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Total Eclipse

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The Aviation Consumer

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Any Hope for a Two-Fuel System?

In covering the ever-evolving avgas replacement story, I talk to a lot of people and receive e-mail from hundreds more. Owners and operators are starting to pay attention to this story and that's a good thing because at some point, they are going to have to decide what they want.

I've noticed a not-so-subtle undercurrent from owners of low-compression airplanes who are alarmed at the idea that there will be only one replacement fuel: an expensive, 100-octane equivalent that they'll be forced to buy for lack of choice. In this issue, we're dealing with one potential second choice, mogas. Although some owners are using it with good results, making it a realistic choice for airports will be a hard, uphill fight. The largest barrier is that finding premium mogas without ethanol—E0—is difficult and getting more so.

Ethanol mandates mean that blenders are looking for every drop of gasoline as a home for the rising tide of ethanol and the tiny E0 niche market is the last target of opportunity. In 2011 or certainly by 2012, the industry will hit the "blend wall," the point at which there isn't enough gasoline to absorb all of the ethanol being distilled. The EPA has already approved E15 as a response and ethanol critics say when this hits the streets, the howl from vehicle owners will be clearly heard in Washington. E15 reduces mileage and some cars just won't run on it. Its affinity for water could make for nightmares if the fuel is stored more than a month or two, which it frequently is for many users.

Our survey this month revealed that some aircraft owners are using E10, something that's not recommended and which isn't a long-term solution. So what is? In this country, there's hard resistance to a dual-fuel system that might consist of 94UL, for example, and an unleaded equivalent of 100LL. Refiners are blunt about this. They don't want to make two fuels and FBOs don't want to invest in tankage that would essentially split sales that are already declining. You can't blame them for not accepting the argument that they should spend $50,000 on tanks as a public service, then make the money on hangar fees and $100 breakfasts. That works for some airports—minimally—but it's a loser for many others.

Yet in western Europe, this model is working. In Sweden, for instance, many smaller airports have tankage for 91/96 (essentially 94UL) and 100LL. How do they make it work? For one thing, the ratio of high-octane engine to low-octane engines is different. In the U.S., the high-octane users burn 70 percent of the avgas consumed. In Europe, it's closer to 50/50 and is trending toward the lower octane. The price Delta between the two fuels is only about a dime in favor of 91/96, so that gives you a reasonable price signal on what 94UL might cost in the U.S. if it ever comes to market. (Actual costs, sans taxes, is $5.14 for 100LL and $5.04 for 91/96. With taxes, the costs are north of $9 per gallon.)

But the real driver is that in Europe, the fuel suppliers typically install and own the tanks, not the airport. Furthermore, at many airports, the operator pays for the fuel only as it's used. At a U.S. airport, when a 7000-gallon tanker shows up, the airport has to cut a $25,000 check. FBOs told me that if someone wanted to build the tankage, they would be receptive to a two-fuel approach. That's about as close to a no-brainer as you're going to get.

I see an opportunity in this for someone who wants to try marketing a second fuel vertically in the U.S. It could be done regionally as a test case, either with mogas or maybe even with 94UL as a test market. And maybe we're wrong to assume every airport will have two fuels. Maybe some will have only low-octane, some high octane, to suit their local market.

I don't know if the idea has legs or not. But to break us loose from the box we're in, the entire avgas replacement problem could stand some out-of-the-box thinking and thus far, I'm not seeing much of that.—*Paul Bertorelli*

Sunglasses Kudos

Good job on the research and info to rank this important pilot tool. I took a pair of G-15 frames and after having three pairs in a row of the glass lenses get damaged by my carelessness on the ramp, dropping off my face in 95-degree weather doing a fuel sump, or oil check for pre-flight or something, I went to a custom progressive polycarb prescription lenses, which I also needed to be legal to fly IFR approaches looking at approach plates. They are tops. Plastic is great. Frame size, optics with a green lens color are very good and the true test: I can wear them for my longest trips; 4.5 hours in a Malibu without any temple pain.

I have also owned a pair or two of Randolph Intruders that were glass lenses and I believe one of the studliest frames around for jock pilots. I have just converted one pair to polycarb lenses and am just breaking them in. Randolph's customer service people are top notch. RayBan and Serengeti are hip, but Raymonds have the best choice in aviator-style frames for old school guys like me.

Jack Thorp
via e-mail

What About 406?

I know both Spot and Spider well and your report in December's *Aviation Consumer* captures the essence of both of them. You also draw a sensible conclusion that they are apples and oranges and you get what you pay for.

But here's my beef with you on this. You parenthetically opened the question about whether 406 MHz ELTs are a worthy alternative or even an additional device intended to accomplish virtually the same task.

You hint that 406 is less than adequate in performance and you hint that sales of 406 ELTs have been weak. But this is not the Bertorelli who speaks straight talk and calls a spade a spade and provides solid facts and rationale for his conclusions and recommendations.

May I humbly suggest that you take on the obvious challenge to directly compare Spot/Spider with 406ELT? I have a hunch that you were simply teasing us as a precursor to an article next month that answers my question.

I see no significant incremental value in 406 so I will continue

with my 121.5 MHz ELT, plus Spot or Spider. But the mandatory 406 requirements in Canada and Mexico place me in a jam because I fly across both borders.

In my view, Canada and Mexico have been duped into mandating 406 ELTs. Sure, they both have a grace period for U.S. aircraft, but that will soon end. If you believe in 406 ELTs, let's be reading your rationale! If I am missing something, I am all ears.

Jim Herd
via e-mail

Paul Bertorelli concedes he is but a shell of his former self but promises to take your request under advisement.

Inogen Oxygen

I read Marc Cook's article on the Inogen oxygen generator in the October 2010 issue with interest. An on-board oxygen generator (OBOG) seems like a good idea whose time may be here.

Two points to make: The article describes a flight at 13,000 feet and converts this to density altitude. Oxygen need is driven by *pressure altitude*, not density altitude. It's the partial pressure of oxygen that is important, not the density. So the table's column of 15,800 feet is actually 13,000 feet. The equipment doesn't look quite so good.

The second point is the use of a cannula which is simply not as good at delivering oxygen to the lungs. I'd recommend repeating the tests with a mask and recalibrate the tables to pressure altitude.

Richard L. Newman
Lexington Park, Maryland

Awesomeness of Glass

With regard to your latest editorial about the value of glass in aging airplanes, I think there are a couple of more aspects to this whole new world. I'm now in my sixties and I've had my airplane for almost 17 years. In my wildest dreams, I never thought it would be what it is today. In my eyes, it's practically an airliner.

If you had told me 10 years ago that all my approach plates would be on the panel and I would no longer have two mechanical vacuum pumps, I would have written you a prescription to ease your anguish.

And I never hear mentioned the hidden benefit of all this newfangled stuff: It brings instrument flying up to a whole new level by bringing the pilot right into the panel. My abilities are way better than before the glass. Know what I mean, Grasshopper?

