April 2014
Volume XLV
Number 4

The consumer resource for pilots and aircraft owners

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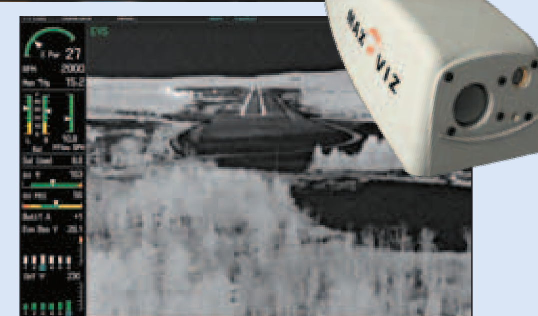

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EDITOR
Larry Anglisano

SENIOR EDITOR
Rick Durden

EDITORIAL DIRECTOR
Paul Bertorelli

CONTRIBUTING EDITOR
Jonathan Doolittle

SUBSCRIPTION DEPARTMENT
P.O. Box 8535
Big Sandy, TX 75755-8535
800-829-9081
www.aviationconsumer.com/cs

FOR CANADA
Subscription Services
Box 7820 STN Main
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AVIATION CONSUMER (ISSN #0147-9911) is published monthly by Belvoir Aviation Group LLC, an affiliate of Belvoir Media Group, 800 Connecticut Avenue, Norwalk, CT 06854-1631. Robert Englander, Chairman and CEO; Timothy H. Cole, Executive Vice President, Editorial Director; Philip L. Penny, Chief Operating Officer; Greg King, Executive Vice President, Marketing Director; Ron Goldberg, Chief Financial Officer; Tom Canfield, Vice President, Circulation.

Periodicals postage paid at Norwalk, CT, and at additional mailing offices. Revenue Canada GST Account #128044658. Subscriptions: $84 annually; single copies, $10.00. Bulk rate subscriptions for organizations are available. Copyright © 2014 Belvoir Aviation Group LLC. All rights reserved. Reproduction in whole or in part is prohibited. Printed in the USA.

Postmaster: Send address corrections to AVIATION CONSUMER, P.O. Box 8535, Big Sandy, TX 75755-8535. In Canada, P.O. Box 39 Norwich, ON NOJ1PO, Canada. Publishing Agreement Number #40016479

SIGNS OF AFFORDABILITY

That's precisely what I was looking for as I walked the static displays at the 2014 U.S. Sport Aviation Expo in Sebring, Florida. The January event is a growing venue that unofficially kicks off a fresh flying season. I look forward to the show because I use it to gauge the health of the LSA market and to sample the mood of buyers in the lower end of the market. The Sun 'n Fun international fly-in, which follows in early April, is more revealing.

Organizers said the 2014 LSA show was the most successful in its 10-year history, but that doesn't necessarily mean vendors were selling lots of airplanes. The ones I talked with said the quality of the visitors was better than in previous years. In show talk, that means fewer tire-kickers and more qualified buyers. Thierry Zibi from Sam Aircraft told me that most of the potential buyers he spoke with were knowledgeable about the LSA market and came to Sebring ready to buy. Other vendors reported a similar trend, but not many orders.

I hung around the Flight Design, Van's Aircraft and American Legend tents and talked to a bunch of buyers that, although weren't quite sure what they wanted to buy, were ready to buy something, as long as it was affordable to own. That's what brought them to the LSA market after deciding that most new or existing Part 23 aircraft wouldn't fit the budget. These were experienced pilots who had previously owned higher-end aircraft, had current medical certificates and expected to pass future FAA medical exams.

"I looked at the used Cirrus market and couldn't justify the cost of operating and maintaining one of those airplanes. The Van's RV-12 is more appealing given its purchase price, economical fuel burn and perceived ease of maintenance," one buyer told me following a demo flight in the RV-12.

While I saw signs of affordability and design improvements in the maturing LSA market, the overall mood toward the rising costs in the certificated market was grim. I left Sebring more skeptical of seeing lower prices in consumables and certified avionics. Then I talked with George Pariza, the director of product marketing at Aspen Avionics.

As we report in the Aspen VFR glass article on page 8, Aspen just introduced a retrofit glass display called the Evolution 1000VFR. It's a certified PFD that's aimed at VFR pilots, lower-end aircraft and lower budgets. Is this the start of a new trend in affordable avionics? At the least, according to Pariza, it's an answer to a market segment that's being ignored. Per Aspen's calculations, more than half of the 470,000-pilot population only flies VFR, yet avionics manufacturers continue to target the entire pilot population with high-end products. These are products with advanced, IFR-flying capability and a high-end price point.

When Aspen surveyed the market, it found that pilots unanimously agreed that avionics manufacturers are delivering products to fit the capability of the aircraft rather than the capability of the pilot. As a result, Aspen believes that a sizable percentage of the current market is asking for a new product that fits the simpler mission of a VFR pilot. Aspen knows that a VFR mission can change. While the new VFR PFD is defeatured (and priced considerably less than the Aspen Pro PFD), it can be upgraded for IFR capability. I'm interested to hear your thoughts on Aspen's read of the market.

The more I think of Aspen's affordable product introduction, the more I think about BendixKing. This was the company that several years ago vowed to address the VFR pilot with a new line of simple yet modern products that are easy to use and easier to afford. If you ask me, it looks like Aspen is answering a market that's tired of waiting. —*Larry Anglisano*

GARMIN PILOT FLAW

In the March 2014 issue of *Aviation Consumer*, you covered the latest version of Garmin's Pilot tablet app along with the new GDL39 3D attitude indicator display. While the article reported on the more modern appearance and other new features within the app, you didn't note that the colors on the trip planning and flight planning screens changed to a much darker gray from the previous lighter color. The text labels for each field are nearly impossible to read when set against the new darker screen, especially when viewed in a bright cockpit.

On two recent flights I had to take the iPad mini out of its cradle and place it in the shade between the seats and down near the trim wheel to enter an ATC amendment to my flight plan. I never had this problem with the previous version, and since these two screens cannot be resized, we have to work with what we've got.

Also gone from the new version is the ability to adjust the brightness of the screen from within the application. For a company that prides itself on ease of use and functionality, this is a major blunder.

Michael Gordon
Ft. Lauderdale, Florida

Garmin's Jessica Koss replies: "Thank you for bringing this to our attention. It is our desire to develop an application that provides easy access to pertinent information to pilots, which enhances their flying experience. We plan to readdress the darker text issue reported ASAP.

Regarding the ability to adjust brightness within Garmin Pilot, in iOS 7 Apple launched a Control Center that is available by swiping up on the device. The Control Center includes Brightness, Settings, Calculator and other additional controls. Garmin Pilot takes advantage of this new feature in iOS 7 and allows customers to adjust screen brightness from the main Control Center."

BENDIX KING MYWINGMAN

A while back, you guys reported on the Bendix King myWingMan tablet app. Now that I'm back in the air, I want to try myWingMan on my iPad. I can't seem to find it in the Apple store. Where can I get it?

Jesse Merchant
via email

You can't get it. According to Bendix King's Paul Hathaway: "After much reflection on the myWingMan product we did not feel that it fully represents the value and quality that Bendix King provides to pilots worldwide on a daily basis. As such we have done the right thing and have removed it from the App store and are in the process of issuing full refunds to all paying subscribers. We are proactively contacting them.

This is a difficult decision for us, but also one that allows Bendix King to focus on providing a better EFB product at a future date. Truth be told, there are some very interesting product announcements coming up and we need a different long-term EFB strategy to complement them."

VAN'S RV12 LSA

Kudos to Larry Anglisano for a thorough flight review of the Van's RV-12 in your March issue. I have to ask, is it really that easy to remove and re-install the wings and put the aircraft on a trailer? Seems like a hassle to me. You should have covered it.

Richard Vanguard
via email

We didn't try it, but Van's told us the wing removal and reinstallation process is accomplished in a few minutes. Loading it onto a trailer might not be so easy.

GRUMMAN CHIGGER?

I just finished reading your used aircraft coverage of the Grumman Tiger. I have owned a couple of Tigers, including the one I own now, which is actually a Cheetah that was Tiger-ized (including the spar) a number of years ago by Fletcher Aviation. I call the airplane a Chigger.

Your article was pretty much right on except for the AD note you mentioned on the hollow crankshaft. The Tiger uses a Lycoming O-360-A4K, which has a solid crankshaft, thus this AD does not apply to any stock Tiger. That's the reason the MT electric prop is the only way we can have a CS prop on a stock Tiger.

Claude Allen
Green Cove Springs, Florida

WHICH AIR FILTER?

How about an objective article comparing the Bracket, Donaldson and Challenger air filters? There's often argument about conflicting claims and benefits.

Mike Skrez
via email

We're actually collecting samples now, so stand by for a review.

CORRECTION

The unleaded fuel sidebar, "Aromatics in Aviation Fuel", in our February issue has an error that refers to benzene as having a composition of C_6H_{12}. Contributor Paul Millner notes the correct empirical formula for benzene is C_6H_6.

CONTACT US

Editorial Office
860-614-1987
E-mail: consumereditor@hotmail.com

Subscription Department
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Small-Engine Overhauls: Affordable, Supportable

Engines that haven't been made for 50 years or more are still remarkably overhaulable, if not necessarily cheap. Continental's A-65 is a favorite.

by Paul Bertorelli

The words "cheap" and "overhaul" aren't known to appear in the same sentence, but it's true that smaller, modest engines are cheaper to overhaul than high-horsepower sixes. But what about *old* and modest, specifically Continental's numerous A-65 series and its offshoots? Are these the gateway to affordable flying or just doddering antiques getting ever more expensive to maintain?

The question is more than academic as many buyers turn to legacy airplanes that qualify for light sport status. They're looking both for flight privileges without fear of medical loss and for affordable ownership, which means an engine that won't decimate the bank account if it crumps a cylinder or eats a valve. The news is mixed. Smaller engines like the A-65, A-75 and A-80 series and the C-series offshoots aren't exactly cheap to overhaul, but despite their advanced age, they remain eminently supportable. Even the utterly orphaned Franklin engines remain viable.

Top photo, author checks freshly overhauled A-75 for oil leaks.

LEGACY LSA

At least seven standard-category or legacy aircraft types qualify for LSA status. With the exception of Piper's classic J-3, many of these are cheap to buy and maintain, although some parts may not necessarily be off-the-shelf available. These older models sport a range of engines, but if there's anything like a common powerplant, it's Continental's four-cylinder A-65. This engine is found in Cubs, Aeroncas, Luscombes, the Taylorcraft BC series and in the Interstate Cadet. The Ercoupe has the A-75 and some of the popular legacy airplanes have been re-engined with more powerful powerplants from the C-series, the C-85 and C-90. However, if LSA is your wont, know that not all models of the same aircraft qualify for light sport with the larger engines, with Cubs and Luscombes as the standouts.

Steve Krog, who runs the Cub Club support organization for Cubs, says that when the J-3 first entered production in 1937, three engine choices were available: a Continental, a Lycoming or a Franklin. "Whatever engine was sitting there when it came down the line, that's what it got," Krog told us. Lycoming stopped supporting the O-145 and the Continental A-65 eventually became the most common engine, although about 100 still fly with the Franklin 4AC. The J-3's type certificate (or STCs) allows engines from the 40-HP A-40 to the Continental O-200.

LOTS OF 65s

Even though the A-65 engine dates to 1939 and has been out of production for some 60 years, it's not exactly a relic. Don Swords, who operates Don's Dream Machines, which specializes in small-displacement Continental overhauls, estimates the number of A-65s still active to be in the tens of thousands. He doesn't lack for overhaul demand. One reason for that may be that even though the engine is eminently supportable, not many shops will agree to overhaul it.

"We've done a couple, but I actually say we don't do them because of the lack of ability to get the carburetor overhauled correctly," says Charlie Mellot of Zephyr Engines in Zephyrhills, Florida. Zephyr's response to our query was typical of other

CHECKLIST

Small-displacement Continentals are numerous and cheap to operate.

Engine parts are widely available with few overhaul show stoppers.

Cheap is relative. Some of the C-series Contis may rival Lycoming O-320 overhaul costs.

shops we contacted. They refer the A-65 overhaul business elsewhere. Cub Club's Krog has a couple of referral recommendations, including Don's Dream Machines in Griffin, Georgia (www.donsdreammachines.com) and Poplar Grove Airmotive (www.poplargroveairmotive.com) in Poplar Grove, Illinois. For cylinder and A-65-related machine work, Krog recommends Harrison Engine Service in LaPorte, Indiana. (See www.harrisonengine.com.) Given its simplicity, the A-65 and its variants—including the C series—are easily repairable by any competent maintenance shop, but overhauls will likely have to be shipped elsewhere. When our partnership J-3C Cub tanked its A-65 last fall, we trucked it to Don's Dream Machines for an overhaul. With only 500 hours on the A-65, one cylinder was flat and one connecting rod was loose on its crank journal.

LIMITED OPTIONS

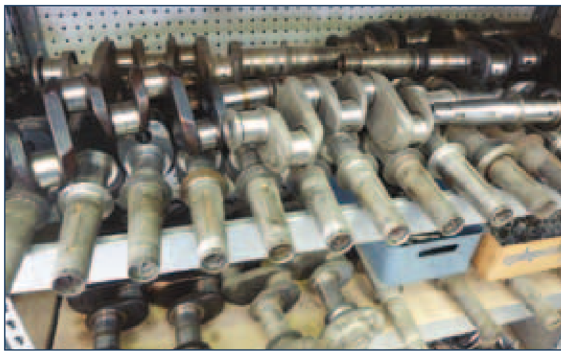
Compared to higher-horsepower engines, there's not much to an A-65 and thus not many menu options during overhaul. Swords said the basic overhaul price is $9500, which includes no accessories, just the basic engine.

It assumes the crankshaft and cam are within service limits and the cylinders and cam followers are as well. Swords says his overhaul includes overhauled cylinders, but additional charges for a rebuilt carburetor, new or overhauled magnetos and harnesses. When dealing with Don's or any engine shop, we recommend a written quote. Not all shops include everything in the basic quote.

One option Don's offers is an extra 10 HP, upgrading the engine to 75 HP. This requires different pistons, rods and pins to support the higher RPM, but the shop doesn't charge for that. To generate the higher RPM, you'll need a new prop, which we ordered from Sensenich through Don's at the shop's cost of $1975.

Despite its advanced age, parts for the A-65 are widely and readily available. Swords told us the overhaul pool is so healthy that he rarely resorts to using new cylinders. But they are available from Superior Air Parts—or will be later this year. The last price we could obtain was $5230 for the complete set of four, so new jugs will be a significant upcharge.

At Don's Dream Machines, top, Jeff Swords assembles an A-65. No new cranks are available, but Don's has plenty of servicible cores, right and lower.



