as many homebuilts as possible before making your selection will help you avoid builder's remorse. If you try to obtain insurance on an airplane that isn't a good match for your skill set, it may be difficult to get and may not even be available.

Obtaining time in a production aircraft that's similar to the Experimental you're considering can be beneficial as well. To get accustomed to the light controls and free-castering nosewheels of the RV series, get some time in a Yankee or Tiger. In such aircraft, proficiency often prevents landing accidents where porpoising is a factor—a dangerous and costly occurrence. Flight time in a Mooney or Bonanza will be beneficial if you're considering *fast glass*—Lancairs, Glasairs or Expresses, for example. "Once you're behind these kinds of planes you don't catch up," Mackey says.

He cautions against falling in love with a particular airplane unless you are sure it can be insured. "Many kit manufacturers have a network of pilots willing to take other builders for a ride to provide some level of orientation," he says. "EAA, working with the FAA, secured an exemption that allows CFIs to provide dual instruction in their own homebuilt airplane for a charge to pilots preparing for transition into a homebuilt airplane."

Depending on your flight experience, the underwriter may require additional training to better meet the demands of your plane. Insurance companies don't like to see FAR violations on a pilot record—they will weigh very negatively in the underwriting process.

But because each pilot's situation is different, there is no concrete number of hours used to determine whether a checkout is necessary. Sometimes the time in type is as (or more) important than total time: a 1000-hour pilot with 750 hours in high-performance retractable-gear aircraft may be more attractive to the underwriter than a 5000-hour pilot with 10 of those hours. If the latter pilot doesn't do the required research before writing the deposit check, that plane that whispered his name on the flightline may be expensive to insure, and hull insurance may not be available at all.

Recent flight experience is also a critical factor. If you haven't flown for several years, you may not be insurable unless you not only become legally current, but also get additional training beyond a 3-hour BFR. Mackey recalled receiving a call from a private pilot with 110 hours of total time and only 3.5 hours in a Long-EZ—not enough to insure him in a Vari-EZ. After they talked a little longer, he discovered that the pilot had flown about 35 hours with his father-in-law in the back seat of that Long-EZ. He wasn't

able to log the time, but it was still valid orientation time.

Looking ahead too far may not work in some builders' favor. A student pilot wishing to build and fly a high-performance kit would not be insurable until he or she has actually logged the time to qualify for coverage. "If we would not insure the pilot in the aircraft *today*, we won't write the policy," Lauerman stresses.

It's been his experience that while builders have every good intention to complete their flight training while building, it is often an unrealistic expectation. They are often so busy building—and maintaining their non-aviation life—that the training falls by the wayside. Lauerman says that Avemco's policy exists so the builder is not disappointed after the plane is completed when he or she finds that they cannot be insured to fly it. Instead, he suggests that the builder contact Avemco when he or she does have the qualifications to fly the plane.

"The builder may never become qualified to fly that plane," he says, "and we don't consider insuring in that manner an appropriate way to conduct business."

Contact Info

AVEMCO INSURANCE COMPANY
888/241-7890
www.avemco.com

FALCON INSURANCE AGENCY
830/257-1000
www.falconinsurance.com

LONDON AVIATION UNDERWRITERS
206/285-5401
www.londonaviation.net

NATIONAIR AVIATION INSURANCE
877/475-5860
www.nationair.com

UNITED STATES AVIATION UNDERWRITERS
972/239-7300
www.usau.com

WILLIS CAROON AGENCY
713/625-1105
www.willis.com

Insurance

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Another important part of the insurance acquisition process is determining the number of pilots to be approved on your policy. Your premium will be more costly if you name additional pilots on your policy. Why? It's likely the plane will be flown more hours, increasing the risk exposure for the insurance company. Most policies for homebuilts don't have an open-pilot warranty. The skill levels of those pilots (total time, time in type, tailwheel or float time if applicable) will also be an important factor in the cost of your policy.

When passengers are included in the mix, the underwriter's risk is multiplied; training and checkouts reduce the risk all around. "The insurance company wants to insure you but they don't want to pay a claim they think has a good chance of happening in the first few hours of flying," Mackey says. Homebuilts with four seats are more of a risk because of the additional exposure to possible passenger injury.

The Current Environment

Avemco's underwriting standards were tightened up after 2001, which led to the separation in the company's working relationship with the EAA. According to Lauerman, it was necessary to reassess Avemco's method of underwriting homebuilt insurance, which had never been very profitable. He noted that there had been an increase in claims, particularly with aircraft that were, at best, nominally amateur-built.

"The professional builders just didn't have the love for the project and the understanding of the plane that the amateur builder has," he said. "Also, a builder who knows every nook and cranny of the plane will be a better pilot and will be better able to troubleshoot that plane."

LAU's Storlie notes that the underwriting industry is trending toward being more restrictive, par-

tially because the increase in fast homebuilts with high wing loading. He added that the proliferation of turbine powerplants adds to the risk exposure faced by the underwriters, who have been more selective in recent years.

VanGuard—For RVs Only

NationAir Aviation Insurance's VanGuard Program is designed to cover builders and owners of Van's RV aircraft. NationAir West Coast Regional Manager Dick Keltner, the driving force behind the VanGuard program, approached Dick VanGrunsven to endorse an insurance program that would bring the premiums in line with production aircraft. Keltner believed that factory support of these pilots, including strict flight and maintenance training, would satisfy the underwriters' requirements for repairability. John "JT" Helms, a NationAir agent and branch manager, administers the VanGuard program from his light aircraft office and has insured more than 1000 RVs over the past five years.

Covered aircraft must have an engine approved by Van's Aircraft, and airplanes with converted automotive engines are not covered at all. Designs based on RVs don't qualify either—Helms estimates that there about 100 examples of Harmon and F-1 Rockets flying, not enough to insulate the underwriters from individual accident payouts. In contrast, more than 3700 RVs have been completed.

Helms says that in the first three years of the program, NationAir paid out more in claims than it took in. The last two years, however, the company's loss ratios have been reduced to 60% (70% is a break-even loss ratio), which has been reflected in lower rates. (The loss ratio is a formula used to relate loss expenses to income: the sum of incurred losses and loss adjustment expenses divided by earned premiums.)

To qualify for all VanGuard program options, a pilot must have a private (or higher) license and a third-class medical certificate. In addition,

The Lancair IV-P
An Insurance Solution

Since the early 1990s, attaining full insurance coverage has been a burr under the Lancair builder's saddle. The blistering speed (330 mph at 24,000 feet) and high wing loading of the Lancair IV-P has kept hull coverage beyond the practical reach of most builders and pilots. Also, lenders will not finance a kit without hull insurance to protect the investment.

In February 2003, Joe Bartels, a Lancair IV-P customer and attorney from New Orleans, purchased Lancair International from founder Lance Neibauer. Bartels is an instrument-rated pilot and A&P who says he's passionately committed to the ongoing safety of the design.

Just before publication, Bartels alerted us to the fact that he has been engaged in serious discussions with a major insurance company to develop a program that would enable qualified Lancair pilots to carry hull *and* liability insurance. Because the program has not been finalized, Bartels couldn't provide the name of the insurance company Lancair is working with—the most he could say was that the company was the holder of an A++ rating.

Bartels' stringent approach covers each operational facet and demands a lot of the pilot. He believes that safety is rooted in knowledge and adds that increased safety will lead to lower insurance rates. The company's builder assist program allows a Lancair builder to spend from one to eight weeks at the Lancair factory in Redmond, Oregon, to take advantage of the staff's technical assistance during construction. The Lancair IV-P will take between 1500-1700 hours of build time, not including firewall-forward installation, electrical, paint or upholstery. Bartels says that this program will increase the repairability of the aircraft, a major insurability issue.

To qualify for the under-development insurance program, builders must take part in the builder assist program, and they must be well-qualified in the air as well—an instrument rating, 1000+ hours total time and at least 500 hours in high-performance, retractable-gear aircraft are required.

Lancair requires that the first flight and airworthiness inspection of the IV-P be completed either by an amateur-built Designated Airworthiness Representative or a qualified professional test pilot. With an approved certified engine/prop combination, the plane must be flown for an additional 25 hours before passengers may be carried.

Bartels also believes the rigorous High Performance Training Program (HPTP) for Lancair pilots will be an essential component in attaining full coverage. HPTP owner Pete Zaccagnino provides flight training and recurrency training in the customer's aircraft; the pilot must be current and have a high-performance/complex sign-off. The syllabus includes aerodynamics, weather, accident avoidance, performance issues and awareness, and is available on the company's web site (www.lancairtraining.com). Upon satisfactory completion of the course, the pilot will receive a certificate that Bartels anticipates will be accepted by the insurance company. Zaccagnino compares it to a BFR: you can't fail it, but you won't get the certificate just by showing up, either.

Lastly, to qualify for the proposed insurance program, Lancair requires that a factory representative perform the annual condition inspection. Bartels says that not only does this program anticipate underwriters' concerns, it would greatly enhance the safe operation that comes from a thorough knowledge of such a challenging and satisfying aircraft.

—Cory Emberson

pilots who have not flown at least 25 hours in RV-series aircraft during the preceding 12 months must complete a ground and flight checkout with an approved RV instructor to be eligible.

Insurance for Homebuilt Rotorcraft

Falcon will write insurance for the RotorWay Exec 162F, but not much else. Why? Rotorcraft seldom have a partial loss—because of the gyroscopic effect of the rotors, rollovers are common, resulting in injury and many total losses.

Mackey credits RotorWay for its proactive approach in educating and training its customers, enhancing not only the helicopter's insurability but also the safety of the product. RotorWay's program is structured so that a builder may not take delivery of the last sub-assembly of the kit (which includes the powerplant) until he or she completes the flight training/maintenance program.

In addition, RotorWay has arranged insurance coverage through Houston agent Willis Caroon. According to Assistant Account Manager Suzanne Moore, the company offers two types of insurance only: (1) physical damage during construction, and (2) third-part liability insurance once the helicopter is flying. During construction, there is no liability damage; Moore recommended keeping the hangar locked and onlookers away. Flight insurance covers third-party liability only; the limits for property damage and bodily injury are $500,000 or $1,000,000, depending on how much you fly. There is no liability coverage available for passengers. Liability insurance is written by U.S. Specialty, and kit construction insurance is written by USAIG. The aircraft must be certified as airworthy to be insured for liability, and the underwriter has the final say in offering a firm quote.