At this point, my airplane is certainly the last one I will ever have and I'm as pleased as punch about

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Phoenix Rising? Eclipse's New Plan

The first step is to rebuild a tarnished reputation, but with the Total Eclipse program, the new company has the airplane where it should have been all along.

Back in the ebullient days of 2002, before the iPhone became the bright, shiny object du jour, our frenzy was focused on something else: The coming of the very light jet or VLJ whose speed, affordability and ease of access were going to revolutionize personal transportation in the same way the internet rewrote the rules of communication. It was to be, said a leading disciple of the cause, "disruptive technology."

Six years later, the lavishly promoted rock star of the VLJ—the Eclipse EA500—was at the bottom of a billion-and-half dollar smoking hole with a reputation so besmirched that only one serious bidder emerged to buy the company's bankrupted assets. From the ashes, the new Eclipse Aerospace hopes to be a green shoot, hitting the timing right and offering what many people in the industry still believe is a concept that ought to work: a highly automated, small, fast, economical jet that a single pilot can easily fly.

The new Eclipse is headquartered in the same place the old company was, at the Albuquerque International Airport, originally lured there by generous concessions from the state of New Mexico and the city. An investor group headed by Mason Holland and Mike Press bought the assets for $40 million, rejiggered the infrastructure to a much smaller footprint and is now busily modifying many of the existing 260 airplanes with known-ice protection and upgraded avionics.

> ***The Total Eclipse is the fully integrated, ice-protected small jet the original was intended to be.***

Eclipse's production tooling is in storage and Holland told us the company will be ready to build new airplanes when the market is ready to buy them. For now, its signature product is a play on words: The Total Eclipse is the fully automated, fully integrated and ice-protected small jet that the original was intended to be. In support of its efforts, the new Eclipse has signed a deal with Sikorksy Aircraft for maintenance and technical support which, by the way, brings some street cred the original company never quite enjoyed, given that it entered the market with a we'll-show-you-how-it's-done attitude.

ECLIPSE HISTORY

If the Total Eclipse represents the original idea done right, the first airplanes the company produced can fairly be viewed as "almost there, but rushed out the door." Press and Holland say the push to develop a design capable of over-ambitious volume production—and creating a company that could produce it—almost guaranteed that early airplanes would emerge half-baked. And they did. Given the pressure to sell airplanes, prime the air taxi pump and generate revenue and buzz, Eclipse succumbed to the notion that it would be better to have incomplete airplanes delivered than to delay deliveries and finish the job correctly.

Had the original company had another year, the story might have been different. As it was, the com-

pany declared bankruptcy ahead of the market meltdown in 2008, so its troubles were not related directly to the current aerospace recession.

Eclipse's original airplanes (up to serial 39) didn't meet promised range and speed parameters and the company fixed that by designing larger tip tanks. It also cleaned up some drag issues to improve speed. These airplanes became the so-called ETT models for extended tip tanks. These airplanes also didn't have approved ice protection, an upgrade that didn't become available until the eve of bankruptcy.

The original airplanes—through number 105 —also had the Avidyne avionics suite, but this was replaced by the Avio system which Eclipse developed with IS&S after falling out with Avidyne. Some 50 serials later, a newer version of this system was installed, but it still had no integrated nav GPS, so in place of a slide-out keyboard originally intended as an input device, Eclipse slotted in a Garmin 400 GPS navigator, which is what most of the airplanes are still flying with today. The latest version of AvioNG available for existing owners is the 1.7 upgrade, which includes everything short of a fully-integrated FMS system. About 100 existing airplanes have been upgraded to this status and the company seems to be keeping busy doing the conversions as customers order them. The hangar was chock-a-block with airplanes when we visited in November of 2010.

When the new company won the assets at auction, it got all of the production equipment and related physical plant, plus about 30 airframes in various states of completion—some were still on the line, others were callbacks from the DayJet air taxi project. These airplanes have been or are being converted into the current state of the art, the Total Eclipse. Furthermore, Eclipse is buying some airframes on the open market and converting them to the Total Eclipse.

These airframes will have full known-ice protection, upgraded interiors and, eventually, a version of the AvioNG which includes GPS and the fully integrated FMS system. The Garmin 400 is removed in favor of the original keyboard, which slides in and out from a spring-loaded drawer under each pilot display. When Eclipse resumes production—and Holland insists that it's "when" not "if," new airframes will have all of these upgrades and perhaps some new ones going forward.

The centerpiece of the Total Eclipse is the soon-to-be-certified AvioNG FMS, above, which has a fully integrated flight management system that includes internal GPS. Note the slide-out keyboard planned for the original, but eliminated to make make room for the Garmin GPS400Ws needed for navigation data. The Avio is rich with synoptic displays, including basic systems, upper right, and real-time weight and balance, lower photo.

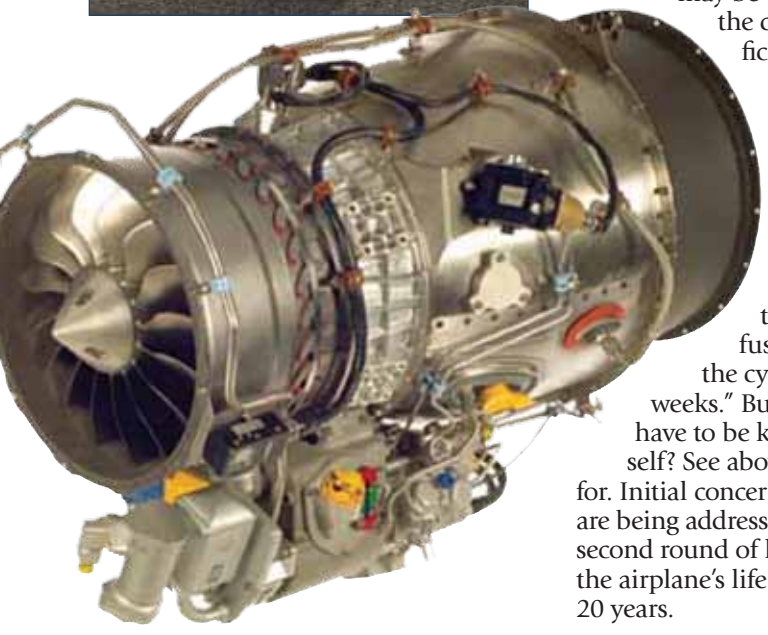
GEARED FOR VOLUME

The original vision for Eclipse was a high-volume, high-utilization, low-cost airframe and it is designed and built accordingly. In Holland's view, Eclipse got that part of the equation exactly right. "Aerodynamically," he says, "nothing else on the market can touch this airplane. We couldn't be happier with this airplane. It's not the best thing for every mission, but 70 percent of flights out there are 750 nautical miles with three people. This airplane does that."