Overhauled cylinders are sent out for some types of work, but Swords does the basics in house. For an engine that will see service in corrosive environments, he also offers Nu-Chrome as an option.

"The only thing we really have problems with is sometimes the cam just won't make it, or the crank won't. But these aren't typical things," Swords told us. Cam follower bodies can also be a problem that adds to the bottom line, if the existing parts can't be reground. There aren't any new cams in the parts pipeline, but there are plenty of used serviceable cams in the pool. In some cases, worn cams can be plated and reground to new or service limits.

Given the play we discovered in the number 2 connecting rod, we weren't too surprised to hear that our crankshaft was trashed, resulting in a $1000 upcharge for a replacement core. We also bought two cylinder cores to be overhauled to service limits for the engine. As with cams, no new cranks are available, but Swords said there are plenty of these on the market, too.

As for mags, Don's overhaul cost does not include new or overhauled mags, as some overhauls do. Don's will clean and inspect mags and harnesses, but shys away from recommending overhauls. "By the time you pay for an overhaul, the price is pretty close to a new mag," Swords says, "so we recommend Champion/Slicks as a replacement." That adds another $3200, so worst case, with new cylinders, a crank upcharge and a set of cam followers, the invoice can total around $18,000 to $20,000. That's actually more than some shops charge for a Lycoming O-320 overhaul.

If the point of the exercise is an economical overhaul and given the way A-65 engines are likely to be operated, opting for new cylinders doesn't strike us as a good-value option unless it's unavoidable. Judging by our discussions with Don's and other shops, overhauled cylinders will remain an option for the foreseeable future.

OTHER CHOICES

For owners looking for more performance and willing to spend the money, some aircraft will support

FRANKLIN: STILL KICKING

Prior to World War II, there were three major light aircraft engine makers, not just two, and Franklin was one of them. Franklin engines had—and still have—a reputation for unusual smoothness and they were used in a number of fixed-wing aircraft and helicopters, including the Bell 47 and the H-13 military variant. The company, although under a different name, Aircooled Motors, survived into the 1970s before being sold to a Brazilian company, then later to the PZL Group in Poland. It still exists under the Franklin name, although it appears to have little market activity.

Nonetheless, Franklin engines are still apparently well supported by Susan Prall's Franklin Engine Co. in Jewett, Texas and by an overhaul shop, Southern Aero in Thomasville, North Carolina. Prall told us that thanks to military contracts, Franklin manufactured significant surpluses of parts and because part interchangeability is high between engine models, there's little problem in supplying any part for a Franklin engine, including cylinders.

"Normally, we overhaul cylinders, but we are working on a line of new cylinders," she told us. She's also building such parts as pistons, bearings and cylinder sleeves. Prall estimates 3000 to 6000 Franklin engines are still in service, with Stinson and Bellanca representing a major part of the market. (Those engines were built by Aircooled Motors.)

Some parts are periodically unavailable, but Prall says she's working on PMA sources for those. She says the Polish-owned Franklin owns the type certificates, but has been unresponsive to requests for parts and new engines.

At Southern Aero, Robert Still says the company is still supporting all of the engines, even the beyond-rare Tucker car engine, which Aircooled also manufactured. "Right now, we haven't had to turn anybody down as far as having to support them and we've been actively seeking manufacturers of parts, even crankshafts and camshafts. The only hurdle we're dealing with is the FAA giving the parts approval," Still told us.

Still thinks the Franklin population might be as large as 8000 airframes, not counting STC'd airplanes of various kinds that have Franklin engines. "They're out there and they seem to keep coming out of the woodwork," Stills says.

Overhaul prices for the four-cylinder 4AC found in the J-3 hover around $10,000, while six-cylinder Franklins vary between $13,000 and $18,000, depending on the model. That makes the four-cylinder Franklins comparable in overhaul price to the Continental A-65, but the six-cylinder models may be cheaper than equivalent Lycoming and Continental sixes. Southern Aero has also partnered with a company called Franklin Aerospace, which bought up the parts stock when PZL moved the factory to Poland.

In our view, support for Franklin engines appears strong enough not to worry about buying an airplane equipped with one. For more, contact Susan Prall at www.franklinparts.com or 903-626-5120. Southern Aero is at www.southern-aero.com and 336-476-9094.

upgrading the A-65 to the higher-horsepower C-series Continentals, to the point of the 100-HP O-200 found in Cessna 150s, at least for the J-3C.

Cub Club's Krog points out that the J-3C type certificate, for instance, allows installation of all the A-series engines, plus the C-85 and C-90, with the latter being a popular mod to later model Cubs that makes them respectable floatplanes. These are generally bolt-up conversions that don't require a specific STC, although some detailing will need paperwork.

"They'll require some exhaust modification and cowl trimming. The dash-12 C-85 has the starter and alternator or generator, so you have to lower the exhaust system to accommodate that," says Swords.

Because aging Baby Boomers may represent a growing market for these older classics, one mod that's proved popular recently is—gasp—electric starters.

"What a lot of guys are doing in the last couple of years, if they can find the C-85 dash-12, they're installing a new lightweight starter with a battery. We've sent out copies of 337s we have on file to probably two dozen people," Krog says. But he cautions owners making these mods to avoid installing a generator, which kicks the airplane up to the next higher level of required basic equipment, including lights. Plus, it kind of misses the point of owning an old classic. Rather than charging via onboard generator, the battery can simply be trickle- or tender-charged for the next use, but one charge will power a couple of weeks' worth of starts, Krog told us.

Pricewise, a C-85 or C-90 conversion is more expensive than a basic A-65 overhaul, even if overhauling the C-85 will cost a little more when that comes due. Don's can provide a C-85 or C-90 conversion with an accessory case for a starter for about $16,900, sans accessories. Complete, such a set-up would cost about $20,000.

CONCLUSION

Continental A-65 and small engine overhauls in general are among the cheapest, if not the cheapest, available. We think any owner planning purchase of such an aircraft should budget about $15,000 at the outside for a potential overhaul.

More important, there seems to be no indication that these engines, either the A-series or the C-series, are approaching their sell-by date.

Concludes Zephyr's Charlie Mellot, "There will be a hiccup or two along the road, like the cam thing on the C-85, but I think they're going to see our lifetime out and then another generation. When overhauls went through $5000 and that was half the value of the airplane, we thought it was all over. And here we are at $20,000 for these engines and they're still out there."

Aspen's Evolution VFR: Scaled Down, Lower Cost

Aspen caters to the VFR crowd with a scaled-back Evolution PFD. There's a substantial savings if you can live without glideslope.

by Larry Anglisano

Aspen Avionics said its market survey showed that many VFR pilots would purchase primary flight displays, but can't justify the high cost of the upgrade. How high? In some cases, a single-screen PFD retrofit can cost $15,000 and higher.

That's one reason why the VFR-only LSA market is appealing. Many LSAs come with full-featured non-certified PFD models from Dynon, Advanced Flight Systems and even Garmin, to name a few.

But in lower-end certified aircraft, some owners are stuck with steam gauges because high-end, high-priced PFD products like the Garmin G500 and Aspen's own Evolution are geared toward IFR aircraft and pilots with IFR missions.

That leaves a void in the lower end of the market and VFR pilots with few upgrade options, other than paying a premium for equipment that's overequipped for the mission or for the aircraft.

Aspen hopes to fill that void with the new Evolution VFR flight display. With a starting price of $5000, it has many of the same primary features of the popular Evolution Pro PFD, but not the advanced features you'll need for IFR flying. Let's see if the economics make sense.

MODEL LINE

Still not familiar with Aspen's Evolution PFD? Here's a quick review. The Evolution has every primary six-pack flight instrument built into a single display, including airspeed and altimeter in a tape format. The electrically driven instrument has an integral air data computer that plugs into the aircraft's pitot and static system, plus a self-contained attitude heading reference system (AHRS). Heading data comes from a remote magnetometer that's equipped with a temperature sensor and GPS receiver. There's also an integral standby battery that powers the display for up to 30 minutes.

Aspen's PFD is a single 760x400 32,768-color LCD screen design that measures six inches. The bezel width is such that it fits dead center in the middle of the six-pack, sliding through the existing three-inch instrument cutouts and secures to a rectangular, surface-mounted bracket. This often requires little if any panel modification or cutting.

The Evolution, which was previously available in two price points—the $6180 entry-level Pilot and the flagship $10,187 Pro—is a primary instrument, but still requires backup flight instruments, including airspeed and altimeter. We first covered the Aspen PFD in the June 2008 issue of *Aviation Consumer*. Since its introduction in 2008, the platform has improved, its features have advanced and Aspen has shipped over 6500 systems. To say that the Evolution has been an avionics success story is an understatement.

At first blush, the new Evolution VFR might appear to be similar to the lower-end Evolution Pilot, but it differs in many respects. The Pilot, while also targeted at VFR missions, has no autopilot interface, no navigational radio interface and won't support any of Aspen's Evolution Hazard Awareness add-on software, including ESV synthetic vision, ADS-B or traffic advisory functions. Compared to the IFR Pro model, the Pilot is stark, with essentially no path for upgrade. According to Aspen, the Pilot will remain in the product line for now.

INTERFACE

A major part of the Evolution interface is the ACU, the analog converter unit. This is a remote converter box that inputs a variety of analog signals (including autopilot and navigational sources) and then outputs the data

The new Evolution VFR, left, shares the same hardware and bezel controls as the flagship Pro model, but there's no electronic HSI (EHSI) or secondary nav source bearing pointers.

The $4995 Evolution VFR, left and the $10,187 Evolution Pro, right, both have the same air data computer and AHRS. Navigation data you won't see on the VFR attitude display is a vertical deviation indicator (VDI) and lateral deviation indicator (LDI) for flying ILS/ARNAV approaches, a selectable altitude minimums field, or a decision height annunciator. The VFR model doesn't have audio outputs for minimums and altitude level-off and won't display radar altimeter data. The Evolution VFR does have pilot-selectable V-speed markings—it's just not selected in the photo. The magenta inverted "V" on the Pro is a flight director.

Autopilot interfacing requires the optional analog converter unit, right. It's an additional $1000, plus additional wiring and installation costs. The required remote sensor module (RSM), bottom, is standard.

to the display in a digital format.

The ACU doesn't come standard with the Evolution VFR. Instead, it's a $1000 add-on and it requires additional interface wiring. Without it, most autopilots won't have heading and navigational tracking capability. With it, most can gain integral GPSS digital steering that's commanded from a dedicated soft key on the display. There's also heading command.

The ACU is required to display analog CDI information from a traditional navigation radio, including the popular King KX155. The VFR model has no HSI—just an onscreen CDI. If you have a Garmin GNS430 or even a standalone GPS navigator that outputs nav data in a digital format, you won't need the optional ACU. These digital receivers output directly to the Evolution display. But there's a sizable limitation.

Garmin's GNS430 and popular versions of the KX155 radio also have glideslope and localizer receivers—a function that won't play on the VFR Aspen—ACU, or not.

Like all of the other Evolution models, the VFR requires (and includes) a magnetometer or heading sensor (RSM). This can be installed on the outside or inside of the fuselage and is a major part of the install. Since the RSM contains an internal GPS receiver for redundant backup, plus a temperature sensor for air data calculations, it's best to install it on the outside. For composite aircraft, this will require additional approvals because it's not included in the STC.

INCREMENTAL UPGRADE

According to Aspen's George Pariza, that's one benefit of buying into the Evolution VFR because it makes upgrade costs more palatable.

"This is an upgradable product with a line of options. If you are a freshly minted VFR pilot with an entry-level aircraft and want to get started with a PFD, the Evolution VFR is a cost-effective way to get one. If you decide to train for instrument flying, there's an upgrade path that brings the Evolution VFR to an IFR Evolution Pro," says Pariza.

That upgrade path to a full-featured Pro is $4690 in addition to the $1000 ACU that might be required,

INSTALLATION: WHAT'S THE BOTTOM LINE?

The chart below shows approximate installed pricing for each Evolution model and the major functions that come standard. The panel work that's required for mounting the display is identical for each model (there's a flush-mount kit that requires cutting). All models will require a backup attitude indicator, airspeed indicator and an altimeter. Keep in mind that install costs will vary, especially if the project includes interfacing with an autopilot and when working with composite structures. There could also be certification costs if the aircraft isn't on Aspen's STC.

MODEL	PRICE	INSTALLED PRICE	WHAT YOU GET	WHAT YOU DON'T GET
EVOLUTION PILOT	$6180	$7500	Onscreen GPS waypoints, six-pack flight instruments, air/data computations with OAT, TAS and wind data.	Navigation interface, autopilot interface, synthetic vision, traffic overlay, weather overlay. No upgrade path to VFR or Pro model.
EVOLUTION VFR	*$4995	$8000	CDI for nav and GPS interface, autopilot interface (requires ACU), traffic/WX/ADS-B compatibility, upgradeable to Pro model.	Synthetic vision, EHSI, glideslope/localizer interface, warning tones, minimum altitude alerts, ADF interface, radar altimeter interface.
EVOLUTION PRO	$10,187	$14,500	All functions of Pilot and VFR models, EHSI, ILS and GPS glideslope display, warning tones, minimum altitude alerts.	Synthetic vision (optional), EA100 A/P gyro emulator (optional), traffic/WX/ADS-B interface (optional).

Autopilot interface requires $1000 ACU. VFR TO PRO software upgrade $4690. Traffic/weather enablement $795.

depending on the interfaced equipment. We think it's wise to purchase the VFR with the ACU option if there's any chance you'll step up to the Pro. This avoids a second teardown and installation when you upgrade to the Pro later on (the VFR to Pro upgrade is accomplished by loading the Pro-specific software into the display).

While on the topic of upgrading, it's worth a look at other Evolution capabilities and pricing, should you anticipate a Pro upgrade. The ESV synthetic vision software is $2995 and now comes as a free trial on all new Pro models. Software for overlaying traffic and weather is $795.

The ACU2, which is an upgraded converter that interfaces select radar altimeters and ADF receivers is $2280. The EA100—a digital autopilot gyro emulator that replaces mechanical autopilot gyros—is $2495. These major options bump the price of an Evolution Pro to $18,752, not including installation. Garmin's G500—the only other competing certified PFD—is just shy of $24,000, without installation. Garmin's noncertified G3X PFD is $4550.

PLAN YOUR MISSION

That's what you'll need to do before committing to the Evolution VFR, while accepting some potential tradeoffs. While we think the system has a price point that can appeal to pilots with simpler missions, we think it limits some VFR operations since it doesn't have glideslope capability.

You don't need to fly in IMC to make use of a glideslope navaid. Referencing a glideslope during visual approaches at night, for example, adds another layer of situational awareness that will be missing on the VFR PFD. If that's a concern, especially if the aircraft is already equipped with a glideslope radio, it's possible that the installing shop can retain the existing CDI for use as the secondary system. Perhaps not the cleanest interface, it offers some redundancy, if there's panel space.