Insurance for gyroplanes is a real sticking point, especially in the realm of training. Joe Souza, owner of Joe Souza

Gyroplanes in Marysville, California, had been training students in his two-seat Bandit until a year ago, when his agent declined to renew his policy. Souza sees this turn of events as counterproductive because recurrent training is a critical factor in reducing accidents and increasing insurability. Because of the counterintuitive nature of flying gyroplanes to a fixed-wing pilot, he emphasizes that a cursory 10-hour checkout is not sufficient to fully explore the flight regimes of a gyro. He is particularly concerned about new gyro pilots who have flown "just enough to be dangerous, but not enough to have experience in challenging conditions or for their skills to be second nature."

Mike Adams, vice president of underwriting for Avemco, stated that the company doesn't insure any helicopters and that the unevenness of the gyroplane industry makes it even more difficult to insure.

In Summary

The field of aircraft insurance, especially as it relates to homebuilts, is immensely detailed. We've only covered the highlights of what a builder should look for in an insurance policy—and a plane—to keep the process moving along without excessive cost or heartburn. And that task that's so crucial while piloting an aircraft will also keep the insurance process trouble-free—plan ahead.

A Beginner's Guide, Part II—

Financing a Kit Aircraft Project

How to fund the leap from dream to reality without a lot of up-front cash.

BY CORY EMBERSON

It's time. You've visited the web sites, prowled the flightline at your nearest EAA convention, maybe even joined some online builders groups—and you've made your decision. You're going to build a plane. Now you need to pay for it, and what you found under the sofa cushions just won't do it.

The solution? Finance the purchase, just like you would if you were buying a car or a boat. The kit aircraft financing landscape has changed considerably in the last few years, but the good news is that the major sources of financing are committed not only to a healthy loan portfolio, but to safe and competent completions.

The 2001 departure of Textron Financial Corporation from the arena of homebuilt financing forced builders to look elsewhere in seeking financing for Experimental aircraft. Textron Financial had owned Green Tree Financial since August 1999, and Green Tree had been a primary source of financing for kit builders for years.

Since then, National Aircraft Finance Company (NAFCO) of Lakeland, Florida, has emerged as the largest single source for financing Experimental aircraft, both in kit and completed form. We spoke with NAFCO General Manager Chuck Dimeler for an overview of how kit aircraft financing works and what builders should consider before making the decision to purchase.

Qualifying the Aircraft

In making a decision on a loan application, NAFCO looks for a good track record for the borrower and the aircraft. According to Dimeler, in order for NAFCO to consider financing a particular kit aircraft, at least 25 completed examples must be flying in the U.S. Why? Because the company has been burned in the past with several kits (he declined to name specific designs or companies) that had unsatisfactory completion rates. NAFCO is not a warehouse for aircraft parts, but that's exactly what results when someone defaults on a loan while the aircraft is still unfinished. The company doesn't enjoy seeing partially completed kits repossessed and returned to its offices.

Off the top of his head, Dimeler easily listed some of the companies that manufacture airplane kits that NAFCO has financed—Van's, Lancair, SkyStar (Kitfox), Velocity, Europa, Zenith, RANS and New Glasair/GlaStar. That's not to say these are the only aircraft on the list; they're simply the more common ones. NAFCO has financed hundreds of Experimental aircraft, and Dimeler says that they will finance the majority of kits from reputable companies with sufficient aircraft already flying.

It has been some time since the company has financed a RotorWay kit helicopter, but Dimeler said he would be pleased to do so again if the loans could be protected with hull insurance. The company will also consider financing selected ultralight kits, although it is a small segment of NAFCO's business; not many companies will finance ultralights at all.

Qualifying the Borrower

Assuming you've selected an aircraft that NAFCO will finance, the next step is for you to qualify. Your credit score (usually what's called your *FICO score*) is based on information in your credit file that indicates how likely you are to repay a loan on time—the higher your score, the less risk you represent. That credit score, ranging from a low of 300 to a stellar 850, helps a lender determine whether you qualify for a loan and what interest rate you'll pay.

NAFCO requires a FICO score of at least 660, considered to be a fair-to-good rating. For major purchases (like airplanes), lenders recommend that you check your credit report with the three major credit bureaus—Experian, Equifax and TransUnion—for any inaccuracies at least 30 days before you submit your application. While you may be able to correct erroneous information sooner, it's better not to count on it.

Overall, you'll need a debt ratio of less than 40%. Calculate this by dividing all monthly debt payments (including mortgage/rent, auto loan, credit

card loans and other revolving payments) by gross monthly income. Living expenses such as utilities, insurance and child care are excluded from this ratio. With all those numbers in front of you, make sure the aircraft loan won't push you over the 40% mark. If not, you'll likely qualify.

NAFCO's Loan Structure

For amateur-built category airplane kits, NAFCO's kit financing program is split into two stages—firewall-back and firewall-forward.

Firewall-back. The loan for the aircraft kit itself is basically an unsecured loan with no meaningful collateral. NAFCO will finance up to 90% of the kit price and will accept receipts for previous out-of-pocket expenses as part of the down payment. Because of the riskier nature during construction of the aircraft, interest rates for this stage are a bit higher than the firewall-forward stage—as of this writing, rates hover around 9.50%. The construction loan may be amortized for 60 months or for up to 10 years with a balloon payment at five years.

Firewall-forward. Once the airframe is complete, the builder can refinance the loan with a firewall-forward loan, which covers the engine, propeller, instrument panel, upholstery, finishing and paint. NAFCO prefers that the builder not take more than five years to get to this point (hence the balloon payment on the firewall-back portion of the loan), but Dimeler says that most builders get to the firewall-forward stage within 24 months.

Assuming the loan still carries a balance at this point, it can be folded into Stage 2 at a lower interest rate. The lower interest rate is offered because this loan is less risky for the lender—it's now secured by the collateral of an airplane, not just a collection of partially completed parts. NAFCO will finance up to 90% of the firewall-forward portion.

Combined with the kit loan, the new loan may be amortized up to 20 years (though Dimeler says that 15 years is usually sufficient), depending on the borrower's credit profile. These loans are simple interest loans with no prepayment penalty. At this writing, interest rates for NAFCO's firewall-forward loan varied between 5.75-6.50%.

NAFCO Loan Officer Jim Janssen, a former pilot, spends most of his time working on kit and selected ultralight applications. He says that when the builder presents the pro-forma invoices for various components of the plane, NAFCO will cut checks payable to those vendors and send them to the builder. If the builder decides to replace, say, a Lycoming engine with a Jabiru, NAFCO will replace that check. If the check becomes stale-dated after one year, it too will be refreshed.

Homebuilder Dan Checkoway of Massachusetts used NAFCO to finance the firewall-forward portion of his RV-7: "They considered my expenses to date as equity in the plane. When I financed the avionics, engine and so on, the $17,000 and change that I had already spent on the airframe was considered well over 20% down—I had no out-of-pocket expenses." Checkoway says that the application to approval process took about two weeks from start to finish.

Ultralight Loans

At NAFCO, a 20% down payment is required to finance an ultralight (again, receipts for previous work are accepted) over the shorter term of five years. The maximum amount allowable for ultralight financing is $10,000, and again, there must be at least 25 examples flying for the company to consider it.

Simply because of the sheer variety, Janssen declined to mention which specific ultralights NAFCO has financed, but he added that if the company was well known and established, the design would probably be considered.

Interest rates for ultralights are a bit higher—at this writing, they were in the range of 10.50-11%.

Insurance Requirements

Because a loan for a not-yet-completed kit aircraft loan is a riskier proposition than one for a Cessna 172, lenders are vehement about sufficient insurance to cover both the construction and flight phases to protect their investment.

According to Dimeler, NAFCO requires hull coverage for the full amount of the loan so the bank's funds can be recovered in the event of a destruction of the project. (Actually, the requirement is the same for factory-built aircraft.) During construction, a builder's policy must cover the full gamut of risks to the project including hangar fire, tornado, hurricane, theft or vandalism.

NAFCO also requires that the policy names the lender as the payee in the event of a loss. In addition, there must be an arrangement that allows the lender to be copied on any 30-day non-payment notices or cancellation notices sent to the insured from the insurance company.

NAFCO does not require liability coverage—although it is wise to carry it to protect your own assets, the lender considers it to be the borrower's personal choice.

Financing Completed Homebuilts

A quick look at NAFCO's web site will provide updated rates and terms for the various loan iterations, including those offered for completed aircraft. Completed kits are considered to be in the same basic category as certificated aircraft. The interest rates for previously owned homebuilt aircraft become more attractive than not-yet-built aircraft, depending on the amount borrowed (4.25-9.50% fixed or variable). Amortizations up to 20 years are available, and you may get lower rates with 1-2 points added to the loan. A discount point is a prepaid fee used to reduce the interest rate; 1 point equals 1% of the loan amount.

Another Solution for RV Builders

Mike Jacobs, president and owner of First Pryority Bank of Pryor, Oklahoma, is clear about the bank's lending policy for homebuilts—Van's RVs only. The company's longevity and reputation for stability inspired Jacobs' confi-

dence in writing those loans: "The planes are everywhere. Some other companies are shooting stars—here today, gone tomorrow."

First Pryority has written loans for production aircraft for the last 10 years and has financed RVs for about seven. Jacobs added that this was a minor part of the bank's total loan portfolio and that it was very conservative in the homebuilt area.

Jacobs' perspective on financing homebuilts comes from experience not only with the planes but with builders as well. Part of what he says makes kit financing risky is the chance that a builder's family won't be tolerant of what can be a long-term project—family support reduces the danger of noncompletion or even a divorce, which may endanger the loan and increases the risk of the bank taking possession of a partially completed kit. He notes that divorce can be a problem in satisfying the loan—an aircraft loan may not be the first priority in the debts to be paid during the dissolution process.

If a potential borrower wishes to finance a previously owned homebuilt plane, Jacobs says that the quality of workmanship performed by the original builder is important in deciding whether to finance the project. He emphasized that it is in the buyer's best interest to have a thorough pre-purchase inspection.

Jacobs says that First Pryority Bank's credit standards are strict on kits and that the borrower's credit history is critical for a number of reasons. In his experience, a builder with a good FICO score (660 is adequate, and 700+ is even better) will be more likely to complete the project in a careful manner.

He stated that a debt ratio of up to 50% would be acceptable if the borrower's payment history was rock-solid—a critical factor. In addition, cash flow and level of education are also crucial in determining creditworthiness.

"We are really, really cautious in this area," Jacobs says. "All the factors must be right with no credit problems. We take more of a chance on this kind of a loan than on a completed aircraft—I don't want boxes of parts in my office under *any* circumstances."

Jacobs is pleased to see the proliferation of quickbuild kits, which dramatically reduce the project time and potential marital discord. The interest rates at this writing for the RV line of aircraft were 7.99% compared with 6.99% for production aircraft.