At 370 knots max, the Eclipse is a little faster than the Cessna Mustang, although even with the larger tip tanks, it lacks the Mustang's range by 200 miles. Pilots who have flown it rave about its handling, the spiffy sidestick and ease of operation. During the early promotional phase, much was made of the friction stir welding used rather than riveting to assemble the fuselage. At the time, the Eclipse's level of integration—especially the graphic synoptics for the airplane's systems, its crew alerting messaging for faults and internal diagnostics for maintenance were considered a great leap forward for small jets, although such technology has been available in transport airplanes.

But how will all that complexity play out in a market where the new Eclipse will probably build a small fraction of what the original company once envisioned? Press thinks the equation favors small production

The Total Eclipse got a new interior, but the original, above, wasn't exactly a slum. Trailing link gear makes for easy landings, but tire life on early airplanes was abysmal. It has been improved with bias-ply tires. The Eclipse's big success story is its engine, the Pratt and Whitney 610F, below.



just as well as volume. For one thing, the investment in the friction stir set-up is sunk money—all of it's paid for and the new company got it for what may be the fire sale price of the century. Second, efficiency is efficiency.

"It's not going to require large volume to make this pay," Press says. "With the welding, we can build one fuselage in one day. It's lighter and it's three times stronger. If that fuselage was riveted, the cycle time would be in weeks." But doesn't the jigging have to be kept busy to pay for itself? See above … it's already paid for. Initial concerns about longevity are being addressed, Press said, in a second round of load testing to prove the airplane's life cycle out to at least 20 years.

With tooling already proven and paid for, Holland sees a viable company with volume in the 50- to 150-airplane range, at unit prices above $2 million. Despite Eclipse's early claims that the airplane would sell for around $1 million or a little under, Holland said it was always at least a $2 million airplane, if not more.

RAVE REVIEWS

After initial teething pains—which were fewer than might be expected with a design this sophisticated—the airplane's complex integration has generally been viewed favorably by operators. Theoretically, things like brushless motors, a lack of hydraulics, automatic everything and sophisticated, always-on system monitoring is supposed to reduce the routine maintenance load. Early beefs about short tire life were addressed by replacing radial tires with the bias-ply tires generally used on aircraft.

One thing unique about the airframe is that it doesn't require an annual inspection, but a 300-hour or two-year extensive maintenance inspection. There are too few fleet hours thus far to prove how this will play out in the long term, but it's telling that there are only six ADs on the airframe, none of them related to major structural or aerodynamic issues.

The most recent was a software fix to address uncommanded frequency changes in the AvioNG system. There's also an AD limiting Eclipse operation to 37,000 feet (from the 41,000 feet originally certified) due to carbon build up on the PW610F-A engine static vane. This led to engine surging, but the altitude restriction evidently addresses this. Press told us Pratt & Whitney is working on a fix.

Otherwise, just as Pratt predicted, the engine has proven reliable and has met maintenance expectations. Owners say it is easy to service and Pratt has backed up the product with a reliable parts chain. We know of no failures in about 60,000 fleet hours and the fleet time leaders are just com-

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ing up on the first hot sections.

FLYING IT

The Eclipse was conceived as a highly integrated, highly automated airplane designed to rid the airframe of mechanical and electromechanical devices. It would also give the pilot an unprecedented real-time glimpse of navigation data and especially aircraft systems status, making it practical and easy for a single pilot to fly.

Did it succeed? Mostly yes, although only with the Total Eclipse program and AvioNG FMS can the airplane's navigation system be considered as measuring up to the state-of-the-art of Garmin's G1000 or Avidyne's Release Nine in self-contained navigational capability. With Garmin GPS400Ws providing the nav source, the 1.7 version is fully functional, but lacks the FMS's full integration and keyboard interface.

The airplane's integrated systems monitoring and synoptics—presented on a large color display in the center of the panel—are well designed, readable and relatively easy to use. With absolutely no training and after seeing it twice, we could begin to grasp its logic. System status for everything from fuel, to engine to environmentals are viewable at a glance.

When we visited Eclipse's Albuquerque shop in October of 2010, the company had more than a dozen aircraft in various stages of repair and upgrade, but none were available to fly so we contacted owner David Green, whose EA500 is based at our home airport, Venice, Florida. Green is also head of the Eclipse Owners Club, an owner organization that has been exceptionally active and involved, primarily because it has had to be.

Green owns serial number 129, which was delivered in 2008 lacking the known-ice package, the improved windshields and tires and other upgrades. He has since added those items and considers the airplane perfect for what he uses it for: personal transportation. He gave us a brief demo flight from Venice to Ocala, Florida.

The EA500 is hardly a large airplane, so getting into the cockpit is a bit of a squeeze, which we would liken to entering a Piper Mirage or any cabin class twin. On the windshield center post is a beefy hand grab that aids the process of levering into the seats. Once you're in, the seats have nice adjustors for height and fore and aft positioning.

What's most striking about the cockpit is how quiet it is, both on the ground with engines off or idling and in the air. There's a lot of carpet and leather to soak up the noise and, we suspect, sound deadening insulation throughout. The most noticeable noise comes from the air conditioning system, which is excellent, keeping the cockpit at a comfortable temperature without subjecting the occupants to gales of blowing air.

As intended, Green operates his Eclipse by the book, using the Avio's center screen to step through pre-start, then backing that up with a quick sweep through a paper checklist. Most of the pre-start effort involves flightplan input into the navigators, checking the weight and balance and reviewing the synoptic displays for any abnormals. The Avio is capable

LOVE THE AIRPLANE, NOT THE COMPANY

That seems to be the typical sentiment when Eclipse owners describe their experience with the original company. And, according to owner David Green, who heads the Eclipse Owners Club, it frames the challenge for the new owners.

So far, so good for the new company, says Green. He says most owners are still concerned about their airplanes becoming lawn ornaments and that with an existing fleet of only 259, the numbers just don't gel for long-term sustainability through just upgrades and support.

"That's why we see the Sikorksy deal as fabulous," Green told us. "The owners want this airplane back in production. [Sikorsky President] Jeff Pino fell in love with this airplane just like we did," he adds. As Green, a retired marketing executive, sees it, Sikorsky bought themselves a look into what was a $1 billion-plus investment with little money and little risk. It could evolve into the deal of the century with little downside risk if it tanks.

Meanwhile, Green believes Mason Holland has moved the needle on polishing the company's besmirched reputation. "I give him lots of credit. He has listened and he has delivered on what he promised," Green says.

That includes delivering on upgrades such as the known ice package and improved windshields and seeing the AvioNG upgrades through to completion. Green says that although some owners have grumbled about the price of these upgrades, they realize Eclipse has to survive, thus they consider them priced on the high side but fair.

As for his personal experience, Green says he'll wait and see about the FMS upgrade because with the AvioNG 1.7, the airplane meets his needs perfectly. "It really is exactly what I was hoping for," Green says.

Hits and misses? Brakes and tires were a weak area, since fixed; the PhostrEx fire bottles for the engines are susceptible to leaks, which can cause expensive corrosion (being re-engineered); access to the nose compartment requires re-caulking and repainting the cover, an expensive nuisance that we suspect will be corrected in new production airplanes.