On the plus side, the VFR PFD is better than no PFD and might add to the aircraft's resale value or at the least, make it more desirable on the used market. It can play traffic and weather graphics, plus its easy upgrade path is also a plus, as long as you install the ACU first.

Last, we think the Evolution VFR can be appealing to buyers that want to spread the purchase out over time. The potential $6000 upfront savings, on average, helps take some of the sting out of budget-blowing avionics upgrades.

Contact www.aspenavionics.com, 888-992-7736.

CHECKLIST

Evolution VFR is half the price of the flagship Pro PFD.

A software upgrade can step the VFR up to an IFR Pro model.

The lack of glideslope capability is limiting, even for VFR operations.

AIRCRAFT FLIGHT TRIAL

Xtreme Decathlon: Formidable Yet Refined

Hanging 210 HP on the Decathlon and increasing the roll rate by 30 percent cranked up performance without hurting its superb manners on the ground.

by Rick Durden

Sometimes you just want to throttle the marketing types. Hanging the purposely edgy "Xtreme" name on the new Decathlon brings to mind a machine with handling that you're lucky to survive and of no practical use outside of aerobatics.

It doesn't accurately describe the new Decathlon's remarkable combination of superior aerobatic capability, excellent air and ground handling and good cross-country capability that put it head and shoulders above all previous iterations.

HISTORY

This year marks the 50th anniversary of the original Citabria, which was, more or less, an Aeronca Champ toughened up for aerobatics. It eventually became the standard of reference for good ground handling for tailwheel airplanes. The 150-HP, inverted fuel system version—7KCAB—became known as a very good basic aerobatic trainer.

The constant itch for just a little more caused the 1972 birth of the Decathlon, known as the 8KCAB—effectively a 7KCAB with a shorter, symmetrical wing and the ability to take much higher loading: +6 and -5 G. It proved to be an even better aerobatic trainer as it did both inside and outside maneuvers reasonably well.

As with the Citabria, its ailerons were heavy. For those wanting to do vertical maneuvers, the draggy airframe and 150 HP meant that a good pilot could get a half roll going up before the airspeed went away and a hammerhead turn was needed. Useful load wasn't particularly good—with two people and chutes only about half fuel could be carried.

In 1976 the 180-HP Super Decathlon went into production. The 30-HP bump nicely increased the rate of climb and gave the airplane a little more vertical ability, allowing about ¾ of a roll on an up line, according to American Champion test pilot Jody Bradt. To improve roll control, spades—they look like little shovels—were hung under the ailerons. They worked, although more than a few pilots have cut their foreheads open on one during preflight. With the heavier engine, the useful load of the Super Decathlon proved poor—as trainers, the airplanes are often flown at or above gross weight.

CHECKLIST

An aggressive weight-saving program paid off in useful load.

New ailerons improve roll rate and reduce forces dramatically.

Power for serious akro; handling and comfort allow all-around use.

DEVELOPMENT

When American Champion was putting the final touches on its new version of the Scout—the Denali—with its new 210-HP, four-cylinder IO-390 engine, Lycoming passed the word that it was willing to make a version of the engine with inverted fuel and oil systems, the AEIO-390-A1B6.

The larger engine would add 39 pounds to the airframe of the Super Decathlon—effectively making it a single-place airplane. According to Jerry Mehlhaff, Jr., American Champion's VP of Engineering, what was to become the Xtreme Decathlon went on a weight loss program that resulted in a 50-pound weight saving, before the engine change—an overall improvement of 11 pounds.

The changes included clipped wing tips, cutting a little more than foot off the span—four pounds; tapered aluminum gear legs—two pounds, even though they are two inches longer to meet the clearance requirement for the larger prop; redesigned ailerons—14 pounds; eliminating carpet—four pounds; and composite floorboards—eight pounds.

The aileron change was purely to save weight. The cross-section redesign was subcontracted to Kevin Kimball of Jim Kimball Enterprises, who reshaped the nose, moved the hinge line and made the ailerons fatter—the nose of each now bulges above and below the wing, similar to the design used by Aviat, Extra and on the Pitts Model 12. According to

A new cowling was designed to hold the 210-HP Lycoming, right. Redesigned, longer gear saved two pounds and allowed clearance for the wide-chord MT prop, lower right.

Mehlhaff, a happy, unexpected result was an increase in roll rate from 90 to 120 degrees per second.

A NEW PANEL

The airplane we flew had a Garmin 795 with GDL 39 ADS-B receiver and an EDM 930 engine monitor. We were very surprised to find no inclinometer. The fuel quantity indicating system proved to be horribly inaccurate. Prior to our flight, a dipstick check of the left fuel tank showed seven gallons—the EDM indicated zero gallons in that tank. After we added three gallons, the EDM indication was nine gallons.

During flight, the fuel quantity indications varied dramatically. We later learned that American Champion agreed to rework the system on the airplane and install the direct-indicating float gauges in wingroots that have been the hallmark of Citabrias and Decathlons for years. They will be also be standard for the 2014 Xtremes.

WEIGHT

We applaud that American Champion publishes loading for the Xtreme in both the Aerobatic and Normal categories. The gross weight in Normal category—no akro allowed—is 150 pounds more than in Aerobatic category, where the airplane is approved to +6 and -5 G. All aerobatic trainers we're familiar with are tight on useful load—this particular Xtreme has a 478 pounds available, and that's better than most.

The dual gross weights meant we could depart with two large adults and parachutes at a weight above the akro gross, but well within Normal category loading, shoot several landings and then fly out to the practice area. By then, we had burned fuel down to the Aerobatic gross weight and still had adequate fuel for our the rest of our flight, plus reserve.

The Normal category useful load is 628 pounds, which allows 388 pounds in the cabin with full fuel. The baggage allowance is 100 pounds.

AFM

Interestingly, there is no POH for the Xtreme—just an Approved Flight Manual (AFM). It is not in the GAMA format. It doesn't include much of the information in a POH and, surprisingly, it presents speeds in MPH rather than knots. Nevertheless, it does provide needed information clearly and explains the different limitations for the airplane in the Aerobatic and Normal categories—such as two different maneuvering speeds (Va), 135 versus 110 MPH.

It also warned about something we'd never run across previously, detuning the engine counterweight system. Detuning results in "rapid and severe damage to the counterweights, rollers and bushings culminating in engine failure." It's caused by rapid throttle movement or high RPM and low manifold pressure.

Pilots are warned not to push the prop control forward on landing until it is assured there will be no increase in RPM. We've always complained about pilots who select high RPM on downwind because of noise; now Lycoming says it causes engine damage.

When flying aerobatics, it's not unusual to blow a maneuver and wind up with the nose down and speed increasing dramatically, requiring pulling the power to idle quickly. The AFM recommends 2500 RPM, rather than the max 2700 RPM during maneuvering—which, we suspect, will help protect against detuning. We'll be interested to see how the new Lycoming holds up in this challenging environment.

Power-off stall speed is 58 MPH IAS, one MPH faster than the Super Decathlon. Published Vx is 57 MPH IAS—being below the power-off stall speed caused some raised eyebrows

SERIOUS AKRO—AT A FLYING CLUB?

We were a little surprised when we learned that the Xtreme Decathlon we were to review was not being sold to a private owner for purely personal use—it was going to be leased to a flying club. Our experience with the airplanes in the more capable end of the aerobatic spectrum is that they are jealously guarded by their owners—while it's not usual for them to be used for training, it's rare for them to be available for rental.

Generally, it makes sense as once you get into the performance range of the Xtreme Decathlon the most common trainer is a two-place Pitts Special—not known for docile manners when the wheels are touching the ground. The Xtreme doesn't quite have the performance of a Pitts S-2A, but it's not that far away, and it has the same ground handling as a Citabria—which has been on rental lines for decades. So—why not?

The Xtreme we flew is owned by Nick Slabakov and leased to the Aspen Flying Club at Centennial Airport, just south of Denver, Colorado, which has had a Citabria available to its members for more than five years. The club and its instructors are used to tailwheel checkouts and deciding who should be turned loose in an airplane where the risk of RLOC is well above its nosewheel brethren.

Slabakov told us that he had been fired up about the Xtreme Decathlon ever since he first heard of it. A member of Aspen Flying Club, he worked with club co-owner Chris Dillis, to put together a lease that would work.

Dillis said that the club had been giving aerobatic and tailwheel dual in the Citabria for years and that the Xtreme Decathlon would open up a new market for akro training. He pointed out that aerobatic schools are few and far apart and the idea of having an airplane with the capabilities of the Xtreme that someone could rent after completing training should increase club membership.

Club members pay $35 per month in dues and can rent the Citabria for $125 per hour and the Xtreme Decathlon for $189 per hour.

The club has put together a fairly extensive set of checkout requirements for the Xtreme, however, for pilots current in the Citabria they didn't look too onerous. We're glad to see an aerobatic airplane with the capability of the Xtreme Decathlon coming to a flying club. We'll be watching to see if there is enough demand to support it.

during our AFM review. However, for a short field/obstacle clearance takeoff, the manual calls for rotating at 58 MPH and letting the speed build to 70 MPH by 50 feet AGL.

We were pleased to see a clear explanation of structural limits in rolling pull ups, something that is important, but not often not addressed in manuals, and not well known to pilots. Under high Gs, adding aileron deflection can overstress one wing, even though the G meter is showing less than what is otherwise the maximum load on the airframe. The AFM allows full aileron deflection at Va up through four G. If the speed is at Va or above, and the pilot pulls any more than four G, full aileron deflection is not allowed.

PERFORMANCE

Performance numbers for the Xtreme are what one expects for a lot of engine on a little airplane—impressive. Sea-level max rate of climb at max gross of 1950 pounds is 1490 FPM. Less than 1000 feet is required to clear a 50-foot obstacle on takeoff at sea level. As the engine is rated for 210 continuous HP, American Champion publishes cruise data for power settings as high as 94 percent.

We were very pleased to see that the recommended leaning procedure for best power (ROP) was at 150 degrees F rich of peak—a far better power setting for engine longevity than the 50 degrees rich of peak that has been the norm with so many other manufacturers for so long.

Book cruise speed at 75 percent power at 9000 feet is 154 MPH (135 knots) with a fuel burn of 12.3 GPH. Pulling the power back to 65 percent drops the fuel burn to 8.3 GPH, more than four GPH, but only results in a speed reduction of 11 MPH, to 143 MPH (124 knots). The airframe is draggy, so getting just a little extra speed takes a lot of fuel. We suspect that with only 40 gallons usable and the need to launch with partial fuel when two adults are aboard, most owners won't shove the power up at cruise.

PREFLIGHT

Preflight of the Xtreme is routine, although the cowling designed for the new engine does not have any access doors, so it's necessary to use a screwdriver on the Dzus fasteners to open the halves to check the oil and drain the strainer drain.

The cabin has adequate room for a wide range of occupant sizes and shapes, although the header tank for the inverted fuel system can get bumped by a tall pilot's knee. The front seat is adjustable fore and aft. The rear seat provides more head and legroom—it's a comfortable spot for instructors. Virtually all of the controls are easy to reach, although only the front seat occupant can control the mixture and prop. The vent and heat controls are out of sight below the panel against the sidewalls.

Start up involves priming the engine with the fuel pump and the mixture full rich. Once that's complete, the mixture is pulled to idle cutoff; the throttle set the tiniest bit above idle and the left mag turned on. On each of our starts, the engine lit instantly and provided plenty of

The new ailerons are thicker than the wing, save 14 pounds and increase roll rate 33 percent, right. Panel has a Garmin 795 with GDL 39 ADS-B receiver and an EDM 930 engine monitor, below right.

time to slide the mixture forward. Once the right mag was turned on the engine smoothed out.

The higher nose attitude due to the two-inch growth in the main gear is noticeable but, to us, did not negatively affect the excellent ground visibility. Later, flying from the rear seat, it didn't make any difference—forward visibility on the ground has always been nil from the back.

Taxiing was even better than we were used to—the Xtreme tracked absolutely straight. Steering was crisp in wide-radius turns—a little brake tightened them up. We learned from American Champion that they try to match the gear legs during construction—it certainly worked on this airplane.

IN FLIGHT

Takeoff was surprising for its lack of drama. Acceleration was as we'd expect for the kind of power—fast. However, we also expected the need for a great deal of right rudder and some dancing on the pedals to remain on centerline—not so. P-factor was surprisingly low. The rudders are not twitchy—modest pressure resulted in immediate, but appropriate response. There was not the tendency to overcontrol one experiences the first few times in something like the hyper-responsive Pitts S-2A, an akro trainer of similar power.

The tail could be raised quickly without worrying about the airplane darting for the toolies. The Xtreme broke ground in short order—the wide-chord, three-blade MT prop doing a nice job of converting horsepower to thrust.

The departure runway elevation was 5800 feet. It didn't seem to matter—we were in the air right at the 750-foot book distance and were looking at a 1200 FPM rate of climb almost immediately. The aircraft POH calls for 1073 FPM, but we were closer to Aerobatic max gross of 1800 pounds than to Normal gross. weight.

Power is destabilizing to an airplane—something that presents a challenge in hanging larger engines on airframes. American Champion test pilot Jody Bradt told us that there was some degradation in yaw stability, but not enough to cause concern. He pointed out that there is the constant tension between stability and responsiveness in aerobatic airplanes. We could not detect any stability issues in climb, cruise or descent. The need for rudder in climb was surprisingly low. It was easy to trim the airplane in cruise at all of the power settings we tried.

SPEED AND POWER

In cruise we observed a TAS of 154 MPH at 75 percent power with a fuel flow of 10.2 GPH, precisely at book speed, but with a fuel flow of 2.1 GPH less than book even though we took care to go 150 degrees ROP. Going lean of peak, the engine was as smooth as it was rich of peak—we liked how Lycoming set up its new engine. Thirty degrees LOP resulted in a cruise of 147 MPH TAS at a fuel burn of 8.5 GPH, a notable savings, especially with the limitations in the ability for the airplane to carry fuel with two people aboard. We think Lycoming needs to get with it and publish LOP data. The engine ran beautifully LOP, plus the airplane has the necessary engine monitoring equipment.

Stalls, power off and power on, resulted in the clean break for which the Decathlon wing is known, however, the airplane rolled off to the right sharply in all of the stalls. We suspect a rigging issue as we haven't seen that with other Decathlons—although absent an inclinometer, we couldn't tell whether we were yawed when the stall broke.

Maneuvering is utterly delightful. After 50 years of too-heavy ailerons, American Champion has, in our opinion, gotten them right. The claimed 33 percent increase in the rate of roll seemed understated. We found ourselves whipping from steep turn to steep turn and doing aileron and slow rolls with fingertip pressure—no more need to slam the ailerons to the stop.