Jacobs notes that he will lend 75-80% of the kit's price or any component, such as avionics equipment, and that it is important for the borrower to have their own funds invested in the project as well. Receipts for out-of-pocket expenses prior to financing are customarily accepted toward the down payment. During the construction phase, payments are interest-only, and upon completion, the terms may be extended to a 10-year amortization to accommodate the full payments. These are simple interest loans, with no prepayment penalty.

First Pryority requires that hull insurance for the full amount of the loan be carried during and after construction. Like NAFCO, First Pryority does not require liability insurance for financing purposes.

Alternative Financing

Credit Unions: There is no rule of thumb regarding the availability of financing for kit aircraft through credit unions. Some credit unions, such as United Airlines' Alliant Credit Union, will finance production aircraft but not homebuilts. Because of the fluid financing market, it is difficult to list particular credit unions that *will* finance them, but if you are a member of a credit union, it is worth asking.

The maturing of the kit aircraft industry and the selection of a kit from a reputable company may reduce the loan's perceived risk to a loan officer who is willing to give it a look. Chances are that the credit standards may be the same as for an unsecured loan. A good credit history, a low debt-to-income ratio, good cash flow and sufficient research on the kit may tip the decision in your favor.

When Charlie England of Mississippi needed to finance his RV-4 kit, his credit union treated his loan request as it would a boat or RV (the kind with wheels and a dinette set). The loan had a shorter amortization and a higher interest rate than the usual 10- to 15-year term for a recreational vehicle.

"I had no desire to finance an aircraft for that long of a period anyway," England said. "All they required beyond the normal items was a report from an aircraft appraiser because they had no Blue Book to follow like for cars and...RVs. Because it was a credit union, the rate was actually better than the rate for used factory aircraft at the time."

Local Banks: Grant Fluent of Newcastle, Nebraska, financed his Kitfox Classic IV through his local bank in a town of about 270 people—where most bank loans issued are for cars, farms or livestock. He brought brochures and comprehensive data on the plane to his banker, who had never loaned money on an airplane, much less a homebuilt.

"He didn't see any problem giving me a loan for the firewall-back kit," Fluent says, "and he even asked for a ride when it was done! I'm sure the large number of Kitfoxes that are flying helped make a positive impression on my banker."

Kit Manufacturers: Some kit manufacturers offer what amounts to an in-house financing program by selling partial kits. Because of the large number of kit companies, it is worth your time to check with the manufacturer of your choice to determine whether this option exists, or if the company would consider it.

Sebastian Heintz, president of Zenith Aircraft Company, realizes that his customers may not wish to—or be able to—finance a kit through a financial institution.

"Some customers that need financing will self-finance," Heintz says. "We offer buy-as-you-build kit programs to minimize the need for traditional financing. Modular kit construction makes it easy to buy and to build sections of the aircraft consecutively."

When Phil Maxson of New Jersey built his Zenith 601 with a converted Corvair engine, he bought his kit in stages. "I financed my kit by buying partial kits and spacing them out,"

CRAZY FOR A KITFOX

In 2002, Scott McClintock was hired by the Alaska Department of Transportation as a civil engineer and was assigned to the western district office in Nome. This was as good a reason as any to justify fulfilling his lifelong dream of becoming a pilot and aircraft owner.

McClintock decided that an Experimental airplane that could handle the challenges of the Alaskan bush was the way to go. After a tour of the SkyStar facility in Caldwell, Idaho, and a demo flight in the factory Kitfox Series 7, the hook had been set—that was his plane.

But McClintock soon realized he didn't have the time to build. He decided to go the route of a used homebuilt instead: "I finally located a beautiful Series 5 that a gentleman in Coeur d'Alene, Idaho, had for sale. This little plane had been built extremely well and had options that I could not have afforded if I had to build myself. The price was comparable to that of a nice pickup truck ($36,000) so I began my search for financing. My first choice was my bank—Wells Fargo—where I had established a good credit history. I thought that getting it financed would be a snap. Boy, was I ever wrong."

McClintock sat down with the loan officer, completed the paperwork and was assured that the loan "would be no problem." While his application was being processed, he contacted the Kitfox owner with the good news and sent him a $1000 check as earnest money. When the loan officer contacted the seller to inform him that the bank was processing the loan, which they had approved, McClintock made travel plans to pick up the plane in Idaho.

Several days later, he was asked to contact the Anchorage office to answer some follow-up questions: He identified the plane's year, model, total time, avionics and modifications. Then the hammer dropped.

"The following day, I was contacted by my local loan officer who informed me that the bank was not going to approve this loan because the plane was Experimental," McClintock said. "They expressed their apologies in not realizing this sooner and any trouble this may cause. Oh boy, *now* what was I going to do? I had already sent the seller my earnest money, bought tickets to Idaho and had no financing."

McClintock was stuck. He had committed to the purchase and couldn't get a commitment for financing from a conventional lender. With little equity, refinancing his home wasn't an option either. He was about to lose his earnest money, the time invested and worse, the loss of his dream plane. He discussed his situation with the seller, and his loan officer even called him to explain the events in hopes of recovering the earnest money.

McClintock was pleasantly surprised this time: "Pilots are a wonderful group of men and women, and I'm proud to be counted among them. My seller and his wife pondered for several days on our situation, the outcome being a true measure of the brotherhood that we pilots have. My seller opted to finance the plane for me rather than call the whole thing off. I was so delighted and thankful. He accepted the same terms and interest rate that Wells Fargo offered me. What a great guy!"

He signed the sales contract and gave the balance of the down payment to the seller in July 2003 and flew back to Nome the following morning. McClintock says that he makes his payments religiously, even making an occasional extra payment to reduce the balance sooner.

He views the roller coaster of a financing adventure philosophically, and his experience with the sellers confirmed what he has since discovered as an Alaskan: "Although Nome is only a town of 5000, I know or am known by most people here. Being truthful and honest is viewed as a strength here, not taken advantage of as a weakness as elsewhere. What could have been a nightmare turned out to be a testimony of trust between pilots."

—Cory Emberson

Maxson says. "When I had the money, I bought a kit—interest free!"

Kit helicopters are generally a difficult sell to a traditional lender, although NAFCO is willing to finance the RotorWay Exec 162F. But for those RotorWay builders who can't secure traditional financing, the company offers an alternative similar to Zenith's program. According to Marketing Director Susie Bell, RotorWay offers a four-stage buy-as-you-go plan in response to Textron Financial's exit from the homebuilt financing market.

Group 1, for instance, is a $13,000 investment that includes the airframe, landing gear and engine mount. Group 4 is the priciest at $18,350 and includes the rotor blades, engine and FADEC system. Bell notes that this arrangement increases the affordability for their customers; approximately one-third of the company's customers use this program, and the kits are normally completed in about two years.

But while programs like these may open doors for some potential builders, they are not without risk. Make sure you're dealing with a company who you are confident will be around when it comes time to buy sub assemblies down the road. A half-completed kit that's missing the additional components is not going to have much resale value to anybody.

Getting Creative: Kit builders are generally a resourceful and determined lot, and many have discovered other alternatives to make their kit dreams become reality: (1) The sustained period of low interest rates has made the home equity loan a popular option for financing kits and completed homebuilts. (2) One builder found that writing two checks every month, devoting the second check to principal only, helped him pay the loan off more quickly. (3) Another used a 0% interest credit card offer to start the building process. (4) Yet another cashed out his life insurance policy (although he didn't recommend that anyone follow his example).

In Summary

Just as the selection and completion of a particular kit aircraft is the result of considerable research and individual choice, so is the decision of paying for your personal wings. Before you pick a kit to build or a completed homebuilt to buy, do a little due diligence on the financing options if you plan to go that route. And because the financial landscape continues to change, remember there truly are no dumb questions if they can save you some change.

For more information on financing through NAFCO, call 800/999-3712 or visit www.airloans.com. Contact First Pryority Bank at 800/462-7032 or www.1st-of-pryor.com.

Additionally, you can check your FICO score at www.myfico.com.

Getting Started in Aerobatics

Lots of homebuilts are designed for this sport.

BY DAVE MARTIN

In the springtime of many a young pilot's flying life, thoughts turn to aerobatics. Pilots attend airshows, and new pilots wonder what it's like to fly rolls and loops and snaps.

In the old days—such as when I was a teenager—student pilots got a tiny taste of this because spins were a required part of training. But the rules changed to optional spins before I was licensed, and the furthest most pilots get from docile flight these days is unusual-attitude recoveries under the hood as part of required basic training.

For those who want more than straight and level, turns, climbs and descents that would be appreciated by first-time passengers, the solution is to find aerobatic instruction. Aerobatic flight schools—often a single aerobatic instructor with a suitable airplane—are spread across the country, and at the end of this, we will provide some help finding one near you.

The Homebuilt Connection

If you're a homebuilder—past, present or potential—chances are greater than for the pilot population as a whole that you are predisposed toward aerobatics. First, you are more adventurous than flyers who would never consider owning or building an Experimental-category aircraft.

Second, a relatively large percentage of homebuilts are designed with aerobatics in mind. Consider that among the kit airplanes, Van's Aircraft reports that more than 3300 RV-4s through RV-8s have been built. And on the plans-built side, some 1300 of the five aerobatic aircraft plans from Steen Aero Lab are reported to be completed.

All of these aircraft were designed to aerobatic load limits or more. The FAA's definition of suitable design for aerobatics is a design load of +6 and -3 G or more with a 50% safety margin (at least +9 and -4.5 G ultimate loading—where the structure breaks).

Many more homebuilts including some made of composites (where the ultimate loading is tested to be 100% more than the design load) are eligible for aerobatics. Check the accompanying sidebar for a list of some of these.

Although most if not all aerobatic instructors teach in their own aircraft, some will also instruct in a customer's aerobatic homebuilt. We will introduce some of them.

For the Fun of It

A few pilots may have competition or even airshow work in mind when they start aerobatic instruction. Most, however, do it out of curiosity or adventure or because aerobatics may make them better, safer pilots.

But *fun* is the reason most proceed beyond the introductory stage. Some join the International Aerobatic Club (IAC), a division of EAA, and others join one of the 50 IAC local chapters and move quickly into local Sportsman class contests. For those who are both good *and* persistent at aerobatics, there is regional and national competition, and a few represent the U.S. in world contests.

Others are content—after completing formal aerobatic training—to perfect their skills frequently without the need for competition. KITPLANES® writer Chuck Berthe lives with his wife and two RVs he built (an RV-3 and an RV-4) on a residential airpark in Georgia. "I fly aerobatics just about every day," he said, "because I get a kick out of it." Berthe says that learning to fly aerobatics in an RV can be challenging, and he has some advice for would-be RV aerobats. See the "Aerobatics in an RV" sidebar for details.