"A lot of owners got these airplanes for $1.3 to $1.4 million or less. That's a steal. But it needs to go back into production to assure success. That's where Sikorsky comes in," says Green.

Eclipse once dominated the Albuquerque Airport, lower photo, but has now collapsed into a smaller footprint where about 125 employees are busily upgrading the existing fleet.

of displaying dozens of crew alerting system messages so what the pilot misses, the airplane won't. Startup is entirely automatic. Just flip the overhead switch to start, then monitor the temps as the engines spool. Even when they light, it's difficult to tell from the cockpit, given how quiet it is.

Piston drivers stepping up to the Eclipse will be challenged by two things: the need to master the avionics and the airplane's speed and acceleration. This is noticeable on the runway as the thing bolts toward rotation speed (under 90 knots), requires a sharp tug to 10-degrees pitch up and then just keeps accelerating. Right off, the climb rate was 2000 FPM at 180 knots and in a brief level out awaiting clearance for higher, we rapidly touched 240 knots. Pitching up out of that speed yielded climb rates as much as 4800 FPM; we easily sustained 2500 FPM to FL200.

Like most owners, Green transitions to the autopilot shortly after takeoff, then flies the airplane from the AP panel under the glareshield. For a small airplane, the Eclipse has surprisingly high control forces in both pitch and roll. Rolling right (from the right seat) is stiffer than left mainly due to physiology: You get more torque with an inward arm motion than an outward one. As in a Cirrus, you learn to position the arm to get effective leverage. High control forces have one benefit: Control inputs are well damped so the ride is silky smooth, with little tendency to overshoot pitch or bank targets.

Because the engine thrust lines aren't far apart, there's not much yaw from differential thrust, thus an engine out is a non-event except for the lost performance. Green demonstrated this by scissoring both throttles while on autopilot; the airplane barely noticed.

FL200 is not the most efficient altitude for the EA500, but 370 is. It will true in the 360-knot range burning about 180 pounds (27 gallons) per side. Green told us the Eclipse's range is about 1000 miles eastbound and 800 miles or a little less westbound, with a generous fuel reserve. If he wishes for anything, he says, it would be for another 300 pounds of fuel to extend the range.

CONCLUSION

For now, Eclipse's mark on aviation history is an epic failure; a case study in overpromising, underdelivering and overspending. But that had little to do with the airplane itself, which by all accounts and confirmed by our impression in flying it, is more right than wrong. Although it falls far short on its original price objectives, it's a credible performer with good speed and adequate if not exceptional range. In short, it's a fast, easy-to fly-airplane that's comfortable and efficient.

It's now up to Mason Holland and company to rebuild the brand's reputation, wait for the market to turn and resume production at realistic volumes and sane prices. Estimates on what "sane" is vary, but it's likely to be around $2.5 million, which would place the new Eclipse in a price niche of its own, competing well below the Cessna Mustang and a bit under the single-engine Piper Altaire, recently bumped up to $2.6 million.

For now, Eclipse has to maintain a delicate dance with current owners to sustain itself through the upgrade and support business, a venture with a limited future. Beyond that, it will need to find demand for new aircraft, restart the line and sell airplanes.

Our guess is that if it does everything right—controls costs, buffs up the reputation, delivers on promises at a profitable price—it has a good chance of success. Evidently, Sikorsky thinks so, too.

AC TV

For a video demonstration of the Eclipse EA500, log on to www.avweb.com and select the video index in the upper right corner of the home page. Scroll down to the Eclipse video.

Autopilot Upgrades: Options are Improving

The Bendix/King KFC225 wins in performance but lacks approval for the masses. Cobham S-TEC fills that gap, but with lesser performance.

By Larry Anglisano

CHECKLIST

- New AHRS interfaces enhance old and new autopilot performance.
- Honeywell KFC225 offers best performance, but the STC list is short.
- S-TEC a good option for lighter craft and offers incremental upgrades.
- Any autopilot install work can blow the budget.

When planning major avionics upgrades, autopilots rank near the top. A panel full of integrated glass or even a single-screen Aspen will be lacking without autopilot integration. But adding a new autopilot could be a budget-blowing proposition.

For most go-places aircraft the investment is worth it, especially with modern AHRS-driven interfaces upping the ante on automation and long-term reliability. Here's an overview of market offerings for retrofit autopilots. One size won't fit all, and that's without covering systems for LSAs or Experimentals. We'll look at those in a future article.

HOW MUCH CONTROL?

When shopping for a system, you'll need to get your axis terminology correct. A single-axis system controls the roll axis of the aircraft only, essentially leveling the wings and driving the ailerons to a selected heading and, if interfaced, tracking or intercepting nav and GPS signals.

A dual-axis system includes pitch control or basic altitude hold. A yaw damper adds the third axis—not heading command as some are led to believe—and uses a dedicated servo to the rudder for coordinated flight.

Then there's pitch trim, both manual electric and automatic electric. Autotrim automatically commands elevator trim when the autopilot makes pitch changes. Some lighter aircraft don't need autotrim, and low-end systems like the S-TEC Thirty don't even support it. But higher-performance aircraft need it. Autotrim requires a dedicated trim servo which adds to the bottom line. There's also trim prompting, which prompts the pilot to trim if it senses an out-of-trim condition.

COBHAM S-TEC

With more autopilots and approved applications than any manufacturer, the Cobham-owned line of S-TEC products is well proven, and easier to install and maintain than other brands. These rate-based systems use a custom turn coordinator to drive the roll axis of the aircraft. They offer backup for vacuum failures since the turn coordinator is electric.

S-TEC claims their rate gyros have a mean time before failure of over 8000 hours because the rotor spins at one third the speed of the average attitude gyro. But there's a catch. Faster and heavier craft with rate-based autopilots often struggle with turbulence and coupled approaches in gusty winds. It's widely accepted that attitude-based autopilots offer a superior ride, but they cost more to install and maintain.

All S-TEC systems use common hardware, servos and sensors. In our view, this is a big advantage that allows you to upgrade or add to the system in stages. Another S-TEC advantage is the ability to save panel space with the S-TEC System Twenty and System Thirty systems, which contain autopilot controls on a replacement turn coordinator.

The S-TEC Thirty replaces the turn coordinator and has a single-knob control. However, a new directional gyro with heading command is another $2000, and GPSS steering adds $4000 more. That's nearly half of an Aspen PFD, which has both functions built in.

All systems can be interfaced with an optional heading system (HSI, DG or PFD) for heading command. GPSS is an option that requires a panel-mounted command switch and remote converter box.

The S-TEC line is so rich with options, it's confusing (see chart on page 11). The entry-level models include the System Twenty and Thirty, as well as the ATI panel-mounted System Forty, which uses a separate turn coordinator and controller. Function-wise, this systems are nearly identical. The System Thirty and System 50 have altitude hold capability and a manual electric trim option. The way we see it, there's little advantage going with the two-piece Forty or 50 system unless you want localizer backcourse tracking, a function that's lacking in the Twenty and Thirty.