Setting full throttle and 2500 RPM allowed aerobatics with minimal altitude loss despite being above 10,000 feet MSL. The extra power was a kick in the pants, making vertical maneuvers much easier and allowing plenty of time to establish and hold an up-line in a hammerhead. While it doesn't quite have the vertical ability of the smaller, cleaner, 200-HP Pitts S-2A, the Xtreme doesn't feel as if it's going to run out of speed instantly when you point the nose straight up.

For instructors, doing aerobatics

continued on page 32

LSA vs. Standard: Sacrifice for Savings

In a head-to-head comparison, an advanced LSA beats a Skyhawk in operating costs, but can't win for mission utility.

by Larry Anglisano

Let's assume you had a cash budget of up to $160,000 to buy an airplane. Your short list of required equipment includes a glass cockpit with autopilot, a modern interior, plus a proven engine that's easy to service and economical to operate. You'll use the plane for local flying, short trips and perhaps some basic instrument training.

But since you want to buy on the cheap, you might consider models in the upper end of the LSA category and those in the lower end of the Standard category. Two that come to mind are the Flight Design CTLS and the early-generation G1000 Cessna 172S Skyhawk. Both have a high-wing design, glass cockpit and cruise at comparable speeds.

Is the LSA cheaper to maintain and operate? In this article we'll get a close look at both models to find out, while assuming both are purchased in used condition. We think it's worth considering a new CTLS, given the three-year factory warranty.

MISSION REALITIES

First, the sales-leading (in category) Flight Design CTLS. It's been in production since 1997 and there are close to 2000 airplanes flying. A well-equipped 2014 model sells for around $170,000, while a late-2000s model can sell for as little as $90,000 when equipped with popular options, including advanced avionics.

As with most models in the LSA category, there are two major limitations that you'll need to accept. With two seats, you're limited to traveling with one passenger, while choosing your baggage sparingly and loading it creatively.

The CTLS has a composite structure and a 49-inch-wide cabin with gull wing doors. With a 34-gallon tank, you can fly it roughly 800 miles at full cruise power. Published top speed is 120 knots, although several CTLS owners told us they often see slightly higher speeds. The base model is powered by the 100-HP, liquid-cooled Rotax 912s. It's a 2000-hour-TBO engine that can sip premium unleaded, including E10 ethenol blends. It can also burn 100LL, with some maintenance penalties. More on that later.

Fuel burn can be as low as 4.3 GPH at lower power settings, although 5-5.5 GPH is more conservative. For 2014, there is an option for the fuel-injected Rotax 912 iS, in addition to the turbocharged 914T. Both of these engines have a 2000-hour TBO. We'll use the carbureted Rotax 912s engine in our comparison because the 912 iS wasn't available in earlier models.

Unless you hold a private pilot certificate, you're limited to daytime VFR flying (the CTLS is approved and equipped for night flying). Since the CTLS is certified in the U.S. under the SLSA category (Special Light Sport Aircraft), you can put it on a flight line for lease back, where it can be used for training and rental. It's a popular model for these purposes and every flight school we talked with had positive things to say about

A late-model Flight Design CTLS and mid-2000s Cessna G1000 Skyhawk, main photo, are logical choices for affordable ownership. The IFR certified, four-seat Skyhawk has a broader mission profile, but you'll need a medical certificate to fly it.

You'll save on navigational data costs with the Dynon Skyview in the CTLS, top photo, since most updates are free. An annual subscription for the G1000, bottom, is $600. Repair costs for the G1000 can be considerably higher.

the CTLS it operates—especially the per-hour operating costs and high dispatch reliability.

The venerable Cessna Skyhawk still soldiers on in Cessna's single-engine line (that line started in 1956) and a 2014 model has a sticker price that closes in on $400,000. When we scoured the used market, we found many first-generation G1000 172S models in decent shape with mid-time engines. The all-glass Hawks with the Nav III glass option hit the market in late 2005.

It's not unheard of to buy one with a higher airframe time for as little as $125,000, particularly if it's well-worn and has come off a flight school training line. A clean G1000 172S with a mid-time engine is realistically going to cost more like $160,000. That's valued considerably higher than a used CTLS.

But face it, the glass Skyhawk could offer more for that initial investment. It has a broader mission profile since it's approved for day and night VFR and IFR. It also has four seats and a bigger payload. Of course, you'll need a private pilot certificate and a current FAA medical to fly one, at least under the current medical certification standards.

The 172S has a 180-HP fuel-injected Lycoming IO-360-L2A engine and despite Lycoming's SI 1070 service letter that approves operating on mogas, the aircraft isn't approved for it. With its 890-pound useful load and a 50-gallon fuel capacity, typical speeds for newer Skyhawk's average around 125 knots.

AVIONICS

The CTLS is available with a variety of glass cockpit options. Early models (pre-2010) had the Dynon D100-D120 package, which included the EFIS100 PFD and EMS120 engine monitoring system. There's also the popular two-axis autopilot option, digital transponder and Garmin SL30 navcomm radio. Newer models are available with what Flight Design calls the Advanced Avionics Package, to include the Dynon Skyview. There's also the Garmin G3X. But the Skyview, with a dual-screen 10-inch PFD and MFD is closer in function to the G1000. It can play traffic and weather overlay, plus it has digital engine monitoring. Flight Design offers an option for Garmin's GTN750 or 650 navigator. Don't expect to find them in older models, which might be lightly equipped with only a Garmin portable GPS, a single radio and a transponder.

The G1000 suite in the first glass Skyhawk didn't have WAAS GPS, although a Cessna service bulletin accommodates the installation of dual WAAS receiver modules and the required antenna work. That project can top $20,000.

The avionics suite also included the Bendix King KAP140 autopilot. The owners we talked with reported substantial repair costs associated with it, including pricey servo motor replacements. A single servo (the KAP140 has three) could easily top $2000. There's also a variety of software updates that might be required for the G1000. You'll pay for shop labor to bring the system up to the current revision, in addition to an annual navigation database subscription. This costs $600 (Dynon offers free updates for the Skyview).

As we reported in the August 2013 issue of *Aviation Consumer,* it's worth considering an extended warranty for the G1000. The coverage can pay for itself in a single repair and has to be purchased from Cessna through a service center.

INSURANCE

Chris Arnold at the Hartford, Connecticut-based Sutton James aircraft insurance agency worked up a theoretical insurance quote for both aircraft. He assumed the operator for either aircraft is a 250-hour certificated private pilot, with 10 hours in make and model, plus has a clean accident history.

For a used CTLS with a $100,000 hull value, we were quoted $1617 for an annual policy. This includes a $1 million/$100,000 per passenger liability limit. With no passenger sublimit, the policy jumps to $2098.

For the Skyhawk that has a $170,000 hull value, the same coverage is $1300 and $1828, respectively. Why does the lesser LSA cost more to insure? Arnold suspects there's uncertainty about how the LSA will hold up over time. Moreover, the Cessna has a more definitive (and perhaps more favorable) accident track record.

"The Skyhawk is a well-known entity and insurance companies know the costs that are associated with it. This allows them to project

CHECKLIST

Preowned LSA models offer modern technology for a lower initial buy-in.

Rotax 912 sips mogas while engine swaps are cheaper than Lycoming.

With two seats and VFR certification, an LSA offers limited utility.

CESSNA 172S G1000*	DATA POINTS	FLIGHT DESIGN CTLS
LENGTH: 27 FT WINGSPAN: 36.1 FT HEIGHT: 8.9 FT	DIMENSIONS	LENGTH: 21.8 FT WINGSPAN: 28.2 FT HEIGHT: 7.8 FT
1670/890 LBS	EMPTY WEIGHT/ USEFUL LOAD	1320/550 LBS
LYCOMING IO-360-L2A	POWERPLANT	ROTAX 912S
2000/$18	TBO/RESERVE PER HOUR	2000 /$10
125 KTS	CRUISE SPEED	120 KTS
50 GAL.	FUEL CAPACITY	34 GAL.
8 GPH	FUEL BURN	5.5 GPH
4	SEATS	2
$125,000-$155,000* (USED)	PURCHASE PRICE	$100,000-$120,000 (USED)
MAINTENANCE: $115 100LL FUEL: $46.40	APPROXIMATE HOURLY COST	MAINTENANCE: $58 91 OCTANE: $21.45

*172S comparison is based on a 2005 model without WAAS upgrade
**Hourly maintenance includes calculated engine reserves and avionics upkeep. Zero capital costs were assumed for both engines.

the potential losses—both in severity and frequency—because there's a long history," he said.

We think the Flight Design, by nature of its design, is at a disadvantage because of its composite build. Not surprisingly, composite structures are more costly to repair than metal ones. According to Arnold, claims that result from runway prangs (damage to landing gear, for example) are fairly common. Whether or not insurance companies are spooked by pilots flying without an FAA medical—and if it's factored into the rates—is unknown. We think it shouldn't matter.

MAINTENANCE

Several shops told us that annual inspections or a 100-hour inspection on a CTLS should cost approximately $700-$900. Keep in mind that if you operate a CTLS in a flight school environment, the 100-hour inspection is required. Otherwise, it's an annual inspection.

We spoke with Dean Vogel at Lockwood Aviation in Sebring, Florida, who told us his busy Rotax shop usually flat-rates the 100-hour inspection on the 912s engine at $450. Of course, that won't cover items that need replacement. In addition, there's a one-time, 25-hour required inspection on every new 912s engine that's put into service. The checklist for that inspection is the same as a 100-hour check.

We couldn't get definitive costs for an annual on a G1000 Skyhawk (above a bare-bones inspection, which can be as low as $900) from any shop, although owners tell us that $1500-$2500 annuals are pretty common. Not surprisingly, upkeep for the G1000 can be pricey. One owner commented about the costs and efforts to keep the G1000 software up to date. "It took my shop a full day to load new software into the suite. That yielded a $1100 invoice," he told us.

The CTLS has a few milestone maintenance events, including the 6-year BRS parachute repack service. According to Flight Design, it's a $1000 job. There's also the 1000-hour gearbox inspection—reduced to 600 hours—if the engine is operated more than 50-percent of the time on 100LL fuel. Lockwood quoted us $300 for this work. The carburetors require a 200-hour disassembly inspection. The $250 service covers cleaning and synchronization.

The Rotax 912s engine has a five-year hose replacement interval, with an average cost of $4000. There's also a 1500-hour mandatory propeller inspection that runs $450, on average.

If the Rotax is operated almost exclusively on mogas, and the oil is synthetic or at least semi-synthetic, the oil and filter changes come at 100 hour intervals. Burn 100LL more than 30 percent of the time and the oil and filter changes come at 50 hours. Burn 100LL more than 50 percent of the time and you'll be changing the oil and filter every 25 hours, due to the lead content. The filters are roughly $23 and the oil is roughly $10 per quart/liter (capacity is roughly three quarts). Owners report that the 912s burns little if any oil between intervals. Speaking of fluids, Rotax recommends readily available automotive lubricants and coolants, which, as most owners can attest, helps keep costs low, but can be difficult to find at a typical FBO.

FIELD REPORTS

When it comes to reliability, costs and ease of maintenance, nearly every Flight Design operator we talked with—commercial and private—raved about the CTLS. Much of that praise is directed toward the Rotax 912s. Tim Busch, owner of Iowa Flight Training in Cedar Rapids, Iowa, has a late 1990s CTLS, plus several Skyhawks on his busy training and rental line.

"If you take capital costs off the table and simply compare the hourly operating costs, I would replace my

entire fleet with CTLS aircraft," Bush told us. He's carefully watching costs.

"I've run the numbers every which way and the CTLS comes out on top every time. The maintenance costs, for one thing, is far lower on the CTLS than it is on the Skyhawk. While there's just not that much to do in comparison to the Lycoming, parts costs for the Rotax 912 engine are so much lower it's silly," said Busch.

That was a theme we heard from every Rotax owner we talked with, particularly when comparing service items like fluids, spark plugs and other miscellaneous maintenance supplies. Still, that doesn't make the Rotax maintenance-free.

"The Rotax isn't exactly a simple engine and I've had a few issues, but I think its modern design (compared to the engine in my old Mooney) adds a level of consumer confidence that I just didn't have when I brought my Mooney in for service," said Ian Ballantine about the Rotax engine in his Remos LSA.

Lockwood's Vogel has enough experience with Rotax invoices to put a hard number on engine reserves. "I usually coach people to simply use $10 per hour as a safe engine reserve toward a 2000-hour TBO. That way, if they do an engine exchange for somewhere in the neighborhood of $17,000, they've got another $3000 cushion to cover labor and most other materials that might get changed out during the swap," he said.

While we recognize the benefits of operating the Rotax, we also think it's easier to find support for the Skyhawk and its Lycoming. What aircraft mechanic doesn't know how to work on a 172? That won't be the case for the Flight Design.

A CTLS running on automotive fuel, in addition to the economical fuel burn, contributes to a sizable savings in hourly fuel costs. Using a conservative 5.5 GPH at an average of $3.90 per gallon of premium unleaded results in a $21.45 per-hour fuel cost. The Cessna, burning $5.80 per-gallon 100LL (at 8 GPH) ends up costing $46.40 per hour.

Hourly maintenance costs can be a little trickier to nail. We looked at the numbers provided by a couple of flight schools that perform much of their own maintenance on the CTLS. If you factor $10 per hour for a Rotax engine reserve, oil changes, 100-hour inspections and the major milestone maintenance events, operators realistically budget hourly costs of $60 (the CTLS generally rents for around $100 per hour). We uncovered just a few issues related to the Dynon avionics, including a failed transponder in one Skyview panel, but Dynon covered it under warranty.

Hourly maintenance figures for the G1000 Skyhawk was considerably higher, at roughly $115 on average. Most operators factor $18-$20 reserve for the Lycoming, plus additional costs for avionics maintenance and a mandatory service for the Amsafe airbag seatbelts.

Interestingly, all of the Cessna owners complained about having to replace broken plastic interior components—a problem that's plagued Cessna interiors for years. We'll cover sources for aftermarket plastic in an upcoming issue.

In general, all of the Skyhawk operators we talked with noted reliable dispatch and a trouble-free experience. That's in line with what we've always known about the Skyhawk, although we think the G1000 adds sizable amounts of complexity and potential upkeep costs.

CHOOSE YOUR MISSION

We can't recommend one aircraft over another because they don't have the same mission. We can say the Skyhawk offers far more utility when it comes to weather, payload and growth potential for new pilots. It's also easy to service.

If none of that matters to your mission, we think an advanced LSA like the Flight Design CTLS wins for overall savings. The freedom to fly it without FAA medical certification is an added bonus.

ROTAX SWAPS: EASY CHOICES

When the four-cylinder, liquid-cooled Rotax that powers your LSA runs out of life, forget most of what you know about the economics and choices for replacing or overhauling a Lycoming or Continental. Thankfully, the decision-making process for a Rotax is more straightforward and a bit cheaper.