Getting Started

Whether you fly your own or rent or borrow, you should be both smooth

JIM KOEPNICK

The Christen Eagle, which is currently offered in kit form by Aviat Aircraft, is one of the most popular aerobatic designs among homebuilts.

ANDREW MCKITTRICK

Former aerobatic Sportsman and Intermediate national champion Vicki Cruse currently flies an Edge 540 in Unlimited aerobatic competition.

Aerobatics

CONTINUED

and competent in the air before starting aerobatic instruction. Aerobatic instructors report that with some of their students, considerable amounts of time and money are spent getting the customer up to levels that will lead to introducing aerobatics.

Pilots who demonstrate steep turns on altitude and who make consistently good tailwheel landings are off to a good start. From that point, lazy 8s and wingovers are used by some instructors to ease into aerobatics while demonstrating the need for smoothness and precision. Accuracy first, yank and bank later.

ANDREW MCKITTRICK

As a person with a rather small build, Cruse is proof that pilots don't need exceptional physical strength to fly aerobatics. She did need rudder pedal extensions in her Eagle, and she used both hands on the stick for some maneuvers.

Sustained inverted flight—which requires an inverted fuel and oil system—is interesting. At first it is quite uncomfortable, especially until you figure out how to get the belts tight enough. When upside down, to roll left, you ease the stick to the left but the rudder to the right. In some training airplanes, you are also pushing hard to maintain altitude inverted. Rolls and loops feel more natural from the start.

With the exception of instructors demonstrating or teaching spins, the FARs require every occupant in an aerobatic aircraft to be wearing an approved parachute packed recently by a licensed rigger. You'll need to rent, borrow or buy a 'chute if you are taking instruction in your own plane.

At first, some pilots experience discomfort that may lead to airsickness. But this is minimized or eliminated if the student aerobat does most of the flying. If there is a problem, it usually subsides quickly—within a few days—if you are flying often. For some (including me), flying on a full stomach also seems to help.

Here is one sport where strength plays a minor role, although being physically fit is certainly a requisite to comfortably pulling the G forces necessary in aerobatics. Many excellent aerobatic pilots are small, and women compete with and often beat the men. In competition, there is no gender distinction. Patty Wagstaff—the former U.S. aerobatic champion and currently active airshow pilot—comes to mind.

One way to start is to check the Yellow Pages under Aircraft Schools. Another idea is to ask local pilots. Easiest, however, may be to check IAC's

Aerobatics in an RV

KITPLANES® writer Chuck Berthe is a retired naval aviator and professional test pilot who enjoys flying aerobatics in both the RV-3 and RV-4 that he built. But he notes that these airplanes need some extra finesse to avoid bending them, or worse; he strongly recommends getting pointers from an RV-savvy aerobatic CFI before flying aerobatics in your RV.

The required technique—as in any low-drag airplane—is to keep airspeed and therefore G down to a safe level. And in the single-seat RV-3, that level is 4.4 G; Van's Aircraft has restricted the G limit to Utility instead of the 6-G Aerobatic category because of several wingspar failures related to an early RV-3 sparcap problem.

"In an RV-3 or -4," Berthe says, "speed builds up so fast when the nose is pointed straight down that you had better not start a split S [a half roll and pull through a descending half loop] at more than about 100 mph, and the nose had better be on the way back up quickly after it passes through vertical."

Berthe says he does an entire RV-3 or -4 routine pulling little more than 3 G, but it takes practice and discipline, especially because the control forces are much lighter than, for example, a Citabria, and the drag is much lower than a Pitts or the other biplanes.

Aileron rolls are easy and safe if you pull the nose up before rolling, he says. But people typically do not pull the nose high enough initially, and they don't roll fast enough at the top when doing a barrel roll, resulting in a nose-low, excessively fast finish.

In an RV-4, the factory has limited Aerobatic-category maneuvers (6-G maximum) to a gross weight of 1300 pounds, which usually precludes having two adults aboard. But Berthe says that two people can fly safely if the pilot limits the load to the 4.4-G Utility-category maximum.

The c.g. must also be checked carefully. Berthe says that in an RV-4 with the smaller O-320 engine and a wood propeller, the c.g. may be too far aft to do aerobatics safely with two full-size adults aboard. He also recommends precluding 0-G or negative-G flight unless you have both an inverted fuel and inverted oil system.

Airshow and competition aerobatics are not the objective of most RV pilots anyway, and there's plenty of aerobatic fun in a properly flown RV without going negative, he says.

—Dave Martin

CARL SCHUPPLE

The RV-4 from Van's Aircraft is an excellent choice for pilots with a mixed mission—it's quite capable of performing recreational aerobatics (a few have even been flown competitively), but its two seats offer a chance for more relaxed cross-country flights as well.

The Sonex is another ideal airplane for pilots with multiple flying goals. While capable of sport aerobatics, the two-place monoplane is easy to build and an excellent platform for cross-country flight.

XAVIER MEAL, COURTESY SONEX

AEROBATIC KITS

COMPANY	MODEL	SEATS	ENGINE	PRICE*
AVIAT AIRCRAFT *www.aviataircraft.com* *307/885-3151*	EAGLE II	2	LYCOMING AEIO-360	$96,000
BRADLEY AEROSPACE *www.vortechonline.com/bradley* *530/899-7918*	AEROBAT	1	80-HP VW	$10,700
CULP'S SPECIALTIES *www.culpsspecialties.com* *318/222-0850*	CULP'S SPECIAL	2	M14 RADIAL	$51,000
JIM KIMBALL ENTERPRISES *www.pittsmodel12.com* *407/889-3451*	PITTS MODEL 12	2	M14P RADIAL	$47,995
MIDWEST AEROSPORT *www.formulagt.biz* *913/397-6701*	FORMULA GT	2	LYCOMING IO-540	$38,350
MUSTANG AERONAUTICS *www.mustangaero.com* *248/649-6818*	MIDGET MUSTANG MUSTANG II	1 2	CONTINENTAL O-200 LYCOMING O-300	$7440 $9925
NEW GLASAIR LLC *www.newglasair.com* *360/435-8533 x232*	GLASAIR III	2	LYCOMING 300 HP	$42,950
RANS *www.rans.com* *785/625-6346*	S-9 CHAOS S-10 SAKOTA	1 2	ROTAX 582 ROTAX 582	$9620 $13,435
RAVEN AIRCRAFT *www.ravenaircraft.com* *604/597-9296*	RAVEN 2XS	2	LYCOMING IO-540	$24,000
SONEX *www.sonex-ltd.com* *920/231-8297*	SONEX	2	120-HP JABIRU	$11,985
TEAM ROCKET AIRCRAFT *www.teamrocketaircraft.com* *512/352-6979*	F-1 ROCKET	2	LYCOMING IO-540	$37,200
ULTIMATE BIPLANE *www.ultimatebiplane.com* *519/749-0668*	10-100 10-200	1 1	CONTINENTAL O-200 LYCOMING O-360	$7670 $12,675
VAN'S AIRCRAFT *www.vansaircraft.com* *503/675-6545*	RV-4 RV-7 RV-8	2 2 2	LYCOMING 160 HP LYCOMING 200 HP LYCOMING 200 HP	$13,070 $17,075 $16,845

AEROBATIC PLANS

COMPANY	MODEL	SEATS	ENGINE	PRICE
AIRCRAFT SPRUCE *www.aircraftspruce.com* *877/4-SPRUCE*	ACRODUSTER TOO ACROLITE STARDUSTER	2 1 2	200 HP ROTAX 912 LYCOMING 180 HP	$175 $300 $175
AVIAT *www.aviataircraft.com* *307/885-3151*	PITTS S-1-11B PITTS S-1S	1 1	LYCOMING IO-540 LYCOMING O-360	$300 $250
CSN *863/646-9446*	CORBY STARLET	1	VW	$175
CLASSIC AERO ENTERPRISES *http://members.cox.net/classic-aero* *757/851-2856*	H-2 HONEY-BEE	1	HIRTH F-30	$250
ELMWOOD AVIATION *613/398-3216*	CHRISTAVIA MK 1	2	CONTINENTAL 65 HP	$200
MEYER AIRCRAFT *www.littletootbiplane.com* *817/430-3507*	MEYER'S LITTLE TOOT	1	LYCOMING O-320	$305
STEEN AERO LAB, INC. *www.steenaero.com* *321/725-4160*	FIREBOLT SKYBOLT KNIGHT TWISTER	2 2 1-2	LYCOMING IO-540 LYCOMING IO-540 LYCOMING 108 HP	 $165 $200
YORK ENTERPRISES *519/797-2930*	ULTIMATE SERIES	1	LYCOMING AEIO-360	$300

**Airframe-only price. Add engine, prop, instruments, avionics, paint, upholstery.*

Here are some of the currently available kit and plansbuilt airplanes designed to meet the FAA's aerobatic strength standards. All of the aircraft listed are presented in more detail in the most recent KITPLANES® annual directories: December 2003 and January 2004.

Before spending more than phone call money on any of these projects, we suggest taking two important steps:

First, after finding a design that might work for your needs, call the kit company or plans seller to discuss its aerobatic potential considering how you might build and fly it. For example, some two-seat designs can be flown only solo in the aerobatic mode.

Pilot weight may be a factor in some designs, and the extra equipment you may want in a general-purpose homebuilt may affect its suitability for aerobatics because of weight and balance considerations.

If the project sounds feasible, proceed to Step 2:

Get the names and phone numbers of builders of your target design who are flying it aerobatically and call them. This is good advice for anybody considering any homebuilt project, but it is essential for picking an aerobatic mount. If the builder's airplane performance and durability are what you are seeking, consider duplicating it as closely as possible. Small changes in weight, balance or aerodynamic features can result in large changes in performance and control.

—Dave Martin

Aerobatics

CONTINUED

web site, www.iac.org. Under *How to Begin*, click *Aerobatic Schools*. You will find more than 50 U.S. and Canadian aerobatics schools including the type of aircraft available and courses offered and whether the instructor may be willing to teach in a student's airplane.

Among those who may teach you in your own plane are two CFIs in Southern California: Rich Stowall of Ventura (800/869-6627) and Bill Cornick in Thousand Oaks (805/492-1066). Both have flown a variety of aerobatic homebuilts. Between them, the list includes Lancairs, Glasairs, Christen/Aviat Eagles, RVs and some of the classic homebuilt biplanes. Bill Bruns of Kenosha, Wisconsin (262/657-8052), is another aerobatic CFI with a lot of experience in homebuilts; he may also teach you in your homebuilt. All of these instructors will make the decision based on the type, configuration and condition of the homebuilt.