All S-TECs will interface for lateral navigation and GPS *tracking*. But the Twenty/Thirty/Forty/Fifty-Five systems won't intercept a course at sharp angles. Instead, you manually put the aircraft on course—including an approach path—and then engage the autopilot's nav mode to stay there. They won't capture a glidepath for an ILS or LPV approach. But they can fly the lateral part of the approach while the pilot controls the vertical. None offer autotrim.

STEC's higher-end systems include the Fifty-Five X, which is the familiar radio rack-mounted controller that has vertical speed command, navigation and glideslope capturing, GPSS and supports autotrim. It also works with the flight director for the Aspen and KI256 (through a separate annunciator). There's an optional remote altitude preselect/alerter with voice callouts. It also includes a new encoding altimeter that commands level-offs and climbs and descents.

A vintage model that remains in the S-TEC line is the System Sixty-Two. It was initially aimed at bigger aircraft and has nearly all the functionality of the Fifty-Five X except integral GPSS. The ST-901 GPSS system can be interfaced with it (and any other S-TEC system). The Sixty-Two also utilizes remote roll and pitch guidance computers that take space in the airframe. Racking them in the avionics bay or in the nose of a twin is in order. The Sixty-Two is a solid performer despite being rate-based, with good nav and glideslope intercepting. The Sixty-One is a single-axis version of the system and a relatively uncommon choice.

The Fifty-Five X and Sixty-series also support control wheel steering (requiring another button on the yoke) and dual-mode intercept, meaning you can fly selected heading to automatically capture a course.

All S-TEC systems call for optional yoke or panel switches for autopilot disconnect and altitude engage/disengage. S-TEC has options for yokes that don't have space for these.

BENDIX/KING KFC225

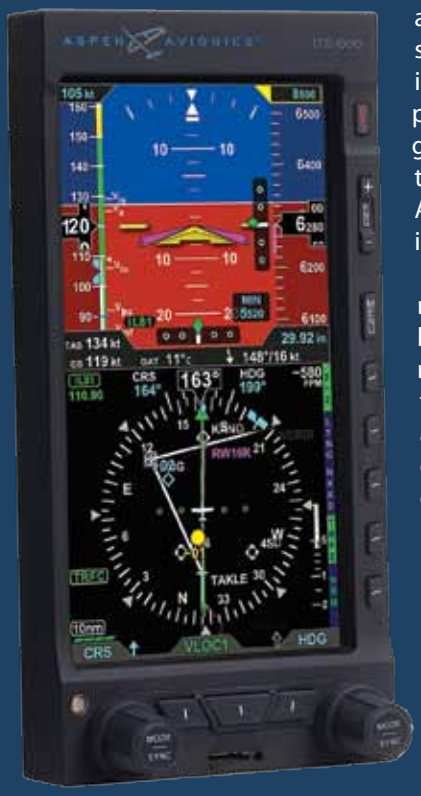
Introduced in 1999, Honeywell dropped the digital KFC225 flight control system in 2007 because of low sales volume. This higher-end system was a stretch for the average budget and with limited STCs. Honeywell says demand is back and

GOING NO GYRO WITH A KFC225

Shop theory has it that attitude-based autopilot performance is only as good as the signal it receives from the driving horizon gyro (or turn coordinator in a rate-based system). If a gyro is lazy and its signal pick-off is erratic, the autopilots performance suffers. Such symptoms might include annoying wing-rock or pitch porpoising that shops struggle to fix. Total or partial gyro failure or an unusual attitude will degrade or fail the system.

But the world of AHRS cuts the spinning autopilot gyro out of the picture once and for all.

Aspen's newly-certified EA100 digital-to-analog autopilot adapter streams AHRS-derived digital roll and pitch data to the autopilot, breathing modern energy into otherwise dated systems. Garmin's GAD43 does the same trick for their G500/600. Both companies have approval for interfacing with most KFC-series Bendix/King autopilots. Considering the average cost to overhaul the popular Bendix/King KI256 autopilot gyro is nearly four grand, springing for the $2495 an EA100 option to couple the Aspen to an existing KFC-series autopilot is a no-brainer, in our view.



The digital interface comes with some modern enhancements: Aspen is able to build in fail-safe health monitoring algorithms to the interface so if a pitch or roll fault is detected, the autopilot immediately disengages. This is likely not the case when a conventional vacuum-driven horizon fails, potentially leaving the autopilot following bogus commands.

There are a lot of KFC200 systems flying around that beg for upgrade. There are also a lot of airplanes that already sport Aspen or G500/600 installs. Given the improved reliability and integration gained, we think the GAD43 or EA100 is a worthy option.

AUTOPILOT	PRICE	SYSTEM TYPE	NAV INTERFACE	G/S?	AUTO TRIM?	COMMENTS /PERFORMANCE
COBHAM S-TEC						
SYSTEM TWENTY	$8232	SINGLE AXIS	TRACKER	NO	NO	ENTRY-LEVEL, EXPANDABLE TO TWO AXIS
SYSTEM THIRTY	$13,104	TWO AXIS	TRACKER	NO	NO	GOOD VALUE, SPACE SAVER
SYSTEM THIRTY ALT	$7014	ALTITUDE HOLD	N/A	NO	NO	ADDS BASIC ALTITUDE HOLD INDEPENDENT OF THE CURRENT ROLL AUTOPILOT
SYSTEM FORTY	$8400	SINGLE AXIS	TRACKER	NO	NO	SEPARATE CONTROL HEAD BUT ADDS LOC BACKCOURSE TRACKING
SYSTEM FIFTY	$13,461	TWO AXIS	TRACKER	NO	NO	SEPARATE CONTROL HEAD BUT ADDS LOC BACKCOURSE TRACKING
SYSTEM FIFTY-FIVE X	$22,323	TWO AXIS	INTERCEPTOR/ TRACKER	YES	OPT. $4725	FLAGSHIP SYSTEM WITH INTEGRAL GPSS STEERING, RADIO RACK MOUNT
SYSTEM SIXTY-ONE	$10,185	SINGLE AXIS	INTERCEPTOR/ TRACKER	NO	NO	BASIC ROLL PLUS ENHANCED NAV CAPABILITY
SYSTEM SIXTY-TWO	$18,018	TWO AXIS	INTERCEPTOR/ TRACKER	YES	OPT.	REMOTE PITCH AND ROLL COMPUTERS EAT AIRFRAME SPACE, GOOD PERFORMER
SYSTEM SIXTY-FIVE	$40,845	TWO AXIS	INTERCEPTOR/ TRACKER	YES	YES	PEDESTAL MOUNT VERSION OF 62
SYSTEM SIXTY PSS	$10,563	ALTITUDE HOLD	N/A	YES	OPT.	ALTITUDE HOLD WITH VERTICAL SPEED COMMAND AND GLIDESLOPE COUPLING
SA-200 PRESELECT	$10,248	ALTITUDE PRESELECT	N/A	N/A	N/A	VOICE AUTOMATED ALTITUDE ALERT/PRESELECT W/ENCODING ALTIMETER
ST-645 FLIGHT DIRECTOR	$1680	REMOTE ANNUNCIATOR	N/A	N/A	N/A	PROVIDES FLIGHT DIRECTOR CAPABILITY WITH KI256 AND ASPEN EFD1000PRO
YAW CONTROL	$6699	YAW DAMPER		N/A	N/A	STANDALONE YAW AXIS CONTROL
HONEYWELL						
KFC225	TBD	TWO AXIS (YAW OPTION)	INTERCEPTOR/TRACK	YES	YES	FULL FEATURED, INTEGRAL GPSS, VOICE AUTOMATION, EA100 COMPATIBLE
CENTURY						
C4000	$19,995	TWO AXIS (YAW OPTION)	INTERCEPTOR/TRACK	YES	OPT.	LIMITED STC TO DATE, STILL USES PRICEY ATTITUDE GYRO, JET-LIKE CONTROL HEAD
AVIDYNE						
DFC90	$9995 BASE	TWO AXIS	INTERCEPTOR/TRACK	YES	YES	AHRS-BASED, EASY RETROFIT FOR 55X-EQUIPPED ENTEGRA MODELS