The first option may be to turn in your core in exchange for a factory new replacement. This means everything you'll get is new—from the ignition and carburetors (a 912 has two carbs)—to the cylinders, the split case, gearbox and camshaft. But in the eyes of the factory, your core is only good if the cylinders, cylinder heads and cases can be reused. If that's the case, it's worth as much as $2000 against the price of a new engine. Several Rotax dealers quoted us around $19,500, less core credit, for a new 912s. We're also told that an experienced Rotax technician can swap an engine in a day. If it goes smoothly, that could result in as little as $800-$1000 in labor costs, not including propeller work, if required.

For contrast, Air Power shows a list price of $46,757 for a new Lycoming IO-360-L2A, including the $17,400 core credit for the removed engine. Based on our experience, installation is going to take every bit of two days.

Then there's the overhauling option—one that generally doesn't yield the sizable savings that you might expect over a new exchange. According to Dean Vogel at Lockwood Aviation, the base price of an overhaul on the 912s is $13,500, but there are often major components that need to be replaced, due to tolerance issues. That drives the cost up. The factory overhaul/exchange price for an IO-360-L2A is $26,722.

As Vogel put it, "For the difference in price between the typical overhaul and a new exchange, most owners prefer to get a new engine. It just makes better sense."

MAINTENANCE

Making Your Prop Last: Neglect Is Expensive

Aluminum propellers are amazingly reliable and durable, nevertheless, a little care and preventive maintenance can make them last even longer.

by Rick Durden

The good news is that aluminum propellers are overdesigned and overbuilt so they operate safely for years. The bad news is that aluminum propellers are overdesigned and overbuilt so they operate safely for years. While each has a published TBO, for some reason aircraft owners who wouldn't dream of running an engine past TBO will utterly ignore that number for a propeller.

Again, it's a good news/bad news situation. The good news is that propellers don't often break in flight—the risk is about the same as being involved in a midair collision—although, when they do, it's usually catastrophic and means a crash of some magnitude, and aircraft owners spend lots of money on traffic alerting systems. . . The bad news is that the complacency brought on by the reliability of metal propellers often means that owners eventually spend more money on them than if they'd done a little preventive maintenance.

Because the idea is to keep your airplane flying along safely without breaking the bank, we'll go into what you can do to keep your prop in good shape while taking advantage of the qualities of design and manufacture that allow it to withstand tons of force while whirling around at near-sonic speeds.

This Super Cub spent the summer on floats—paint erosion on the propeller shows the effect of water being sucked into the prop in normal operations. The leading edge has been carefully dressed to clean up nicks. Light oil has been applied to fight corrosion. It will be repainted.

PREFLIGHT

Preflight the prop with your fingertips. Use your tactile sense to detect nicks and gouges. When you detect a nick, have your mechanic look at it right away. This is one time when delay almost invariably means more expense. Nicks don't heal—they get bigger, attract corrosion and become stress risers that give birth to cracks. The vast majority can be filed or "dressed" out by your mechanic. It's a fast, easy and inexpensive procedure.

Using your thumb and first two fingers try to move (with the mags off) the prop blades four ways: fore and aft, toward and away from the hub, lifting and pushing down with the blades horizontal and rotating it in the hub (constant speed only). If there is any feeling of looseness, get your mechanic involved.

On a constant-speed prop, if you see grease, oil or red dye leaking onto the prop blades from the hub, don't delay addressing the issue. It means a seal in the hub is leaking. As Bryan

Mathews, president of H & S Propeller Shop, put it, "If something can get out of the hub, moisture can get in." That means corrosion. Sending the prop in early may mean you can go with an IRAN (Inspect and Replace As Necessary) or procedure rather than a full overhaul—before corroded parts have to be replaced.

CORROSION PREVENTION

The number one enemy of propeller longevity is corrosion. One of the simplest ways to fight it is to spray the blades with a light oil and use a clean cloth to spread it around. Derek DeRuiter, owner of Northwoods Aviation in Cadillac, Michigan, operates seaplanes—one of the very worst environments for propellers—told us that he uses LPS 2 oil on his props every 50 hours of operation. He recommended an application every month or two for airplanes that don't fly frequently, especially in moist climates—even if the airplane is hangared, a recommendation emphatically seconded by Bryan Mathews.

TOWBAR

Treat your towbar as a lethal weapon. When you put the towbar on the nosewheel, don't let go of it until you remove it. Make it an absolute rule. Mathews told us, and incident reports we read confirmed, that one of the most common causes of expensive prop damage is leaving the tow bar on and having it hit by the prop.

TAXIING

Don't multi-task when taxiing. Along with towbar strikes, wandering off of taxiways and hitting something with the prop is high on the stupid-pilot-prop-wrecking-trick hit parade. Keep the yoke/stick fully aft when taxiing (unless there's a strong tailwind) and during runup. Even on pavement there is often loose sand or gravel—an extra inch or two of prop clearance helps reduce erosion, which over time costs you money. It doesn't cost a cent to keep the yoke full aft.

Keep the RPM as low as possible when operating in the presence of gravel or puddles. Every piece of grit your prop hits is eroding your wallet.

GROUND HANDLING

Don't use the prop to move the airplane. Yes, the prop moves the

OVERHAUL OR IRAN?

Published TBOs for aluminum propellers vary, although they generally range from 1500 to 2400 hours of service or 60 to 72 months, whichever comes first. For reference, figure on $2000 to overhaul a two-blade prop on a Cessna 182, according to Bryan Mathews, President of H & S Propeller Shop in White Lake, Michigan—near Pontiac Airport.

If a blade is needed, plan on $1400 for a used, serviceable blade, or $3000 for a new one. Mathews told us that a set of blades usually will make it through three or four overhauls unless the prop is operated regularly on gravel or the owner delays overhauls. If it's been a long time since the prop was in the shop, there's a good chance there will be enough corrosion in the hub to require replacement of internal components—raising the price.

For a constant-speed propeller, an overhaul consists of an initial visual inspection; disassembly; cleaning of all components that are not to be replaced; inspect, measure, conduct nondestructive testing, which may include dye penetrant, eddy current and/or magniflux; rework/refinish components to be reused; cadmium plate components with a corrosion risk; finish/paint components; replace hub studs, miscellaneous hardware, seals and gaskets; reassemble; balance; and bench test—set pitch angles and assure the blades match at all reference stations.

Fixed-pitch props get reconditioned, although the process is often called an overhaul. H & S Prop charges $700 to recondition the prop on a Grumman Tiger. It consists of inspecting the entire prop and measuring blade width, thickness and angle at each reference station (defined distances from the hub), check face and edge alignment, grind out nicks and gouges, strip the paint, inspect for cracks, inspect the bolt holes and hub, correct any errors in blade angle and track and then paint and balance the prop.

Overhauling a prop at TBO is not required for Part 91 operators. In the real world virtually no one overhauls a prop at TBO (even some Part 135 operators have extensions). If you don't overhaul your prop at TBO, we think a wise alternative is to send it to the prop shop for what's called a reseal or IRAN (Inspect and Replace As Necessary).

That means taking the prop apart, inspecting it for wear and corrosion, making needed repairs, replacing seals and gaskets and putting it back together. According to Mathews, IRAN for a Cessna 182 prop costs $900 and often solves a developing internal problem, avoiding an overhaul that might otherwise soon be necessary.

The bottom line of the interviews we conducted and research we did was that waiting as long as possible before sending a prop out for work—usually an overhaul—increases the risk that the overhaul is going to be very expensive. This is because the effects of corrosion are going to require replacing a lot of components in the hub, or you're going to have to replace the entire prop.

We appreciated the approach Derek DeRuiter, a Part 135 operator, uses for his seaplanes—he sends props for reseal at 1000 hours because his experience has been that it means he's much less likely to have to pay for replacement parts when he sends them out for overhaul at TBO.

Our recommendation? For a fixed-pitch prop, have it reconditioned when you have the engine overhauled. For a constant-speed prop, if you haven't already done so, send it out for reseal/IRAN at engine overhaul—that way there's a good chance it won't need overhaul until the next time you overhaul the engine and even then, it may not need replacement blades or hub components.

A prop blade undergoing the measuring process during inspection, left. Measuring blade angle with a protractor following overhaul and reassembly, below left.

airplane when it's running, but the load is spread out over the blade. The prop manufacturers are unanimous on this one—even if you hold the prop close to the hub when you shove on it, you're doing damage.

Keep the prop painted. Bare aluminum invites corrosion.

Don't ignore surface corrosion—it shows up first as little pits on the leading edge. If it's on the blades, it's in the hub. Mathews expressed utter amazement at the number of props his shop gets with severe corrosion within the hub as well as obvious corrosion on the blades. He told us that most of the time, had the owner sent the prop in when he found pitting, the corrosion could have been stopped and corrected before it was necessary to replace expensive parts.

GREASE

The hubs on Hartzell constant speed props can be greased—something that can be down by an owner with a private pilot certificate or better. The recommendations we received were every 100 hours of operation and at the annual. We were cautioned that the idea of forcing a lot of grease into the hub with the idea that it will drive the old grease out isn't accurate—it's more likely to damage one of the seals, allowing moisture in. Go easy on it.

SIZE MATTERS

Props get smaller with age and use. There are prescribed minimum prop widths and lengths in the airplane's Type Certificate Data Sheet—they are not recommendations. The numbers are generated from a complex combination of factors that include vibration, strength, blade twist and flex during operation and ability to convert engine torque and RPM into thrust.

In service, blades get filed because of nicks and may be shortened for a number of reasons, including tip damage. At some point the blade no longer meets minimum size requirements. You usually find out about it during the annual when you get a phone call from your mechanic with the word that you either need a new prop (fixed pitch) or a blade replacement.

There's no negotiating that matter—there's no gray area, a blade is either undersize or it's not.

In our research for this article, we found that most owners are aware that their prop is approaching minimum size because their mechanics keep them advised at each annual. The ones who are surprised by the news tend to be owners who didn't realize there was a gouge in the prop and the repair was going to take the blade undersize. Or new owners who either didn't have a prebuy performed, or didn't have the prop measured on the prebuy, and only discovered it on the first annual inspection.

How do you prolong the time before the prop is undersize? File nicks out early, but do it gently. A big pile of aluminum shavings under the repair isn't the goal.

OOPS

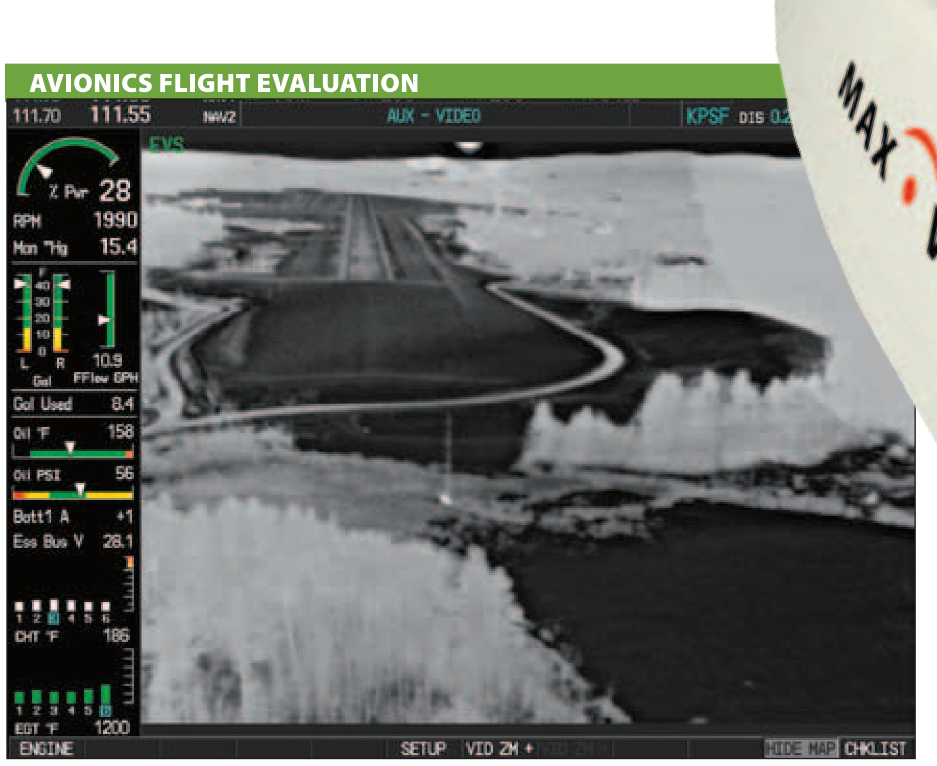
Things go wrong—it's the nature of human endeavors. When something happens to a prop the questions tend to be "What's this going to cost?" and, "Can it be operated safely?" What we used to call prop strikes are now referred to as a foreign object strikes—and they can happen whether the prop is moving or stationary.

Time and experience have caused the manufacturers to come up with instructions for how to handle almost every conceivable type of prop impact event—face it, over the last 80 years they've seen it all. The criteria published by the manufacturer will tell you what's going to be necessary: inspect, repair, overhaul or replace.

Most of the time when a prop is damaged, there is no second guessing—it's pulled and sent to the shop. Our research turned up something disturbing—minor prop damage events turning into expensive problems or serious accidents.

The common denominator was that a blade got bent, but not a lot. The kind of bend is an easy fix for a prop shop—but the owner decided to bend it back in the field, either on his own or with his mechanic's help. However, without the equipment available at a prop shop, the homegrown repair usually means inducing a second bend into the prop.

continued on page 32



A live EVS image, left, of a dark approach to Runway 26 at Pittsfield Airport in western Massachusetts. The Max-Viz software fuses visible light and infrared heat signatures from the runway pavement and surrounding snow-covered trees. The EVS600, top, houses both sensors.

Astronics Max-Viz EVS: Thermal Imaging

Enhanced Vision won't see through clouds, but it's an effective tool during low altitude maneuvering in low visibility and darkness.

by Larry Anglisano

It's easy to confuse the Max-Viz enhanced vision system (EVS) with popular synthetic vision systems (SVS). These include Garmin's proprietary SVT and Aspen's ESV synthetic vision software. While synthetic vision is just that—a GPS-based synthetic depiction of terrain, obstacle and landscape features—the Max-Viz product from Oregon-based Astronics is a live moving image of the outside environment.

Max-Viz isn't a new product. It's been in use in a variety of military and tactical applications, plus select general aviation applications. But a growing list of STC and TC approvals is giving the product legs for more retrofit and OEM installations.

UNCOOLED INFRARED

The Astronics Max-Viz is an electro-optical system that uses a long-wave infrared sensor and a visible light camera that's usually mounted on the underside of the wing. The model EVS600 relies on the infrared sensor to produce an image of heat signatures on the earth, while the low-light CMOS camera enhances it. Software processing then fuses the two images into one before it's transmitted to the cockpit display.