In some cases, training in something similar to your airplane will suffice as a preface for rolling your own, but advice from someone who regularly flies aerobatics in a plane like yours should be considered mandatory. At the edges of the flight envelope, different airplanes behave quite differently. And within a single make and model, varying powerplants, propellers and other systems often change flight characteristics.

One Pilot's Experience

Some people find aerobatics to be addictive. Recent IAC board member and former Sportsman and Intermediate national champion Vicki Cruse started flying in 1993. Two years later, her fascination with airshow aerobatics led her to buy a Christen Eagle II. But she was not confident enough to fly it until she took an emergency-maneuver training course from Rich Stowell in California in '97.

The course concentrated on spins, which she had experienced during flight training in a Cessna 152 but found frightening. In Stowell's Decathlon, spinning was easier to understand and was more comfortable.

Cruse joined an IAC chapter and was encouraged to enter Sportsman competition. In fact, she flew the Nationals contest in '97, was disappointed with her performance and decided to fly all the contests she could in 1998. She competed in 13 that year and earned the 1998 national Sportsman championship. At the Chandler, Arizona, contest in 2000, Cruse won in the Intermediate category.

She is proof that pilots don't need a lot of strength to fly aerobatics. As a small person, she needed rudder pedal

extensions in her Eagle, and she used both hands on the stick for some maneuvers.

Cruse sold the Eagle and now flies her Edge 540 in Unlimited competition. There's no need for two hands on the stick in the Edge, she says. Cruse was chosen to be a member of the 2003 U.S. aerobatic team, hopes to make the '05 team and to compete in Spain for the U.S. in 2005.

Helping Hands

IAC's new recreational aerobatic program may be available near you in the future. The organization's president, Gerry Molidor, is promoting a series of one-day seminars called Rallies for pilots curious about the sport. These are intended as social and informational get-togethers for pilots interested in aerobatics for the fun of it and without any emphasis on competition.

"Many pilots own aerobatic-capable airplanes," Molidor said, "and we want to emphasize the camaraderie that develops in such a group." The plan is classroom gatherings to include a description of aerobatics and training along with maintenance tips and other topics. Depending on the location, an aerobatic demonstration by one of the instructors may follow the classroom session.

By the time you read this, an IAC Rally may have occurred in the Chicago area; check IAC's web site for future Rallies. In the past, the FAA has recognized training like this toward its Wings proficiency program. But the main objective is to introduce recreational pilots to a whole new way to have fun in the air.

FOR MORE INFORMATION, contact IAC by calling 920/426-6574 or visit www.iac.org. The site lists schools and other information for those interested in recreational and competitive aerobatics. Membership costs EAA members an extra $45 per year and includes IAC's monthly magazine. See IAC's web site for other membership options.

JIM KOEPNICK

The designs of Curtis Pitts, some of which are available in kit form, have always been popular for aerobatic flight. Currently, Aviat Aircraft offers a certified Pitts aircraft (the S-2C) and plans for single-place designs (above). Jim Kimball Enterprises sells a kit for the Pitts Model 12 (below).

JIM KOEPNICK

8500 Faith Road
Montague, CA 96064

Robert and Jean Kube's Zenith STOL CH-701

We completed our Zenith STOL in October 2003, and one month later on November 1, 2003, our plane passed its FAA airworthiness inspection without any problems. While our plane didn't actually have its first flight until March 2004 because of inclement weather, we still test-ran the Rotax 912 engine to check for pressures, temperature and leaks—everything was within the parameters with no leaks.

With build time amounting to more than 2000 hours, our Zenith boasts many custom touches, such as an engine-turned instrument panel with Grand Rapids Technologies EIS, Microair transceiver, Sigtronics intercom, headset plug-ins at the front lip of the baggage compartment (between seats) and many other basic instruments. We installed cabin heat and designed and manufactured flap control quadrant with five detents. The plane was built with full Lexan doors and boasts an Aboriginal art rendering of an Australian Go-Anna airbrushed over light jade green. During first flight, our Zenith flew straight and level, and its engine performed perfectly.

Thanks to Nicholas Heintz at Zenith for his assistance and to Chris Heintz for a great design. A special thanks to my wife, Jean, for her patience and assistance in building our second plane.

Submissions to "Completions" should include a typed, double-spaced description (a few paragraphs) of the project and the finished aircraft. Also include a good color photograph of the completed aircraft (slides are also acceptable) that we may keep. Please include a daytime phone number where we can contact you, if necessary. Also indicate whether we may publish your address in case other builders would like to contact you. Submissions should be sent to: Completions, c/o KITPLANES, 239 New Road, Suite B-201, Parsippany, NJ 07054.

The Top 20, Part 2

Meet the most influential figures who have shaped the homebuilt aviation industry.

BY RICK LINDSTROM

In furthering the spirit of celebrating the 20th anniversary of KITPLANES® we continue with last month's series on the 20 most influential figures in the homebuilt aviation industry. A difficult task to narrow down, we managed to round the list out—the remainder appear in this second part of this two-part series.

Chris Heintz

Chris Heintz came to North America from France in 1973 and went to work for DeHavilland in Toronto, where he translated aeronautical engineering drawings from metric into English units. This career ultimately evaporated, and with five children eventually going to college, another income source was needed. Why not turn his simple, light aircraft designs into kits for sale?

Heintz's garage became a workshop, and Zenith (an anagram of Heintz) Aircraft was born. The market for an easy to build, solid metal kit exceeded his expectations, and within a year, Zenith added three employees and relocated to a bona fide factory. Just more than 2000 Zenith kits have shipped worldwide, including the first kit ever to be shipped to New Guinea.

The Zenith philosophy helps customers all the way through flight testing, ensuring that the completed kit will meet expectations *and* fly safely as well. Zenith's goal? Happy customers.

"You must use creativity and responsibility together to build airplanes," Heintz says. "And considering the past 30 years, I have not wasted my life."

Frank Christensen

During his last year at Stanford in 1960, Frank Christensen founded a company that produced special-purpose tooling for the infant semiconductor industry in what would later become Silicon Valley. That industry's incredible nationwide growth required that Christensen replace his Cessna twin with a faster, higher-altitude aircraft. He chose the Cavalier 51 (a P-51 modified with two seats and creature comforts for executive use) as his aerial chariot.

During his checkout in Florida,

Christensen was introduced to basic aerobatics and found another passion; he made an unsuccessful bid to acquire the company created by Curtis Pitts. But with help from former Pitts employee Herb Anderson, production started on an unlimited aerobatic kit airplane.

The Christen Eagle debuted at Oshkosh in 1979 with a price tag of $14,750 for all 26 subkits. Remarkably complete and well-documented, the Eagle kit raised the bar for other manufacturers. "It was the first truly complete kit, containing everything down to the paint and graphics," Christensen recalls. "The FAA was worried, having visions of the sky gray with Christen Eagles." The kit was modified, allowing the builder to do more of the actu-

PHOTOS: RICK LINDSTROM

al component part fabrication, and the Feds were happy.

Christensen ultimately acquired the Pitts aircraft line, also introducing the Husky as an improved version of the Super Cub. The product liability frenzy of the 1980s hastened Christensen's retirement from the aviation business in 1990, before liability reforms were enacted to protect aviation manufacturers from an increasingly frivolous and oppressive legal climate.

Today, you can benefit from Christensen' s heavy lifting in the early days of the aircraft kit and buy your own Eagle kit, a ready-to-fly Pitts or a Husky from Aviat Aircraft. "I always wanted to provide airplanes you couldn't easily get elsewhere," Christensen said. Seeing how far the kit industry has progressed from those early days, I can only wonder where it would be without pioneers like Frank Christensen.

Ray Stits

Talking to Ray Stits is like trying to sip from a fire hose. Although Stits has built sport airplanes since 1948—five years before the first EAA meeting—he hasn't slowed down much since then. Although he has more than 30 years on me, I had to shift into mental overdrive to avoid being left behind by this human dynamo.

With more than a dozen aircraft designs to his credit, including the Playboy that was the foundation for Dick VanGrunsven's RV series, Stits' other accomplishments in aviation range far and wide. He's still going strong, saving airports from becoming Section VIII housing and putting the finishing touches on EAA Chapter One's new home at FlaBob Airport in Southern California.

His greatest contribution to aviation safety is the Stits covering method, which uses nonflammable polyester cloth and coatings to replace the silver nitrate dope and fabric that was typical for rag-and-tube airplanes for decades. The fabric burned ferociously, and after igniting some scraps, a scorched Stits knew there must be a better way. His research and subsequent introduction in 1962 of the Poly-Fiber method has saved countless flyers from immolation in formerly commonplace aircraft fires. Immune to cracking and peeling, Stits' covering system lasts for decades with proper care and is STC'd for production aircraft.

"I don't like to put a title on myself," he responded when I asked him about his aeronautical background. "I just get things done." No kidding, Ray.

Ken Rand *(1932-1979)*

Like many other available designs, the KR line began in 1968 when a couple of guys decided to build an aircraft that reflected what they wanted to fly. With building partner Stu Robinson, Rand took his experience at McDonnell Douglas Aircraft coupled with his local EAA chapter to create a wood, foam and fiberglass monoplane that used the cheap and abundant Volkswagen powerplant to produce blistering performance.

The single-seat KR-1 was an instant hit at the 20th EAA convention in Oshkosh; it was awarded "Best Aircraft Application of New Materials" for Rand's innovative use of the newly utilized composite technology. The aerodynamically clean surfaces, strength and light weight allowed 180-mph cruise speeds for a song. After articles appeared in *Popular Science*, *Popular Mechanics* and *Air Progress*, Rand decided to follow his heart and leave McDonnell Douglas in 1973, turning Rand Robinson Engineering into a full-time gig.

The aerodynamically clean surfaces, strength and light weight allowed 180-mph cruise speeds for a song.

The two-seat KR-2 appeared in 1974, using wet layup construction. The KR-2S followed in 1979, offering prepreg components that cut build time significantly to under 1000 hours.

Returning from Lakeland, Florida, to Southern California in January 1979, Rand encountered severe weather over the mountains just short of his destination. The wreckage of his KR was finally located after an exhaustive search several days later.

Rand's legacy lives on—the KR series is still available from plans-only to complete airframe kits, in both fixed and retractable gear. The KR still reflects Rand's dream of affordable, high-performance flying for the common pilot.

Lance Neibauer

With a B.A. in fine arts from Michigan State in 1971, Lance Neibauer rec-

ognized the work of art that is inherent in many aircraft designs. An early customer for the KR-2, Neibauer cut his kit teeth by building a beautiful example using then-new composite technology. In 1979, he helped Rand's widow, Jeanette, develop the marketing tools sorely needed for the KR series.