is returning the KFC225 to market.

A big part of the KFC225 expense was that the STCs included the pricey KCS55A HSI/compass system. But now that Aspen and Garmin have STCs to interface their displays to the KFC225—removing the need for the KCS55A and KI256 Flight Director—the KFC225 is a viable option.

Picking up where the excellent-performing analog KFC150 autopilot left off, the digital 225 is packed with features and a proven performer. In our experience, it outperforms any rate-based system in all modes. The system is intuitive, has GPSS, autotrim, voice alert automation and an integrated altitude preselector; and is equally at home in a Baron or single-engine Rockwell. That's a lot of punch in a single package. A yaw damper is the only major option.

Digital servo motors have a lot to do with the KFC225's tight and authoritative command. It aggressively grabs the localizer and glideslope even in high winds and best-forward speed—exactly the conditions where an S-TEC system might disappoint.

This isn't to say that the KFC225 won't fail, but we don't see nearly as much as with the lesser and discontinued KAP140. We like the maintenance-friendly servo installation that allows for motor and clutch removal while the capstan assembly stays connected to the controls. This time-saver makes avionics techs smile. Further, the KFC225 stores diagnostic codes that techs access through a digital interface, speeding troubleshooting efforts.

Honeywell hasn't firmed up pricing for the KFC225. Applications will include a healthy list of Beechcraft Barons, Bonanzas, Piper Navajos, some twin Cessnas. We're told the Cessna 210 and others may be added at a later date.

CENTURY FLIGHT SYSTEMS

Seemingly fallen off the face of the earth, Century is still around and offers good repair service on most vintage models. They recently announced a new autopilot: the C4000.

On paper (we've yet to see one) the 4000 system looks high-end, with a Dzus-mount control head and lots of mode lights and buttons. The C4000 is attitude-based and driven by the 52D267, a pricey old-school gyro.

Here's a preview of Century's new ride, the C4000. No, we're not sure what all those buttons and lights do, either.

Standard on the 4000 is heading hold, nav/approach intercept and tracking (including ILS, VOR and localizer back course) and GPSS steering. The altitude function offers trim prompting or autotrim, pitch attitude hold, vertical speed select and hold and glideslope from above or below the glide slope.

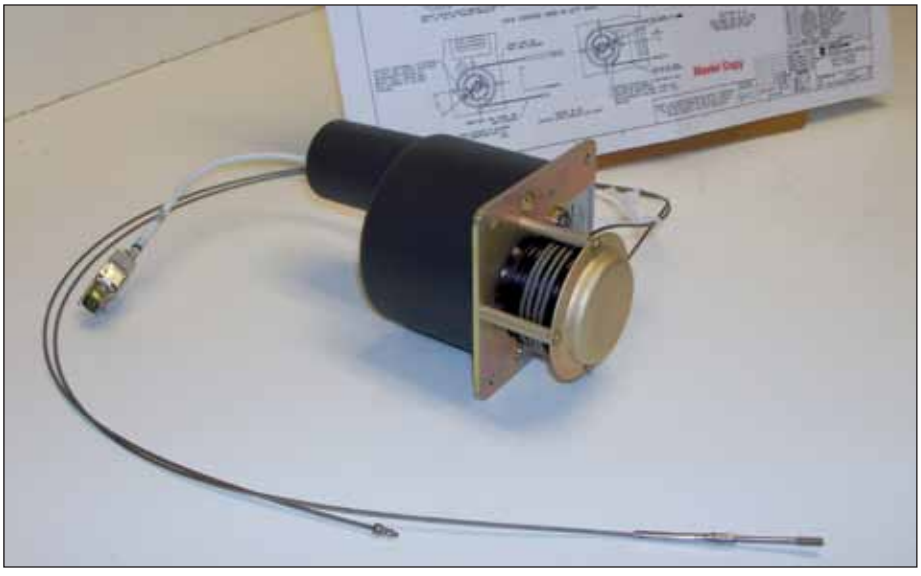
The base C4000 system is $19,995. Century offered us little information on STC approvals but they don't appear to be extensive. We get the feeling that if you wanted a new C4000 for your aircraft, Century would work with you on the STC. Plan on hauling the aircraft to Century's headquarters in Texas for the project.

AVIDYNE DFC90

We covered the Avidyne DFC90 retrofit system in the September 2010 issue of *Aviation Consumer,* and it's a reasonably easy yet pricey upgrade to the stock S-TEC Fifty-Five X found in many Avidyne Entegra (PFD/MFD) installations. It's an attitude-based autopilot driven by the Entegra PFD and therefore only available for those systems. The DFC90 addresses the griping many Cirrus owners have with the Fifty-Five X's performance, particularly in the SR22. It also adds safety features, including speed protection and an emergency return-to-level button.

The DFC90 is $9990. The modification to the PFD to send new signals on the old S-TEC wiring harness is $3600 if you're already running Release 7 (WAAS) software or $5800 for earlier PFDs. Installation runs between three and six hours, including removal of the PFD for the upgrade and the flight test. Whether the performance gain is worth the $15,000 upgrade is questionable, in our view. Currently the STCs are for only Cirrus aircraft, but Avidyne tells us they are expanding the list. The DFC90 will not be offered for non-Enterga aircraft.

S-TEC components including servos are notably reliable. We wish the capstan could stay in place when the servo needs to come out for service the way Honeywell units can.



CONCLUSION

It's important to consider future upgrade plans when upgrading the autopilot now. For example, if your plans eventually include an Aspen or Garmin G500, installing a $4000 GPSS system and $2000 directional gyro will be wasted when the PFD is installed since that functionality will be built in. Also remember that a rate-based system installed in a Navajo won't yield the performance of an attitude-based one.