Unlike a video camera, the Max-Viz thermal imaging detects differences in heat, rather than differences in light. Moreover, some complex infrared systems, known as photon-sensors, require refrigeration units to cool the sensor to subzero temperatures so it can detect heat sources. Given the size and the expense of the equipment, these older cryogeneric sensors just aren't practical for small aircraft.

The uncooled, heat-detecting sensor array in the Max-Viz EVS is microbolometer-based. This technology has been around since the 1970s, but was classified until the early 1990s because of its use in military night-vision systems.

NIGHT TO DAY

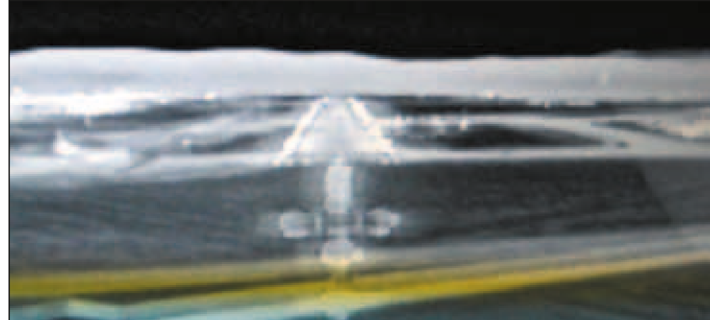
We flew with the EVS600 in a Garmin G1000 Perspective-equipped Cirrus SR22, one application where Max-Vis is available as a factory-installed option or for retrofit. The system is also an option on new Cessna 172, 182 and 206 models. In

CHECKLIST

EVS can improve situational awareness during night and low-visibility operations.

Compatible with OEM and aftermarket avionics displays with video input.

The big-dollar investment is questionable for lower-end aircraft.



Clockwise from lower left: EVS is perhaps most useful on approach, adding another layer of awareness to synthetic vision software. If the sensor picks up the lead-in lights before nearing minimums, your eyes should soon follow.

the aftermarket, there are over 200 type-approvals in place, including an AML-STC for all existing single-engine Cessna models, except the P210. Max-Viz is also approved for the Robinson R44 helicopter.

While the system can see through haze, smog, smoke and some precipitation, it won't see through clouds. We found the system particularly useful in darkness, especially while maneuvering around the airport environment (and during taxi).

Astronic's Lou Churchville told us that fusing the visible-light camera with the infrared sensor was intended to give pilots the most unambiguous, at-a-glance situational awareness during night operations, especially when approaching a dark runway environment—a claim we agree with, based on our flights.

To appreciate the effectiveness of the light-seeing camera, you need to understand the limitation of infrared technology. Unlike the human eye, a long-wave infrared sensor won't see visible light, which means important airport-identifying features like runway and taxiway lights would be missing from the EVS image. Conversely, the EVS infrared sensor is effective in low visibility because the thermal energy from the ground is able to penetrate visibility-limiting atmospheric particles (usually smaller than 12 microns). But temperature-based imaging has limitations, especially in heavier precipitation and thick fog. Depending on the location of the sensor, performance could be degraded by heavy rain, especially in certain airflow conditions. The fixed field of view is 40 degrees wide and 30 degrees vertical. The sensor housing, which weighs 1.2 pounds, has integral window heaters for operation in icing

The displayed monochrome resolution of the EVS image is 320x240 pixels, which isn't great compared to what you might be accustomed to with most modern cockpit displays and televisions. It will likely look worse on smaller displays.

STRATEGIC USE

While we went flying on a relatively clear night, we ventured over the mountainous terrain in the Berkshires of western Massachusetts. On the dark, icy taxiway at Pittsfield Airport, the combined image made taxiing a no-brainer. The EVS infrared sensor picked up the heat of the pavement, painted centerlines and surrounding trees, while the visible light camera saw the taxiway lighting.

With mountains on both sides of the departure end of the runway, the EVS was useful during the dark climbout, displaying the surrounding terrain and clouds as if it were daylight. But the real advantage, in our view, is during approaches in low visibility and clouds.

On the G1000, one strategy is to transition from the moving map to the EVS once the aircraft is inside the final approach fix. Using the EVS camera, you're looking for the runway lead-in lights and the features of the surrounding runway environment. If the EVS doesn't pick up ground signatures as you get closer to minimums on the approach, it's a pretty good bet that you'll be making a missed approach.

Enroute, EVS can be helpful for surveying cloud layers and terrain. On the runway, it can identify wildlife and other aircraft.

NOT A CHEAP BUY-IN

The list price of the EVS600 system is just shy of $18,000 and doesn't include a display. The EVS600 is targeted at aircraft with speeds below 250 knots. The EVS1500 is for turbine applications, has dual pilot-selectable field of view and a zoom feature.

You don't need a G1000 display for displaying the EVS image. Any MFD that accepts a RS170 coaxial auxiliary video input (including the Garmin G500/600) will work. There's a variety of aftermarket portable monitors, plus the system is known to work with the new AVMAP EKP portable GPS and a variety of EFBs. Visit www.max-vis.com, 888-629-7888.

TV EVS VIDEO

Smartphone Wind Meter: Speed, But No Direction

We think Vaavud's plug-in anemometer and smartphone app could be more useful if it measured wind direction.

by Larry Anglisano

Talk about an impulse purchase. When we spotted the Vaavud digital wind meter for smartphones in the Sporty's catalog, the marketing photos made it easy to justify dropping $49.95 plus shipping on the thing. Turns out it didn't provide the level of utility we anticipated, at least for our flying missions.

It's not that the device doesn't deliver enough gee-whiz factor for weather geeks, or provide at least some utility for a number of outdoor activities—including watersports (we used it on a boat where it was helpful for docking). It's also accurate, in comparison with the airport ATIS broadcast.

Vaavud is a company in Denmark that's led by a group of outdoor sports enthusiasts, engineers and software designers. The product is distributed by Sporty's, as well as some marine product distributors in the U.S.

Vaavud says the plastic two-cup anemometer design was inspired by professional models (those models often use a three-cup design), but the Vaavud device is designed with two cups to make it easy to stash in a pocket. The wind cups sit on a one-piece molded rotor with a low-friction Teflon bearing. The sensor tuned out to be extremely durable. It got stepped on accidentally and it didn't crack or bend. It's also designed to be rinsed clean with water should dirt or any other debris get inside the assembly. The anemometer, which doesn't have any electronics, simply plugs into the headphone jack.

The Vaavud smartphone app uses the magnetic field sensor that's built into the phone, which measures the speed of the anemometer's spinning magnets. The app's main screen is easy to interpret at a glance and measures average, current and maximum wind velocity, in addition to displaying a trend graph. The app is free and is compatible with iOS and Android, plus it works with a variety of devices. We used the device with an Apple iPhone 5 that's covered with an Otterbox Defender case. That turned out to be problematic because the Otter has an attached retractable protective cover for the input jack. When the cover is removed, it still gets in the way of the rotor, hindering its rotation. A compromise is to tuck the cover inside the case or snip it off, but we weren't about to trash a $65 case.

While we think this is a nifty product, we also think—for the price—it could offer more utility if its app could somehow measure wind direction, but it's simply not that sophisticated.

Contact www.vaavud.com.

The anemometer's housing and rotor, top, is durable and simple. However, it won't work well with some protective cases, including the Otter Defender, bottom photo.

Cessna Cardinal

An economical cruiser that looks more modern than a Skyhawk, the fixed-gear Cardinal is a good choice for performance-seekers on a budget.

Although the design is more than four decades old, the Cessna 177 Cardinal—with its racy sloped windshield, wide doors and strutless wings—looks more modern than the newest Skyhawks coming out of Cessna's Independence, Kansas, plant. Yet, sadly, the Cardinal is a poster child for why innovation and audacity in general aviation development has often met dismal results in the market. Despite high expectations for a design that would usher in new thinking in light aircraft, the Cardinal had a rocky start and was gone from Cessna's inventory a decade after it emerged.

Although the Cardinal was intended to be a Skyhawk killer, the venerable 172 outlasted it and continues to be a mainstay in Cessna's current piston aircraft line. Still, the Cardinal enjoys enthusiastic support among owners for many of the reasons that Cessna thought it would become a hit. And despite its warts and shortfalls, many of which have been rectified, the airplane is an excellent choice for owners who want a bit more performance than the Skyhawk offers without stepping up to the 182 Skylane.

MODEL HISTORY

By the time the Cardinal appeared, the Cessna 172 was long in the tooth, having been on the market for 12 years. It was time for something new. When the first Cardinals hit dealers in 1967, buyers were clearly confronted with just that.

Despite having fairly light control forces, the Cardinal makes a fine instrument platform.

Besides being sleeker and strutless, the new model had a stabilator, just like Piper's competing Cherokees did. With the wings placed aft of the main part of the cabin, the pilot sat ahead of the leading edge, which produced better inflight visibility than any of the previous Cessnas had.

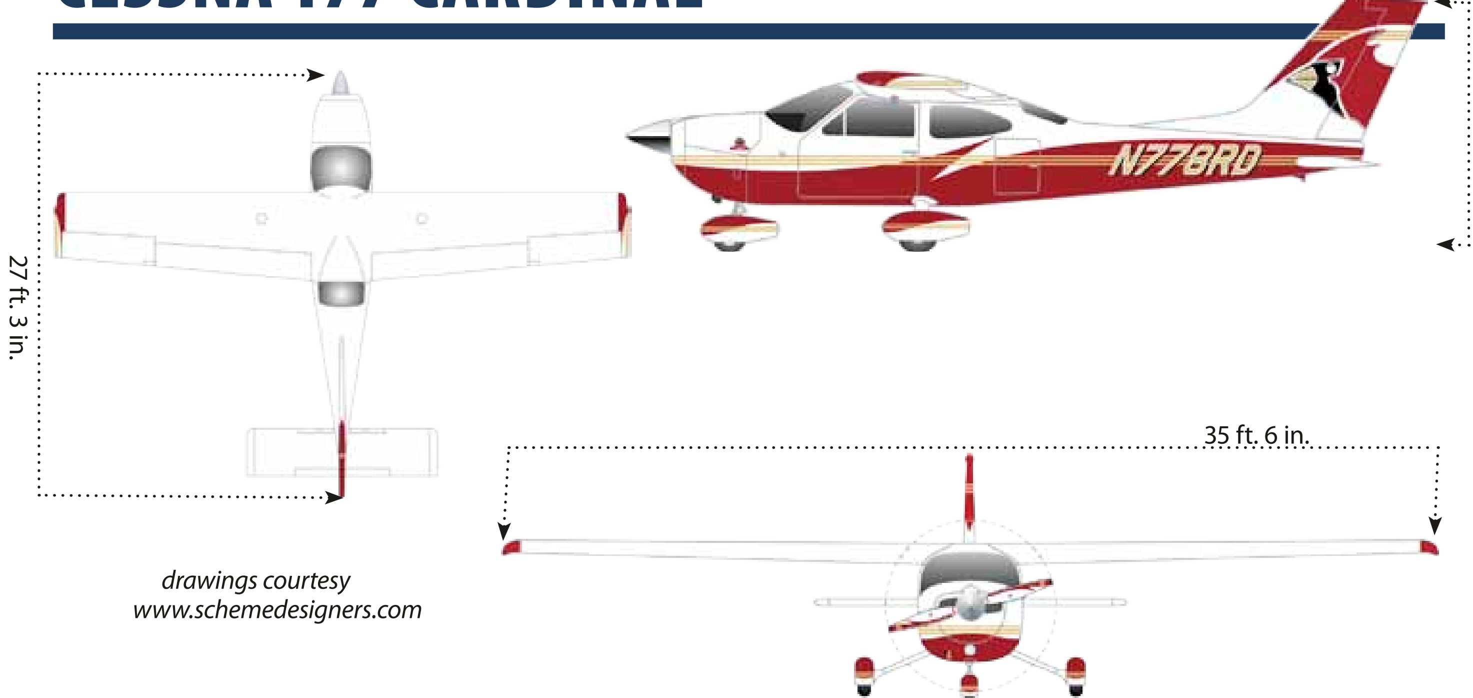
The 1968 Cardinal had a fixed-pitch prop and a Lycoming O-320-E2D. The airplane was designed with the 180-HP engine in mind, but Cessna had ordered 2000 150-HP engines from Lycoming—its first purchase from the company.

Cessna was so confident that the Cardinal would succeed that the Skyhawk production line was actually shut down in anticipation of the Hawk's planned demise. Things didn't work out that way, however.

The 150-HP, fixed-pitch prop Cardinal looked great, but gained a reputation for lethargic climb performance. In reality, it took some time for Cessna to figure out that

That's Richard Harmon's 1974 Cardinal, main photo, wearing an early 2000s Cessna paint scheme.

CESSNA 177 CARDINAL

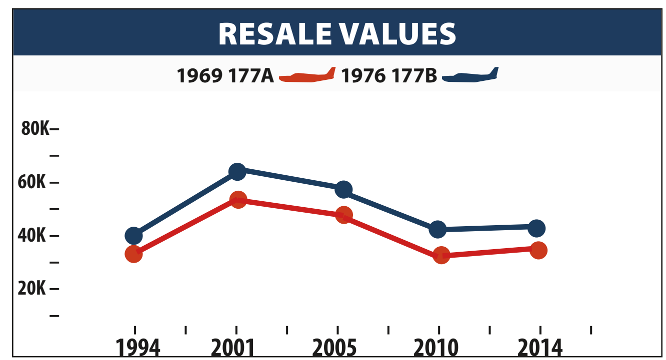


drawings courtesy www.schemedesigners.com

CARDINAL SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1968 177	LYC. 150-HP O-320-E2D	2000	$20,000	50	900 LBS	115-120 KTS	±$32,000
1969 177A	LYC. 180-HP O-360-A2F	2000	$23,000	50	900 LBS	120-125 KTS	±$34,000
1970-72 177B	LYC. 180-HP O-360-A2F	2000	$23,000	50	900 LBS	125-130 KTS	±$35,000
1973-74 177B	LYC. 180-HP O-360-A1F6D	2000	$23,000	50	900 LBS	125-130 KTS	±$37,000
1975-76 177B	LYC. 180-HP O-360-A1F6D	2000	$23,000	50	900 LBS	125-130 KTS	±$40,000
1977-78 177B	LYC. 180-HP O-360-A1F6D	2000	$23,000	50	900 LBS	125-130 KTS	±$43,000

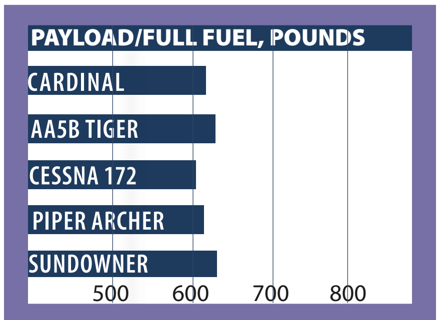
RESALE VALUES

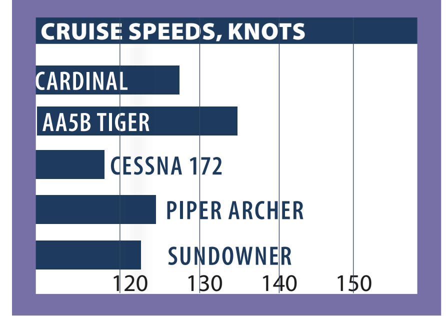


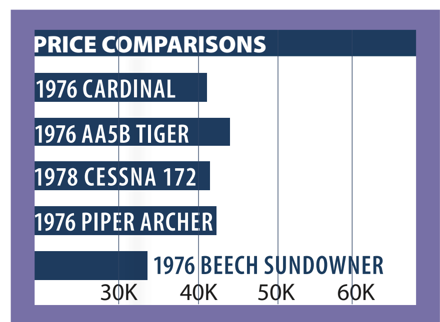
SELECT RECENT ADs

AD 2011-10-09	SEAT RAIL ASSEMBLY
AD 2004-19-01	SHOULDER HARNESS
AD 2000-06-01	FUEL VALVES/STRAINERS
AD 98-02-08	CRANK BORE CORROSION
AD 97-01-13	FUEL, OIL, HYDRAULIC HOSES

SELECT MODEL COMPARISONS







The Cardinal wing and cabin door arrangement is a winner, left. It affords wonderful visibility and easy ingress/egress. Tall folks, however, had better watch the noggin.

pilots were loading and flying the Cardinal as if it were a 172—which meant they were often over gross weight—since it carried 10 more gallons of fuel and had a heavier empty weight. Worse, Cessna discovered that pilots were climbing the aircraft well below Vy (Vy in the 172 was 10 MPH slower than it was for the Cardinal). When flown and maintained properly, the 150-HP Cardinal actually outclimbed and outran the 150-HP 172.