Eventually exploring his own concepts, Neibauer designed the most beautiful airplane he could imagine and left it to the engineers to work out the aerodynamics. With sleek, svelte lines that softly echo such timeless beauty found in designs like the Falco, the new Lancairs fulfilled those who needed an airplane that looked just as good as it flew. From a funky little airport in Santa Paula, California, Neibauer would launch what have become the…well…*sexiest* kit and certified sport airplanes available.

The prototype Lancair 200 first flew in the mid-1980s and was the seed that eventually grew into a full line of two- and four-seat personal aircraft with both fixed and retractable gear. Now located in Oregon, Lancair International Inc. and Neico Aviation have delivered nearly 2000 kits and finished aircraft worldwide. Instantly recognizable in the air or on the ramp, the Lancairs, by comparison, make other light aircraft look dated and boxy.

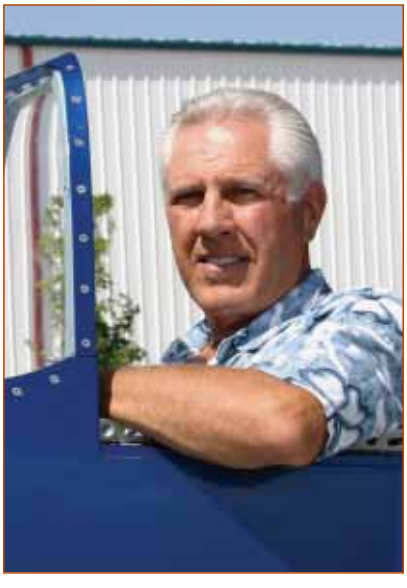
Such innovative combinations of form and function don't go unnoticed, and Neibauer has earned numerous awards for the Lancair designs, both inside and outside the aviation community. Such broad recognition is unusual in an industry that is generally supported only by itself. Do the Lancairs perform as good as they look, or look as good as they fly? It's an argument that doesn't have a clear answer, perhaps the best indicator of Neibauer getting it right while raising the bar for kit aircraft style and performance.

Dan Denney

In 1980, Dan Denney wandered down to the ultralight field during the EAA convention at Oshkosh and checked out the latest thing in personal aviation. Although he liked what he saw, he thought that these early ultralights might put off a lot of potential pilots with their minimalistic, barebones design. Denney was convinced he could develop a better solution for those looking for a cheap-to-get, cheap-to-fly airplane.

Partnering with Dean Wilson, who had designed the Eagle agplane, the two conspired to produce a small, lightweight fun plane that was powered by a small two-stroke engine with a lawnmower-style pull start. The new Avid Flyer was the hit of the 1983 EAA convention at Oshkosh.

After reaching an impasse on



The 21st?

Like many other sport aviation pioneers, Dennis Fetters started with the dream of an inexpensive, single-seat helicopter that looked like a scaled-down Hughes 500. The Mini 500 first flew in 1990, and it wasn't long until others wanted a piece of Fetters' dream. His company, Revolution Helicopter, shipped just more than 500 kits in the following decade. Approximately 200 Mini 500s are currently flying with varying degrees of satisfaction.

Plagued with problems like cracking airframes, defective clutches, soft gears, seized engines and rotor tip weights that depart the machine like a bullet, the Mini 500 hasn't exactly met expectations. Predictably, this led to Fetters leaving the business in the late 1990s after the pressure became intolerable, even to the point of leaving the country. The assets of Revolution Helicopter were auctioned off, and you might expect the Mini 500 story to end right there.

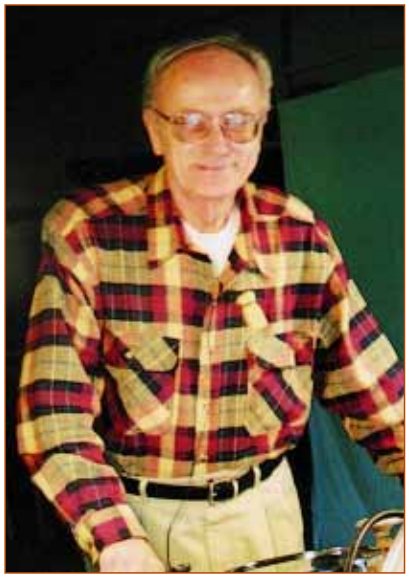
But the Mini 500 is still a cool concept, as flawed as the execution may have been. The project has been resurrected under the direction of Richard Stitt (Stitt Industries, Inc.), who says he can provide a zero-time military surplus T-62 turbine upgrade to a Mini 500 for around $32,000. This modification eliminates most of the original design issues, letting the cool little helicopter originally envisioned by Fetters to actually become viable.

It's tempting to focus just on the many problems that have appeared in the original Mini 500 design, but we should also take a look into the successes that Dennis Fetters had in bringing the concept to flying reality.

—Rick Lindstrom

which direction to take the design, Wilson and Denney dissolved their partnership, and Wilson bought Denney out. Without a non-compete clause, Denney launched the Kitfox project in October 1983. First flight was on May 7, 1984, and two were sold immediately at the plane's airshow debut in Hollister, California. Before the business was sold in 1992 to Phil Reed, who rechristened the company as SkyStar, Denney had delivered 2000 Kitfox kits to those who just wanted to fly for the fun of it.

Recognizing that there will always be a market for a basic airplane that delivers maximum adventure for a minimum of expense, Denney's Kitfox filled that desire for flyers worldwide.



B.J. Schramm *(1939-2004)*

The dream of a small, personal helicopter goes back to Leonardo da Vinci, whose early depictions of a human-crewed vertical air-screw were conceptually close but lacked the practical knowledge of airfoils and torque that would only be discovered centuries later.

Some dreams are timeless, and Buford John (B.J.) Schramm's Scorpion single-seat helicopter debuted in Oshkosh in 1966, soon followed by the two-seat Scorpion Too. Although these early designs were plagued by

reliability issues, da Vinci's dream was still vivid, and the Executive was soon introduced for those lusting for their own helicopter. But having a good design doesn't necessarily guarantee commercial success, and Schramm had some difficulty bringing the Executive to market.

One of his customers in England, John Netherwood, saw an opportunity to use his experience in the heavy equipment business to bring the Exec to market with improved financial backing. Netherwood bought Schramm's company, and the RotorWay Exec has since earned the reputation of being the premier two-seat kit helicopter available anywhere.

You can't keep a helicopter pilot on the ground for long, and Schramm concentrated his efforts on the single-seat Helicycle, reflecting his original dream of a simple, reliable helicopter for individual flight. The Helicycle fulfilled its promise—the embodiment of all Schramm had learned in four decades of light helicopter design. But after a recent photo shoot in Idaho, Schramm's Helicycle was reported missing. In April 2004, searchers found Schramm deceased, still strapped into his helicopter.

Schramm's passion for sharing helicopter flight with the common man burned as brightly as ever, despite obstacles that would have discouraged most aircraft designers. His success in fulfilling da Vinci's ancient dream will not be forgotten.

Ken Brock *(1932-2001)*

In existence since 1923, the gyroplane is one of the most misunderstood and underappreciated flying machines ever invented. Ken Brock saw the promise and safety inherent in its design and became one of the world's foremost experts and devotees of the rotorcraft.

In existence since 1923, the gyroplane is one of the most misunderstood and underappreciated flying machines ever invented.

Brock's involvement with the gyroplane began in the mid-1950s and continued until his death in 2001. He set many records in his KB-2 gyroplane, including cross-country and over-water flights, and served as president and board member of the Popular Rotorcraft Association for more than 15 years.

Ironically, a defective tailwheel-induced crash at El Mirage Dry Lake in his Thorp T-18 not only ended his brilliant career prematurely, but underscored his belief in the inherent safety of the gyroplane design. Brock's wife, Marie, was slightly injured in the crash and still manages Ken Brock Manufacturing, which supplies machined component parts for Brock's gyroplanes, the Thorp T-18 line of homebuilts, the Marquart Charger and even Burt Rutan's line of canard aircraft.

Innovators like Ken Brock don't come along often, and his work in sport aviation will be sorely missed.

Alan & Dale Klapmeier

"It was a summer project that took two-and-a-half years," Dale Klapmeier recalls. In their teens, Dale and his

brother, Alan, happened upon a flipped-over Champ in Wisconsin and quickly made a deal for the wreck for $3000. They had the money in savings, and their local banker cut the check before mom and dad could nix the deal.

By the time the banker tipped off their parents, it was too late to back out. The brothers rebuilt that Champ from the airframe out, and the bug had bitten hard.

During the Oshkosh convention of 1981, they saw the Glasair and just had to have one. Lacking the money to buy a kit, they appealed to their parents to float a loan for the project. What they got instead was an assignment to write a business plan that detailed why building a Glasair was important to their future and made fiscal sense. They produced 25 pages of detail, eventually driving home from the *Pig Farm* in Washington with a 35-foot box loaded on a boat trailer—their Glasair flew in March 1984.

The brothers were soon carving foam blocks in the barn, creating the first VK-30. With visions of being swamped with orders at Oshkosh, the interest in their VK-30 mock-up was a bit disappointing when the design debuted. They learned that designing a viable kit differed from designing a finished airplane. So they created a certified airplane that used the latest in technology then found only in Experimentals and military designs.

Today, Cirrus Design ships more than 40 aircraft monthly, an unqualified success story. "Pilots will put up with almost anything to fly," Dale says. "We designed the Cirrus to appeal to the people in the mall by overcoming their objections to light airplanes." It's a simple concept, one that's eluded a lot of aviation people until the Klapmeier brothers got into the act.

John Monnett

Back in the 50s and 60s, John Monnett was building flying model airplanes like most other kids. Fascinated with radio control, he found that he could sell a well-appointed flying model for a good chunk of change, buy an Aeronca Defender that needed some TLC and still have some money left over. So he did.

Tinkering with the "Air Knocker" eventually led to building a highly modified Jeannie's Teenie, and then designing his own airplane. Monnett's Sonerai was introduced in 1970 as a plansbuilt project. He began building and supplying component parts to accompany the plans and found himself in the kit business. "I started with the concept that a personal airplane shouldn't cost more than the average car," Monnett says. "And because we're lazy, we kept it very simple in design and to build."

Designed around the Volkswagen engine, it turned in impressive performance figures while being stressed for aerobatics. The instantly recognizable fuselage design allows

lift to be generated along with the wings, taking advantage of every efficiency available. The Sonerai design was eventually joined by the Monerai sailplane, the Monex racer, the Sonex two-place monoplane, the Waiex V-tail version and the Xenos sailplane.

Was he ever tempted to design larger, more powerful airplanes? Monnett says, "We're aware of our niche. Our favorite saying around here is *reality check*. Our mission is to build affordable sport airplanes that are aerobatic but have low stall speeds and go really fast. We think our airplanes are a good reflection of what flying's all about."