If we have to pick an autopilot for higher-end aircraft singles and twins, Bendix/King's KFC225 wins hands down. We wish there were more STCs available but we're told there will be in the future. For the less-speedy crowd of Skyhawks et al., our top pick is the S-TEC System Thirty. It's a no-frills navigation solution but offers reliability and enough performance for most missions for around $15K, and can offer GPSS with or without a glass panel.

CONTACTS

Avidyne Corporation
www.avidyne.com
781-402-7400

Century Flight Systems
www.centuryflight.com
940-325-2517

Cobham Avionics/S-TEC
www.s-tec.com
800-872-7832

Honeywell/Bendix/King
www.bendixking.com
877-712-2386

The Kennon cover (center left with blue lining) and Bruce's (far left) have a lining material and webbing under the buckles to protect the fuselage. The Aero Covers cover (nearest left) had neither.

Aircraft Cover Shootout: Bruce's and Kennon Rule

When it comes to your windows and interior, Bruce's and Kennon offered the best fit, sturdiest design and the easiest installation.

by Jeff Van West

We get glimpses into the thinning aviation market whenever we do a round-up article like this. Out of the eight companies we contacted, we ended up with only four still in business and interested in participating: Aero Covers, Bruce's Custom Covers, Kennon Aircraft Covers and Mac's Airplane Covers. We found Bruce's and Kennon to be the walk-away winners, albeit with different strengths.

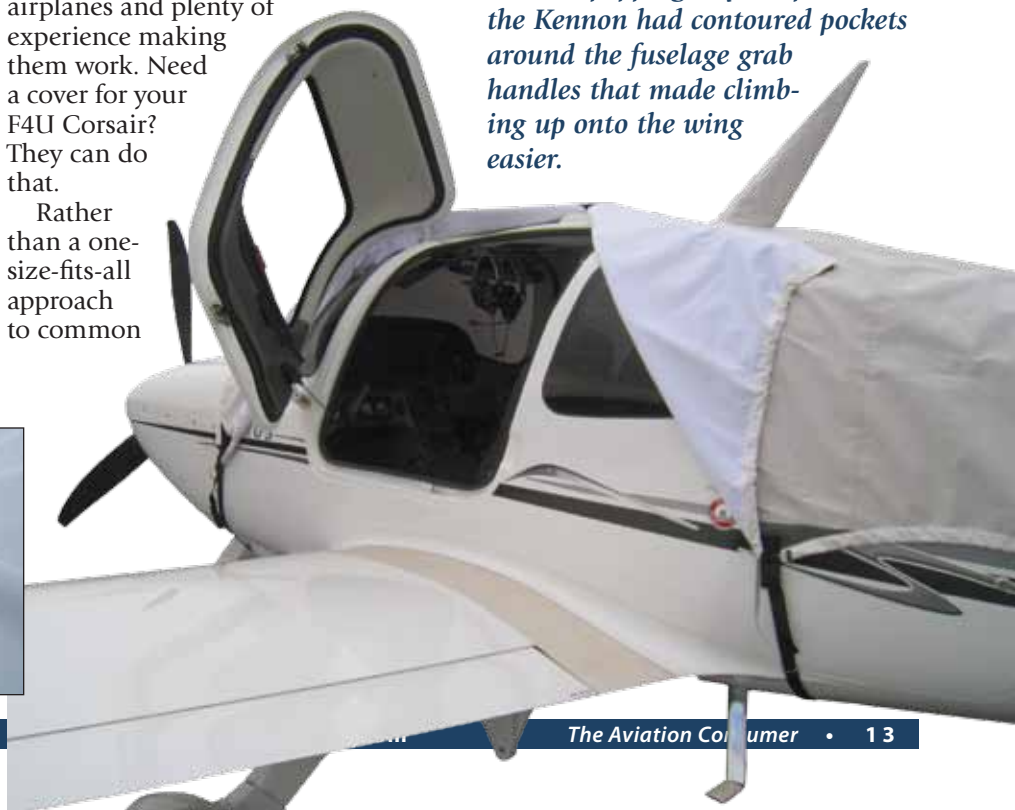
BRUCE'S DOMINANCE

It's our opinion that you can't go wrong with a cover from Bruce's. The company has patterns at the ready for common and uncommon airplanes and plenty of experience making them work. Need a cover for your F4U Corsair? They can do that.

Rather than a one-size-fits-all approach to common models, there are many options to choose from. We tested both a basic canopy cover for the Cirrus SR22 and their standard canopy cover for the Cessna 172. These covered the windows and doors on both aircraft. But the Cirrus one can be ordered to cover the fuselage and engine cowl in a single cover, and the Cessna can be made to cover more of the wing roots, more of the fuselage, include the engine cowl or any combination thereof.

The Bruce's covers are heavy-duty, which could be both a benefit and a drawback. The cover will clearly take the abuse of the elements, and we hear from owners that the covers stand the test of time. But the Bruce's covers for the Cirrus and the Cessna took up twice the volume of competing covers when packed perfectly in the bags that arrived from the factory. After stuffing the things haphazardly back in the bags during our testing—as the winds picked up and

Both Bruce's and Kennon had big velcro openings for cabin access without popping any straps. But the Kennon had contoured pockets around the fuselage grab handles that made climbing up onto the wing easier.



CONTACTS

Aero Covers
www.aerocovers.com
800-461-4589

Kennon Aircraft Covers
www.kennoncovers.com
307-674-6498

Bruce's Custom Covers
www.aircraftcovers.com
800-777-6405

Mac's Airplane Covers
www.airplane-covers.com
906-343-6664

BETTER THAN SCRAPING OFF ICE

Do you park outside in a snowy climate? We feel your pain. If you don't have an option for sticking your plane inside the night before a winter departure, one alternative is wing covers. These covers cover the top surface of the wings (and, optionally, the tail) and strap securely underneath. When it's time to fly, you pull off the cover and all the ice and snow comes with it.

Getting them on and off is awkward, especially on a high-wing aircraft , but not as hard as you might think. Bruce's was kind enough to lend us wing covers for the 172 and SR22 to try out. We were able to get them on and off in a wind with just one person. The Bruce's covers for the 172 had a convenient zipper in the end that cups the outboard wing, which came in handy getting the right fit. The SR22 cover had a pocket on the right wing for the easily bent aileron trim tab.

Unfortunately, these things are unlikely to travel with you, which is when you might need them most. The bags take up three times the volume and weigh twice as much as the basic fuselage cover. They also aren't cheap. Basic covers for a 172's wings and tail from Bruce's are $650 and from Kennon they are $485-865, depending on materials. Kennon also offers wind spoilers for the wings to keep them from flapping around in a Chinook or Santa Ana blow. But if you're hangarless up north and have a place to stash the things when you go flying, they can save you an hour of hacking and scraping to get the wings clean.

the temperature dropped—the difference was even more noticeable. The Bruce's covers were also two to three pounds heavier than competing designs.

The covers have a soft liner on the inside and strapping material under the buckles to protect the aircraft. They also had bungee material strung through the edge of the covers. This worked well to snug up the cover and made it easier to attach once the buckles were set for the right length, because we could stretch the cover a bit, connect and then it would pull tight on its own.