Cessna produced 1164 Cardinals that first year, but word got around about the airplane's performance. The following year, sales slumped, while other models were selling well. In fact, no more than 250 Cardinals were built in any single year after the airplane's introduction. (A total of 2752 were built, eventually.)

The Cardinal's wing was a high-performance NACA 6400 series airfoil, the same one used in the Aerostar and Learjet. But that airfoil tends to build up drag quickly at high angles of attack and low speeds, which isn't a good trait for an airplane flown by low-time, step-up pilots. The stall speed was higher than the Skyhawk's, too.

In the late 1970s, an accident involving an original model 150-HP Cardinal prompted a series of test flights (performed by an expert test pilot working for plaintiffs' attorneys) in an attempt to prove that the 177 didn't live up to its performance figures. The accident in question involved a pilot who supposedly had operated the airplane as described in the manual and wound up clipping the trees at the end of the runway. But because these trials weren't conducted by the FAA or Cessna, no official action was taken against Cessna. It wasn't until the early 1990s that the expert test pilot was proven wrong in court about his claims of the Cardinal's short field takeoff performance.

TOUCHY CONTROL

The 1968 Cardinal as originally delivered was quite sensitive on the controls, particularly in the pitch mode. In crosswinds, the stabilator could stall in the landing flare, resulting in a sudden loss of tail power and an unexpected plunge of the nosewheel onto the runway.

Porpoising and bounced landings were commonplace. Various studies showed a disproportionately high rate of hard landings and takeoff stall-mush accidents for the early models.

Cessna realized it had made a major gaffe with the Cardinal. It restarted the Skyhawk production line and set to work fixing the Cardinal's problems. Under the so-called "Cardinal Rule" program, it retrofitted leading slots to stabilators on Cardinals already in the field. This fixed the stabilator-stalling problem, although pitch forces remained lighter than average for a Cessna.

The 1969 model (177A) had a 180-HP Lycoming engine, plus there was a 150-pound increase in gross weight to compensate for both the engine's increased mass and some shortcomings in the original airplane's useful load. The stabilator slots were incorporated and the stabilator-to-wheel control linkage was changed to improve the pitch characteristics. The nosegear/firewall area was also beefed up to prevent bent metal from bounced landings. This fix was offered as a retrofit to 1968 models via an early bulletin.

Despite the improvements, 1969 sales nose-dived to about 200 units, while Skyhawk sales rebounded to their former league-leading levels. In 1970, Cessna made more major improvements, yielding the 177B. The 6400 series airfoil was changed to a more conventional 2400-series similar to the Skyhawk's, plus a constant-speed propeller was added for better takeoff and climb performance.

At last, the Cardinal had all the makings of a good airplane. From 1971 on, the Cardinal got only minor changes. In 1973, a 61-gallon fuel capacity became optional, and cowling improvements boosted cruise speed from 139 to 143 MPH. In 1978, a 28-volt electrical system was added. These days, that's appreciated for avionics upgrades.

In 1975, speed went up again, but this was really mostly the result of some creative number crunching by Cessna. For example, the cruise RPM limit was increased so that 75 percent power could be obtained at 10,000 feet instead of at 8000 feet, as before.

At the time, Cessna's marketing department called the Cardinal "the fastest 180-HP, fixed-gear airplane in the world." Not true—the Grumman Tiger was at least 8 or 9 knots faster—at about the same price.

Finally, 1976 brought a new instrument panel. The older panels had a 1960s Buick-style split panel arrangement that did little but rob panel space. The 1976 panel is a more conventional, full-width design.

Throughout this period, the airplane continued to be a slow seller, despite Cessna's successful efforts to fix the original Cardinal's quirks. It was the only Cessna single that didn't lead its category in sales. Piper's Cherokee 180/Archer beat it handily, as did the upstart Grumman Tiger.

In 1977, Cessna finally gave up on further changes to the Cardinal. The Hawk XP was introduced—same performance, less attractive, worse handling, noisier, more cramped, much higher fuel consumption and engine maintenance, lower engine reliability and TBO. Such is the way of GA marketing, however.

Meanwhile, Cessna added ARC radios to the standard equipment list and boosted the Cardinal's price by about 50 percent. Customers preferred the Hawk XP by a four-to-one

margin. Price and competition from Grumman and Piper undoubtedly had a lot to do with the poor sales, but the Cardinal's reputation clung to the model like a cheap suit.

In 1978, Cessna made one last-ditch effort to save the Cardinal. The company spruced it up with some fancy interior appointments and radio packages—along with an absurdly high price tag—and called it the Cardinal Classic. Only 79 intrepid souls sprang for the gussied-up airplane.

No surprise here because the average flyaway price of a Cardinal Classic was more than $50,000, compared to $30,000 for a Tiger or under $40,000 for an Archer. But the Classic remained devalued for quite some time. Normally, an airplane depreciates from its new value for eight years before resuming an upward value climb, eventually surpassing its new price.

As of spring 2014, a Cardinal Classic retails for around $45,000, although some may fetch more, depending on avionics and other mods. We saw one at AirVenture last summer decked out with a Garmin G500 glass display, dual GTN750 navigators, a high-end autopilot, plus leather interior and other luxuries. Its owner was asking nearly $70,000. Still, the airplane eventually took about 20 years to regain close to its original value, which is a dismal price performance compared to other models in this or any other class.

But there's a silver lining in that cloud for potential buyers. Because other models have had price spikes—namely the Archer and the Tiger—we think the Cardinal represents a better value, based on pure performance alone. With price parity, the buyer can choose the greater comfort of the Cardinal or the speed of the Tiger without paying a sizable premium either way.

PERFORMANCE

The Cardinal's performance is adequate by 1970s standards for 180-HP airplanes but more modern designs best it. Book cruise speeds range from 120 to 130 knots, while the 150-HP 177 is listed at 115 knots. Those numbers fall short of the Grumman Tiger (139 knots) and are about on par with the Cherokee 180/ Archer and better than the pokey

CARDINAL WRECKS: LANDINGS, FUEL

As we reviewed the most recent 100 Cessna Cardinal accidents we noted that the majority of accidents involved pilots doing something wrong on landing—hard landings, RLOC, blown go arounds—no surprise there. What got our attention was that there were 21 fuel-related accidents—all but one involving fuel exhaustion. The other was water in the fuel—a problem that has almost disappeared since the advent of "umbrella" style fuel caps.

Despite having a dirt simple fuel system (both, left, right, off) 20 pilots ran the tanks dry, almost invariably after departing with partial fuel. The NTSB Probable Cause report could be written with a rubber stamp: "The pilot's inadequate preflight verification of the fuel quantity and his inadequate fuel consumption calculations, which resulted in fuel exhaustion."

Quite a few pilots had difficulty landing Cardinals—the airplane remains responsive in all three axes at low speed, so it's not uncommon for pilots to overcontrol if they are used to less-responsive airplanes.

Plus, it's necessary to get the nose of a Cardinal high enough in the flare that it blocks visibility straight aheed—otherwise it will hit on the nose wheel and the pilot may then induce oscillations that can lead to breaking the nose gear. Approaching fast in a Cardinal is not a good thing, as the number of PIO and running off the end of the runway accidents attested.

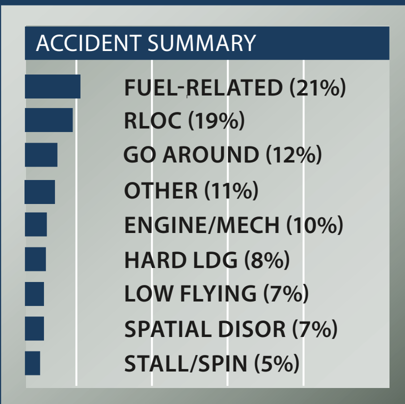
The Runway Loss of Control (RLOC) accidents spanned the spectrum from simply not keeping things collected and zipping off the side of the runway, to failing to keep the airplane on the runway on takeoff to landing long and going off the end.

Twelve pilots recognized that things weren't going well on landing and did the smart thing—they went around, either before or after touching down. About half promptly retracted the flaps—the manual calls for reducing to half flaps, initially—and sank until they impacted the ground or an obstruction. The others either delayed going around so long that they hit obstructions off the end of the runway or didn't maintain directional control and smacked into something off to the side.

One pilot had torn up a Cardinal in a landing accident. The FAA required that he take a "709" ride to assess his competency. He arranged for another Cardinal and went out to practice landings on the same airport. For some reason, he decided to make the landings downwind in a 10-knot breeze. He went around on the first two before touchdown. On the third, he forced the airplane onto the nosewheel. PIO ensued. He then went around, but pitched up so enthusiastically that he stalled the airplane at 200 feet and was killed in the subsequent, nearly vertical, impact.

One Cardinal pilot reacted to the disagreement between a failed attitude indicator and working turn coordinator while in IMC by entering a diving spiral. He emerged from the cloud bases at very high speed and was then able to recover to straight-and-level flight. However, the wing dihedral had increased.

Everything was going well for one pilot during initial climb until vibration caused the improperly reinstalled panel to lock up the contol yoke. He survived the out-of-control impact off the end of the runway.



In 1969, the 177A got the 180-HP Lycoming engine, top photo. Pre-1976 models had the split instrument panel with a single radio stack, bottom photo. The radio stack is just large enough for a modest upgrade.

Beech Sundowner. New-age designs such as the Diamond Star and Cirrus SR20—still four-place, fixed-gear cruisers like the Cardinal—obviously do better.

Owners report real-world performance reasonably close to book figures, except for the 1968 model. Typical figures: 125 knots on 9 to 10 GPH. The 1968 model, judging from some owner reports, is lucky to cruise at 110 knots, although we suspect faulty rigging has a lot to do with these low numbers. Climb rate is about average for this class of aircraft—again, with the exception of the 1968 airplane, whose owners universally complain about its lethargic climb performance.

Owners typically report useful loads in the 850-950-pound range, depending on installed equipment. That's a bit less than the Cherokee 180 or the Grumman Tiger, but perhaps not enough to rule in favor of one or the other solely on payload issues.

Assuming a fairly typical 900-pound useful load and 49-gallon tanks, the Cardinal has roughly 600 pounds for people and bags once the tanks are filled. That's three FAA-standard people—well, a little less if "standard" becomes 195 pounds—and 90 pounds of luggage.

If you want to carry four full-size people and 100 pounds of luggage, you'll be limited to perhaps 20 gallons of fuel—barely enough to fly anywhere safely. Weight limitations make the Cardinal essentially a three-passenger airplane, or at best a two-plus-two with adults and kids aboard, certainly not four large rear-ended adults—chose pax wisely.

With full tanks, the Cardinal has decent but not exceptional range. The 49 gallons usable and typical 9- to 10-GPH fuel flow allow the Cardinal to fly four hours with reserves and cover more than 500 miles. The 60-gallon tanks available on post-1973 models boost endurance by an hour and range by 150 miles, at the expense of 66 pounds of payload.

A typical 60-gallon Cardinal with tanks full can carry just 540 pounds of cabin load. The 1968 150-HP Cardinal (2350 pounds gross) has a gross weight 150 pounds lower than the 177A and 177B. Empty weight is only a bit less, so the 177's equipped useful load may be as low as 750 pounds. Put in four 170-pounders and 70 pounds of luggage and there's zero—yes zero—left for fuel.

Legally speaking, the 177s converted to the 180-HP constant-speed setup are worse, since useful load can't be legally increased while the new engine/prop package is about 50 pounds heavier. But most pilots of the 180-HP 177s fly as if they have 177As or Bs. From the performance point of view, they're perfectly safe doing that. As far as the landing gear and wing spar go, we're not so sure. Interestingly, the c.g. is so long that if you abide by the 120-pound baggage restrictions, it's nearly impossible to load out of c.g., even with two heavyweights up front (but no passengers in the back), or two heavyweights in the back and a lightweight pilot up front.

CABIN, ERGONOMICS

One goal Cessna hoped to achieve with the Cardinal was to improve cabin comfort and design over the 172/182 series aircraft and to best the competition. In this regard, it succeeded. The Cardinal cabin is fully 6 inches wider than a Cherokee's and puts its sibling Skyhawk to shame.

The baggage compartment is enormous and relatively easy to get to through a dedicated door. As noted, the airplane's wing sits higher and farther back, allowing excellent visibility out of the panoramic windshield. Unlike the other high-wing Cessnas, the pilot's vision up and to the side is not blocked by the wing. To a degree, this gives the pilot some of the best of both worlds—good visibility up, down and to the side.

The Cardinal's enormous doors offer another benefit: Of all airplane models we're familiar with, it's the easiest to get in and out of. There's no wing strut to get in the way and the floor sits lower to the ground than other high-wing Cessnas, so the step up is a small one.

Those doors require special care, by the way. Owners tell us that a gust of wind can damage the door and surrounding sheet metal when it opens violently. One reader pointed out that with both doors open and the airplane pointed downwind, the doors can act as fairly efficient sails.