Your Thoughts

Did we leave somebody out? Surely! With so many pioneers in the homebuilt aircraft industry, we could only begin to write about some of the ones we deemed most influential. If you disagree with someone that we wrote about, or if we left someone out that you think was worthy, let us know.

Send your thoughts to us at editorial@kitplanes.com. We may publish some comments in the Letters column or on our web site.

—Ed.

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A309RS

Redundancy! Anticipate and manage failures by designing for safety.

There is a large body of knowledge of good engineering practice for aircraft. Most of this knowledge was gained the hard way, and it should not be ignored. In the certified airplane world, many of these principles are enforced by certification regulations. But homebuilders (in the U.S.) are free of such regulations. They are allowed to take whatever risks they're personally willing to accept, assuming they can pass an airworthiness inspection. This allows them to innovate in the areas of configurations, structural materials and powerplants without going through the torturous certification process before flight. The homebuilder decides what level of testing and analysis is sufficient to allow a new design to take to the air.

But with this freedom comes additional responsibility. Many safety principles that the regulations enforce on manufacturers are important, and while homebuilders are permitted to violate them, it is neither safe nor prudent to do so. A large part of designing for safety is an exercise in anticipating and managing failures. Failure analysis, whether formal or not, is part of the design process. The engineer tries to determine how a system can fail and the consequences of the failure. This information is then used to ensure that the design is such that failures are rare, and any failure that occurs will not lead to disaster.

Single-Point Failures

When evaluating the integrity of a design, one useful technique is to imagine the consequences of a single failure. Look at the airplane and think through the consequences of, for example, a single bolt coming out or a single rivet failing. If a single failure of a single component will have catastrophic consequences, we call this a *single-point failure mode.*

In general, single-point failure modes in safety-critical parts of airplanes are unacceptable. Ideally, no single-point failure should lead to an accident. In practice this is difficult to achieve, but situations where a single failure can lead to disaster should be eliminated wherever possible.

There are a few components, such as the wingspar, that must never fail. Where a single component must never fail, great care must be taken in its design to absolutely minimize the chance of a failure. This is why primary structure should always be designed with a large factor of safety.

Here are some principles to follow to help produce a safe design:

Safe Design Principle No. 1

No single failure should lead to loss of control of the airplane.

Most certification rules require redundant flight controls that allow the airplane to retain its ability to fly and land with any single flight control disabled. Mechanical control systems have many pivot pins or bolts that cannot easily be made redundant and thus are potential single-point failure sites. Since we can't eliminate all the single-point failure modes in the control system, we should provide enough redundancy to make the system failure tolerant.

More than one airplane has been lost due to the loss of a single bolt in the control system. Even though homebuilts are not required to meet FAR Part 23, they should still be designed to meet the intent of the control redundancy rules.

In the lateral/directional axes, the rudder and the ailerons can back each other up. The pilot should be able to maintain control with either aileron alone or rudder alone.

To protect against the effects of rudder failure, the airplane should be controllable in climb at full power with the pilot's feet off the rudder pedals. It should be possible to perform a turn and recover to level flight without using rudder. This means that the airplane must have a combination of low enough adverse yaw and high enough directional stability so it can make turns without coordinated control inputs. The turns might be uncoordinated, but they must be controllable.

In order to guard against aileron failure, the airplane must have stable dihedral effect. The pilot must be able to raise a wing by applying rudder away from that wing. Ideally, the pilot should be able to make shallow turns and also keep the airplane wings level using only rudder and elevator.

The FARs require that the pilot be able to raise a wing by applying rudder. Some certified airplanes meet this requirement by using a spring interconnect between the ailerons and rudder so that applying rudder also moves the ailerons. While this meets the letter of the rule, it doesn't really meet its intent—a failure of the aileron linkage can disable both the pilot's ability to move the aileron with the stick and the ability of the rudder pedals to move the ailerons through the interconnect spring.

In pitch, the pitch trim system serves as a redundant control. If the pitch trim system has sufficient authority, the airplane can be flown and landed on pitch trim alone. In practice, it is difficult to make a good landing using pitch trim as the sole control, but it does provide enough control to make the arrival survivable.

An airplane without pitch trim is vulnerable to a single failure in the elevator control circuit. This is not a purely hypothetical situation. In-flight control disconnects do happen. In fact, a fatal accident that cost us one of the pioneers in the ultralight world was caused by an elevator disconnect. Additionally, I recently spoke with a friend

who survived a hairy low-altitude, high-speed bailout after a total loss of pitch control was caused by a single misinstalled nut on an elevator bellcrank that was coming off.

To be useful as a backup pitch control, the pitch trim system must use linkages other than the primary elevator linkage. A spring trim system that puts pressure on the stick to trim the airplane does not qualify as a backup control, since it will fail along with the primary pitch control if a linkage fails. A tab-type system or a trimmable horizontal tail both work as backup pitch controls.

While the trim system is valuable as a backup pitch control system, it too can pose a failure risk. The trim system should never be capable of overpowering the pilot, particularly if it is a powered rather than manual system. It should be possible for a pilot to maintain control of the airplane even if the trim is hard over.

Trim runaways can and have caused accidents. If the trim system is powered, the pilot should be able to disable the trim in the event of an electrical failure that causes the trim to move on its own. This is of particular concern on some of the larger manual control airplanes currently flying. Because of the large size of the control surfaces, these airplanes (typically large twins) have powerful trim systems to ease pilot workload. A hard-over trim runaway, especially at cruise speed, can rapidly cause a situation where the pilot must exert 75-100 pounds of stick force to keep the airplane under control. All such airplanes provide the pilot with an easy-to-reach trim disconnect switch; most airplanes have auditory trim-in-motion warnings and a backup trim system to allow the pilot to retrim the airplane after a primary trim failure.

Another set of airplane components that can cause loss of control problems are doors, windows and canopies. Some airplanes become difficult or impossible to control if one of these pops open in flight. Ideally, the airplane should remain controllable with any door, canopy or window open, missing or unlatched. If this is not possible, then redundant latches to help reduce the likelihood of an inadvertent in-flight opening should be provided.

This requirement is not limited to crew access doors and transparencies. Small doors such as inspection doors or fuel-filler doors on the wings or tail surfaces can have large aerodynamic effects. I know of one incident where a home-builder put access doors in the upper surfaces of his wings to provide access to the plane's retractable landing gear. One of the doors opened in flight and acted as a spoiler, with dramatic effect. He was able to land safely, but it was a close call.

Safe Design Principle No. 2

No single failure should lead to catastrophic structural failure.

In practice, this requirement is almost impossible to meet completely. Few airplanes are so strong that a determinedly stupid pilot cannot break them in flight. Still, the designer should try to reduce the number of critical single-point failure sites to an absolute minimum.

Often the difference between a failure-prone design and a safe one can be as simple as adding one more bolt or rivet to a joint. It is rarely necessary to hang the safety of the airplane on a single fastener. If at all possible, safety-critical joints should have redundant fasteners, and the airplane should remain safely flyable with one fastener missing or broken. Of course the loss of a fastener will weaken the airplane, but it should be able to sustain at least normal category loads in this situation.

On primary wing- and strut-attach fittings, it is difficult to make the attach bolts redundant, and many airplanes have single-point failure points there. These critical bolts should be sized with a high factor of safety, and they should be carefully inspected to make sure they are safetied. Such joints should be easy to inspect and be designed to minimize the likelihood that the bolt will fall out if it loses its nut.

Safe Design Principle No. 3

Provide backup wherever possible.

It is not possible to make an airplane so redundant that every conceivable failure leaves the airplane completely mission-capable. In spite of this, it should be possible to make a safe precautionary landing after any single failure. In the absolute worst case, a single failure should result in a survivable forced landing.

Emergency backup systems can greatly reduce the consequences of a failure; the goal of a backup system is to get the occupants of the airplane safely on the ground. These backup functions can be separate systems or an emergency mode of operation of the primary system that allows it to function after a failure of a component. We have already seen how this type of approach is applied to primary flight controls.

Often, the backup is a secondary system that is less capable than the primary system but adequate in an emergency. For example, many pilots carry battery-operated handheld com radios as backups. They are relatively short-range but are quite adequate for communicating with ATC if the primary radios fail.

Another good example of a backup system is emergency extension of retractable landing gear. There are many ways of doing this—some systems have hand-driven hydraulic pumps or mechanical systems that allow a pilot to extend the gear, and other systems use springs that will pull the gear down if the up-lock is released. The springs are loaded when the retraction actuators pull up the gear and are powerful enough to extend the gear on their own. One of the simplest approaches is to design the gear so that it will fall into a down/locked position if released. Emergency gear-extension systems have saved many airplanes from damage and changed what could have been a scary gear-up emergency landing into a mere maintenance/repair hassle.

A good example of a backup designed to change a total catastrophe into a situation where a survivable forced landing is possible is the engine-retention cables required in Formula 1 racing airplanes. The propellers on these airplanes are thin and operate at high rpm. The airplanes pull a lot of G as they make the turns on the racecourse. These factors combine to cause high gyroscopic stresses in the propeller blades, and propeller failures are relatively common.

If the prop loses a blade, the intense vibration caused by a drastically out-of-balance propeller can tear the engine off the mount or break the mount. If the engine were to separate from the airplane, the c.g. would move so far aft that the airplane would become uncontrollable. A strong steel cable wrapped around the engine and attached firmly to the fuselage structure can keep the engine from falling off the airplane. Even with the engine hanging from the cable, the airplane remains in balance and controllable, giving the pilot a good chance of making a safe forced landing.

Fuel systems are another area where backup systems are important. If the fuel will not gravity-feed, it must be pumped to the engine. Most powerplants have engine-driven fuel pumps to do this. An electric boost pump that can take over for the engine-driven pump is standard equipment on all certified airplanes that cannot gravity-feed fuel. The boost pump is routinely used during takeoff and landing and can keep the engine running on its own if necessary. It's also common to have a bypass line around the boost pump with a check valve in it. If the boost pump fails and impedes fuel flow, the engine-driven pump can pull fuel around the dead boost pump through the bypass line.

The Lesson

In general, if there is a system on the airplane that is critical for safe flight or a safe landing, it should either be redundant or be backstopped by an emergency system that makes a safe mission abort possible.

Aerodynamic questions of a general nature should be sent to editorial@kitplanes.com. Use "Wind Tunnel" as the subject line.

BY JIM WEIR

An old project revisited—
the Wire Rack MK-II.