Overall, the Cardinal is probably the roomiest four-place airplane made, not counting semi-six-seaters like the Bonanza or Cessna 210. The tradeoff for a big cabin, of course, is speed. The main reason for the Tiger's speed advantage over the Cardinal is that the latter has a bigger passenger compartment while the former is tight, with a minimal backseat and smaller frontal area.

HANDLING/FUEL CONTROL

The Cardinal wins praise from own-

A three-blade prop looks sexy, but some owners say it's extra drag and weight on the Cardinal's nose.

ers for its handling qualities. Despite having lighter control forces than other Cessnas, the airplane makes a fine instrument platform. In truth, the pitch sensitivity and porpoising tendencies of the Cardinal have never really been completely tamed. Fly a Cardinal with an autopilot that has automatic electric pitch trim and you'll see that trim wheel always moving.

Pitch control forces are light (particularly compared to the notoriously ponderous Skyhawk and Skylane), and Skyhawk pilots are sometimes surprised by the responsiveness and pitch authority. On takeoff, the Cardinal must be rotated with firm wheel pressure, at least with only two people in front and flaps up. This is, in part, because the pilot sits well ahead of the wing; all that weight out front has its consequences. Dropping 10 to 15 degrees of flaps for takeoff, however, will require a much less vigorous rotation moment.

In cruise flight, the Cardinal is a steady IFR airplane—if you can get it trimmed out laterally and keep the fuel balanced. Several owners reported gross fuel-flow discrepancies when the fuel selector is on "both," with the tendency for fuel to flow from the left wing. Left-right switching every half hour may be necessary to maintain good lateral trim or a few seconds of uncoordinated flight to clear the liquid from tank vent system, which is what causes the imbalance.

Otherwise, the Cardinal's fuel system is well designed. There's a reservoir under the floor, which means that there's essentially no chance of unporting as the result of maneuvering with low fuel. There is, however, a warning in the handbook about long nose-down descents with low fuel, which tends to run to the front of the wing tanks. The tank vents are cross-connected to the opposite wing and are led through the trailing edge where ice buildup shouldn't be much of a concern.

MAINTENANCE

At least some owners are attracted to the Cardinal because it has a benign maintenance history with few expensive gotchas.

Owners tell us annual inspections typically cost about $1000 to $1500 for the basic once-over, which is typical for this class of airplane when performed by higher-end shops and thorough mechanics. But this can vary widely. You might have to spend $5000-plus to bring back a barn dweller to airworthy status. Parts aren't a real problem, despite the model's relatively low population.

One other major maintenance factor: ARC radios, which are finally starting to disappear. Most Cardinals came with avionics manufactured by Cessna's onetime captive ARC company. Starting in the mid-1970s, the quality of ARC radios began to decline. ARC equipment rated dead last in our avionics owner surveys during that period and there were big shake-ups at the ARC factory at the time. Many owners have replaced part or all of older ARC panels. The 28-volt digital ARC navcomm radios, for example, are more serviceable than the mechanical 14-volt versions. We caution against spending money on these.

There are few onerous ADs on the Cardinal. A couple of shotgun ADs (2000-06-01 and 99-27-02) deal with fuel valves and strainers; not a big deal. Another shotgun AD is a big deal, however. It's 98-2-8, which calls for inspection of the crank bore for corrosion on the fixed-pitch airplanes. At the least, it's repetitive, and it could mean replacement of the crank. Make sure it has been done.

MODS, OWNER GROUPS

The big mod for the Cardinal is the one that converts the 150-HP

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model to the 180-HP constant-speed Lycoming. The conversion is quick and easy, basically a bolt-on job, so no surprise that hundreds have been done.

Two STCs are available, one from Avcon Conversions (316-284-2842) and one from Bush (800-752-0748). The two are similar. Both sell STC paperwork and kit parts; you buy an engine and prop elsewhere and hire out the shop to do the job yourself. The 1968 177A and B are on the same type certificate and some have upgraded to the later Cessna-selected counterbalanced engine/prop configuration.

Horton Industries (800-835-205) offers a STOL kit for the Cardinal consisting of a leading-edge cuff, conical wing tips and vortex generators on the vertical fin. The above-mentioned Bush also offers a STOL mod for the Cardinal, as does Sierra Industries. Contact Sierra at 888-835-9377 or www.sijet.com.

There's a burgeoning business in Cardinal speed mods. Canadian Roy Sobchuck came up with most of them and they're sold by Maple Leaf Aviation (204-728-7618). The mods include a nose strut fairing—claimed speed gain of 8 MPH—tailcone fairing (177A/B only, 7 MPH claimed but seldom seen) exhaust stack fairing, for a 2 MPH gain and a 75-degree drop in engine temperature.

The company also sells landing light covers, cowl cheek fairings, fuel drain fairings, ADF loop covers and wheel pants for which minor speed increases are claimed.

Cardinal owners have a choice of two major organizations. The Cessna Pilots Association (www.cessna.org and 805-922-2580) is the biggest overall Cessna group and publishes useful technical info, much of it of interest to other single-engine Cessna owners.

For the true Cardinal fan, we recommend the highly regarded Cardinal Flyers Online, (www.cardinal-flyers.com) which has a first-rate website and a near daily e-mail newsletter.

OWNER FEEDBACK

I purchased my 1975 177B in 2007. Since then, I've flown it all over the country and twice, coast-to-coast. The two best attributes are the cabin (longer and wider than a 182) and the improved visibility in a turn compared to other Cessnas.

My Cardinal has a three-blade prop and while I love the way it looks, I wouldn't recommend it. This is not because it results in lower cruise speeds, which I haven't observed, but because of the significantly increased weight on the nose as well as the unnecessary drag during descent. This makes power-off landings a challenge, requiring a large and well-timed pitch change between short final and flare. Normal and crosswind landings are simple as long as a small amount of power is carried through the approach and the throttle is pulled to idle just prior to flare.

Insurance is around $800 per year and the airplane has been relatively inexpensive to maintain. I associate most of the more expensive repairs with high time and age rather than the aircraft type. A few issues unique to the Cardinal that I've dealt with are overheating (typically on 90-degree-plus days, solved by flushing the oil cooler and installing the Maple Leaf exhaust fairing). There are loose door hinges and nose wheel shimmy. Most issues are well-understood thanks to the exceptional support provided by Cardinal Flyers Online, run by Paul Millner and Keith Peterson, plus an array of knowledgeable owners who gather around their site.

Chris Berg
Woodbridge, Virginia

I've owned a 1973 Cardinal since 2010 and bought it for training before even getting my license (I was a little worried that I may have been a bit impulsive). However, more than three years later, I've had no regrets. When I purchased it, the plane was almost all original, including engine, paint and interior. It has always been hangared and only had 1160 totals hours since new. Since purchase, I've added a Garmin GNS430W, JPI 830 engine analyzer, PMA8000 intercom, Alpha Systems Angle of Attack indicator and a Guardian CO detector that I connect to cabin iPads.

I paid $51,000 for the plane and generally flight plan for a fuel burn of 11 GPH, which is conservative. For insurance, I have a $1 million smooth policy that costs under $1400 per year, which is probably a bit higher than it will be when I get my instrument rating and over the 500-hour hurdle. It's a little hard for me to separate out the pure maintenance costs versus the upgrades I've made, but it would probably come in at about $2500 per year. I use Savvy Aircraft Maintenance, who coordinates with Cecil County Aero in Elkton, Maryland. Both have been outstanding. Although the 1650-hour engine is 40 years old, it seems to be doing fine and I am not yet considering an overhaul.

The cabin feels relatively roomy and my wife doesn't get claustrophobic. It's also a lot easier to get in and out of compared to the low wing planes we looked at before buying the Cardinal. I flight plan for 116 knots, so it's not real fast but it cuts my trips from Wilmington, Delaware, to our summer place on Cape Cod from about eight hours driving time to around 2.5 hours in the air.

Steve Furlong
Via email

I have owned N1419C, a 1978 Cardinal Classic for six years and have flown it for just over 1000 hours. I have used it primarily to transport passengers for Angel Flight and Life Line Pilots. Most of the flights are to transport passengers for cancer treatment but also to transport children to summer special needs summer camps in northern Minnesota. I have also had a flight for Pilots and Paws, transporting rescue dogs, which I found to be a very rewarding experience.

Many of these passengers find it difficult to get in and out of small airplanes, but the Cardinal's wide doors and low stance make it much easier for the physically limited passengers to get in and out of the

plane. These wide doors can be a problem if they get caught in a tail wind because they are so big, but this problem is solved by installing the Door Steward modification. The Cardinal Flyers Online web page has been an invaluable aid in learning about the plane, the many upgrades and modifications, plus special maintenance solutions. It has been a very reliable and comfortable plane—especially for the needy passengers I transport.

Derek Sharvelle
Battle Ground, Indiana

Our family of four has owned a 1968 Cardinal for five years. The Cardinal has proven to be a versatile airplane and flying in it is a real treat compared to other Cessnas. Probably the most obvious to pilot and passengers is the absence of a wing strut. This results in improved views down, but most noticeable is the much easier entrance and egress. The large size of the doors also contributes to easy access, but they do require caution when opening in a tail wind.

Another feature of the Cardinal is the location of the front of the wing—it's farther back than other Cessna models and results in improved visibility for the pilot and front passenger when looking up.

Our Cardinal has the original Lycoming O-320-E2D with the LyCon 160-HP STC. The performance is such that I am routinely comfortable taking off from our home airport that is 5000 feet above sea level. Not all pilots would be comfortable with the climb rate in the summer, which is often 200-300 FPM at our elevation.

We live in the eastern foothills of the Rocky Mountains, which means that 14,000-foot peaks are only about 30 miles west. As a result, I avoid going directly west through the mountains but have experienced no difficulties. Our Cardinal burns a little over 8 GPH and I flight plan for 110 knots, making it a fairly economical flyer. We have to decide whether the Cardinal is full of fuel or people, but with minimal planning, it routinely suits our missions.

Having done owner-assisted annuals on the Cardinal, I have not found it a difficult plane to work on. More important though is that my mechanics have not found it difficult to work on. However, they do remind me on occasion that there are many parts on the Cardinal that are unique, since it was a clean slate design.

My annuals typically run around $1500, with the high being $2600—comparable with other four-cylinder, fixed-gear, fixed-pitch aircraft. The insurance on the Cardinal is also very reasonable, and I have managed to get decent coverage for under $600 a year.

One of the benefits of being a Cardinal owner is the enthusiastic following of the aircraft. From model-specific support groups like Cardinal Flyers Online, to the many modifications from Roy Sobchuk, it is relatively easy to get expert support and improvements to keep a Cardinal safe and efficient.

Owning a Cardinal is just enough different to be fun. Not everyone has seen one and most would agree that it was one of Cessna's best efforts when it comes to ramp appeal. The 150-160-HP Cardinals are not as fast as they look, but as all pilots know, looks count for something.

Tom Lynch
Fort Collins, Colorado

We note, with sadness, that the designer of the Cardinal, Ted Moody, died this past February after a protracted battle with cancer.

Rick Durden, our senior editor, spent extended periods of time with Mr. Moody from 1979 through 1994 and had access to the original design records of the Cardinal. He recalls Mr. Moody's description of the intense secrecy surrounding the development of the airplane, including referring to it as the "Model 172J" so that competitors would think that Cessna was just coming up with another model year change for the 172. In fact, the original Cardinal had no virtually no parts in common with the 1967 172 beyond such things as brakes, wheels and tires. The Cardinal was the nearest to a clean sheet of paper design any of the manufacturers had created in some years.

Durden recalls Mr. Moody's description of how devastated he was upon learning of the first fatal Cardinal accident because, as Durden put it, "Ted Moody put his heart and soul into that airplane."

The Aviation Consumer®

Xtreme Decathlon

(continued from page 13)

from the rear seat of a Decathlon had always been a good news, bad news situation—the long line of the airplane in front of you made it easy to precisely nail pitch attitudes, but the combination of short control stick length and heavy ailerons made rolling maneuvers less than fun. The new ailerons solve that problem.

LANDING IT

Back in the pattern, we found that the disc area of the MT prop makes for substantial drag when the power is pulled back and the blades hit the low pitch lock—the airplane will come down with enthusiasm. A small bit of power breaks the descent easily. We found that when simulating an engine failure near the end of downwind, pulling the prop to low RPM and turning toward the runway early was necessary to make our desired landing spot. The prop control proved to function almost as well as speed brakes on a glider.

Three-point and wheel landings were normal Decathlon—utterly predictable and precise so long as you approach on speed. Tacking on extra speed on final isn't a good idea—there's plenty of control response at the book speed—and the resulting float from extra speed doesn't do anything good for the landing.

Max demonstrated crosswind is 20 MPH. We tried landings in various wind conditions. There was never any feeling of running out of control authority during any takeoff or landing. Go arounds were nearly instantaneous. Even taking more than five seconds from idle to full power, the Xtreme was climbing away from the runway smartly without any need for heroics on the rudders or retrimming.

CONCLUSION

At $285,000 decently equipped, the Xtreme is less expensive than we anticipated when we first heard about the airplane and its capabilities. Historically, there has been a limited market for two-place, highly capable aerobatic airplanes—largely because they were of little use for anything else, especially taking a friend on a weekend jaunt. In the past, one bought a Pitts to get serious performance—and accepted that you pretty much had to fly it weekly to be able to comfortably handle its challenging handling on landing. Plus, you weren't taking a friend on a trip—no range, no baggage and no heater.

The Xtreme changes the equation completely. Its muscular performance allows competition at the Intermediate level, it doesn't move your heart rate to triple digits on final and it will take you cross country in comfort, with baggage. We think American Champion has produced a winner.

Prop Care

(continued from page 20)

The result: after some time in service either the blade (or prop) had to be replaced—much more expensive than the original fix would have been—or the blade separated in flight, leading to a crash.

CONCLUSION

We prefer overhauling engines and propellers on condition, not at a time in service or calendar time—we think it's the safe and prudent way to go. With a propeller, attention by the owner in the form of regularly oiling the surface, using caution when taxiing, having nicks and gouges attended to immediately and sending the prop out for a reseal or IRAN at the published TBO can keep maintenance costs down.

IRAN or resealing a prop can delay the need for expensive replacement of blades and hub components most often caused by corrosion and can help assure that when you do have the prop overhauled, you'll minimize the cost.

FEEDBACK WANTED

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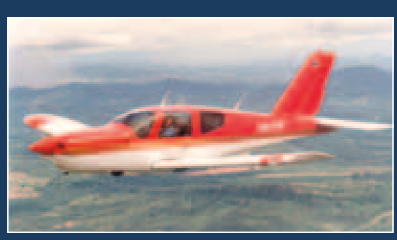

For the July 2014 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Socata TB20 Trinidad, the four-place, retractable single. We want to know what it's like to own these planes, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs you'd care to share. We accept digital photos e-mailed to the address below. We welcome information on mods, support organizations or any other pertinent comments. Please send correspondence on the Socata Trinidad by May 1, 2014, to:

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