Way back in the stone ages (1997), Bill Clinton was just starting his second term as president, avgas was a buck-fifty a gallon, the Marlins took the Series in game seven from the Indians, I had brown hair and was one month away from marrying the prettiest lady in the world, and KITPLANES® ran a story in the July issue about a wire rack you could build out of PVC for a couple of dollars.

The Shortcomings

That wire rack has served both EAA Chapter 1175 and me well over the last seven years, but it had a couple of design features (alright, goof-ups) that left something to be desired.

In the first place, it didn't hold enough wire. When I designed it, all I wanted was enough room for a half dozen different spools of nylon-jacket DCC white aircraft wire. However, what evolved was an avionics requirement for 20 different spools of colors—10 solid colors, nine striped colors and a spool of shielded coax cable.

Second, the rack had a notable lack of stability. In aircraft terms, the c.g. was too high. It didn't take much of a pull on a wire to topple the thing over. You have no idea the fun of unraveling a hangar floor full of a half dozen white wires that all look alike. Besides, it plays hob with the nice, neat hangar floor paint when a few dozen pounds of wire come crashing down. Being tall also meant that it didn't fit nicely under any of the workbenches; it required its own personal real estate inside the hangar, which generally comes at a premium.

Third was a nasty tendency of the PVC to stripe the wire itself. That is, I didn't grommet both sides of the PVC guide pipe, so when the wire was pulled, the sharp edges of the PVC hole would strip the color coat from the wire. You wound up with color/white striped wire regardless of whether you wanted that particular feature.

Fourth, pulling on one wire caused the reel to rotate, which caused the adjacent reel to rotate, making somewhat of a mess of loose wire from the adjacent reel.

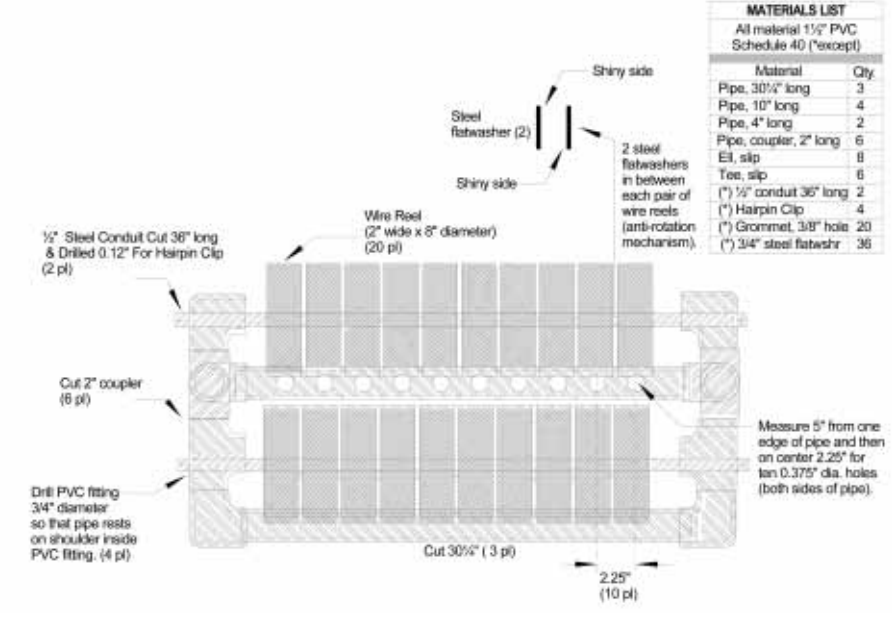
Finally, the bearing (a PVC tee) on the wire pipe allowed the pipe to chatter when the wire was spooled a little energetically. In engine terms, we had ourselves a spun bearing.

The Solutions

The basic concept was still valid. It just took a bit of refinement to work out all the undesirable features. (Hey, go look at your airplane. See that big *EXPERIMENTAL* sign on it? That's why we do the MK-I—the MK-II allows us the freedom to find out what doesn't work and to then correct it.) Here's what we did to correct the noted problems:

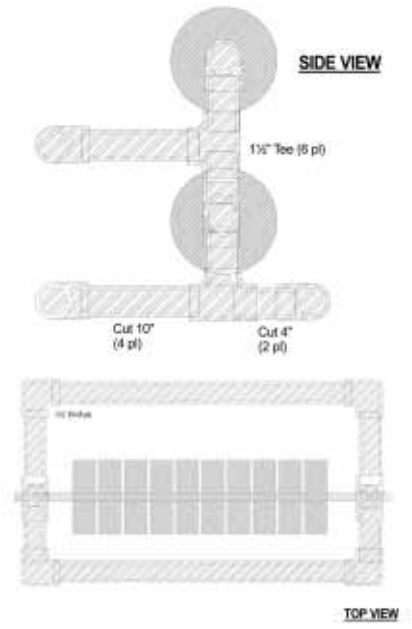
•It is now a double wire pipe and made wider to accommodate 20 standard 2-inch-wide spools of wire. The spool diameter was chosen to allow standard 1000-foot spools to be stacked one above the other with a center hole on the spool just a bit larger than a pipe made of ½-inch galvanized steel conduit.

•The wire is now much lower to the ground with much less of a moment arm to cause topple-over to be the predominant failure mode. The frame is now a complete box on the ground with much more stability than the short leg braces of the original, and the width is kept well below the standard 48 inches of most workbench braces.



A front view engineering drawing of the $5 wire rack that the author redesigned. Note the double wire pipe that was widened to accommodate 20 stainless 2-inch-wide spools of wire.

ILLUSTRATIONS: JIM WEIR



A top and side view of the wire rack.

A blast from the past—the author (with a little bit more brown in his hair) loads the wire onto the original rack that he built in 1997.

•We also offset the wire, putting the weight of the wire much further aft to help further prevent front-topple effect. One unforeseen benefit of moving the wire further aft is a tendency of the wire not to get kicked under the workbench. It is nearly impossible to hit or kick the wire with the front guide pipe being so far forward. I guess Shaq could do it…but he's not building an airplane.

•We grommeted both front and back guide holes in the front guide pipe, and this time we chose grommets that are much larger than the wire size. We also chose grommets that are widely available in the common *Keystone* and *HH Smith* from the usual mail order sources (Mouser, Digi-Key, etc.) as well as generic brand grommets you can buy at Radio Shack or Home Depot.

•Using two steel flatwashers with the shiny (smooth) sides of the washers face to face reduced the tendency of one spool to rotate adjacent spools to nearly zero.

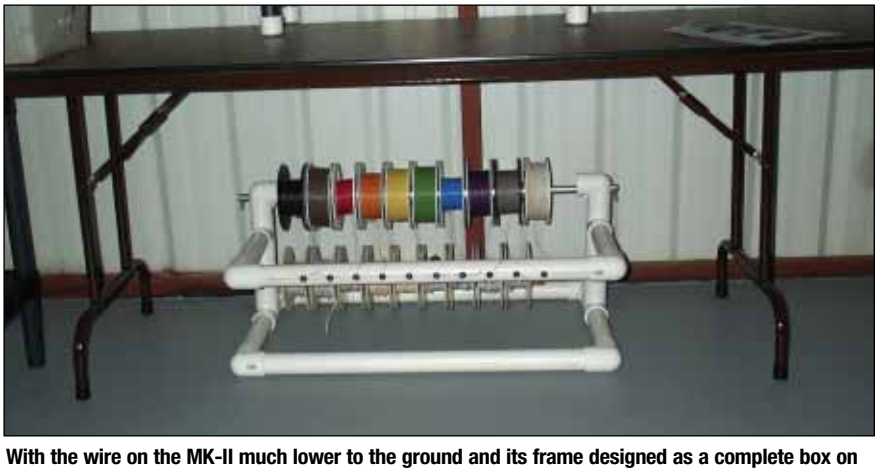
•Instead of just laying the wire pipes in a PVC tee, we drilled a ¾-inch hole in the PVC itself to act as a bearing surface. There is about 5‰ clearance to a regular old piece of cheap ½-inch conduit, and this makes a superior bearing. Not only that, but we offset the hole in the fitting so that the pipe not only is bearing on the hole but on the shoulder inside the fittings. It's as smooth as glass now.

That's it for the redesigned $5 wire rack, but there's still one thing I need to fix. The lady is still the prettiest lady in the world, but the problem is the lack of brown in my hair. Suggestions? *Sigh.*

Seven years later, the author poses with his new and improved wire rack. Same dog, summer haircut.

Jim Weir is the chief avioniker at RST Engineering. He answers avionics questions in the Internet newsgroup rec.aviation.homebuilt.

Check out his web site at www.rst-engr.com/kitplanes for previous articles and supplements.



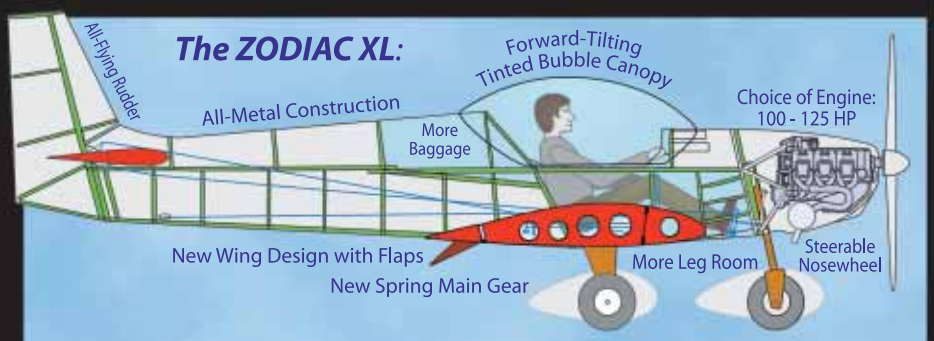
With the wire on the MK-II much lower to the ground and its frame designed as a complete box on the ground, the new wire rack can be neatly stored under a workbench in your shop.

BY ROBRUCHA


GOVERNMENT SURPLUS HAS LOTS OF NEAT STUFF!
I'M GOING TO ORDER THIS 'FOLDING AEROSPACE VEHICLE
NASA MRVR
WOW! COOL!
THE WORKMANSHIP IS VERY GOOD. IT ALL FITS PERFECTLY!
HEY BOB! IT'S ALL TOGETHER BUT I HAVE A BIT OF A PROBLEM! CAN YOU COME OVER?
THERE MUST BE ANOTHER BOX TO IT. THE SEAT AND ENGINE ARE MISSING!
ROBRUCHA

ZODIAC XL

SPORT PILOT READY*



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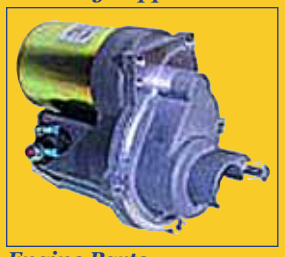

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