Two things we liked about the Cessna 172 cover was that it only used two straps underneath the belly (every extra strap matters when your fingers are turning white or rain is pouring down) and that it used a snap to attach above the windshield. The snap is added to the fuselage by replacing one of the screws holding down the windshield fairing. A stiff rod keeps the cover straight between the snaps.

The snap avoids tossing straps or cloth over the top of the airplane. We know of one Cessna that has the top of its flaps utterly pockmarked by years of cords being tossed over the wings to connect its cover. The snaps also made getting the cover stabilized in a wind, well, a snap. Bruce's offers an alternate design where cloth goes over the top of the canopy to protect skylights that doesn't require the snap.

The 172 cover we tried costs $395. Extending the coverage lower on the fuselage (below the windows) raises that to $455. If you went for full coverage including the engine cowl and hail protection (but not the wings—see sidebar), it could run $1030. The SR22 covers range from $455 all the way to $1740 for near hangar-like protection.

KENNON'S CHALLENGE

Working with the companies before the covers were shipped, Keynon was the most concerned with the exact

AC TV

For a video demonstration of some of these covers in action, go to www.avweb.com/video/ and look for the video Canopy Covers Compared.

The Bruce's cover for the SR22 is 11 pounds versus the Kennon's 8.5, and takes up almost twice the volume. The Bruce's cover for the 172 (lower) is the easiest to put on, as it snaps to the top of the fuselage rather than having straps thrown over the top.

placement and dimensions of the antennas probes. It showed on the SR22 cover that was the best fitting cover we've seen. Areas over each flat antenna were reinforced and pockets were made for the items that stood up. Bruce's did this for the Cirrus' dorsal antenna, but Kennon also did it for the fuselage handles to climb up on the wing. That made climbing up with the cover installed easier.

Kennon covers are lined with a material they claim is a better choice than the traditional soft, fuzzy liner, as the fuzz, and its resultant static, could retain grit that would scratch the aircraft. This choice may be part of the reason Kennon covers are lighter and pack smaller than Bruce's. Like the Bruce's covers, there is extra webbing to pad the buckles. We were impressed with the apparent construction quality from Kennon. We also thought the Kennon cover was the best looking of the lot, if you're concerned with fashion as you're buttoning up your airplane against the elements.

The Kennon 172 cover wasn't as perfect a fit as the SR22 version was, but it was fine once we got its straps sized right. There are two belly straps, which we like, but there is also a line from the rear strap to the tail tiedown to help hold it tight. We're not sure this is necessary. The Kennon 172 design also has straps with clips that toss over the top of the wind, which we've already noted can chip paint over time.

Kennon pricing is simple. A high-wing cabin cover is $395, with an extension to cover a skylight for an extra $50. Low-wing covers range from $425-$690 depending on how long a fuselage you need covered.

AERO COVERS AND MAC'S

The entrants from Aero Covers and Mac's Airplane Covers had some clever points. The SR22 cover from Aero Covers had the traditional front and back around-the-belly straps, but the center strap simply connected around the wing step. That's one less reaching under the plane, and at the fattest part of the fuselage. However, the dorsal antenna simply went through a hole in this cover, rather than the pocket used by Bruce's or Kennon.

Aero Covers' 172 cover was a good fit, but the second of the three belly straps interferes with the door opening with the cover installed if you just need to get something from inside. The covers also had no liner and no material protecting the fuselage from the connecting clips. The company is Canadian, so in Canadian dollars it's $350 for a high wing and $390 for a low wing.

Mac's only sent us their 172 cover, but it was a clever design where cloth was tossed over the center of the fuselage rather than straps. It was the smallest and lightest, and also the only design that offered access to both doors with the cover still installed. Rather than Velcro closures at the door, this cover used zippers that zipped up from the bottom. We found this more cumbersome than the Velcro used by others. The cover is a bargain at $230, however. It can be had without a lining for $180.

BUYING CONSIDERATIONS

When you're shopping for a cover, be sure to get exactly what you need. For example, an over-the-top fuselage cover would not work on the 172 we used without some pocket for the roof-mounted OAT probe. Get the exact measurements for any antennas or probes that stick out.

None of these covers extend far enough to cover the fuel caps on a 172. If leakage at the caps is a problem you have, you might need some customization or a design that reaches further outboard on the wing. As the cover is custom made for you, this should be an option.

Then pick a color that works for you. Do remember that a cover is a sacrificial item that weathers instead of your windows and paint, but it's a lot cheaper than replacing those items, too.

Prices and comments on tested covers

	SR22	C172	HITS ⊕	MISSES ⊖
Aero Covers	$385	$345	Some clever design elements	No liner, no buckle protection, 3 straps on 172
Mac's	n/a	$230	Lightweight, access to both doors, clever design, price	Zippers more cumbersome than Velcro
Bruce's	$455	$395	Beefy construction, bungee keeps snug, snap-on 172	Heaviest and bulkiest cover
Kennon	$425	$395	Good looking, tight fitting, mid-weight but not bulky	Fit not as tight on 172 as some competitors

Smile, This Flight is Being Recorded

It's not often our curmudgeonly editors offer a trifecta of kudos, but all three of these devices ace their respective—if radically different—missions.

by Jeff Van West

It's easy to pick out a couple of pilots talking: Look for the folks bending their hands through the air trying to recreate a visual for that death-defying turn to final immediately followed by three consecutive touchdowns from one landing attempt.

Technology can now put more fact into these fish stories or offer a better way to debrief exactly what happened right before the CFI hollered, "My airplane!" These three solutions hit different, but overlapping, missions. None are cheap, but all do the job they set out for.

NFLIGHTCAM

The NFlightCam is small and to-the-point, so we will be too: The thing works great.

The camera is actually a ContourHD 1080 wearable camcorder that's less than four inches long and weighs about five ounces. NFlightCam replaces the standard mic with a circuit and cable to record cabin audio from the intercom. That's plugged into any headset jack and can be connected inline so you can use a headset in the same outlet.

The lens has a 110-degree field of view, so you can mount it high behind the front seats to get both cockpit and runway ahead. However, the cabin may be somewhat dark due to the brighter view outside. You can mount it at any angle because the lens rotates, complete with a button to project two lasers for getting a level-image reference. After that, slide a beefy switch forward to record and aft to stop.

The back face of the camera slides off to connect move files to the computer via USB and recharge the battery, which the company claims will last two hours. We ran out of recording space after 30 minutes on the 2GB microSD card we had. The camera will take up to a 16GB card. The package includes software to configure the camera for resolution and sound level, as well as download the movies. That software is refreshingly simple and available for both Mac and Windows.

The NFlightCam is $399 from the company or from outlets like Sporty's (who lent us one). A new version with an internal GPS is $499. We haven't tried that one, but it claims to allow playback of the flight on Google Earth.

FLYVIE PRO AND LITE

The Flyvie Pro recording system captures video from two cameras—one trained on the pilots and panel from behind, and one looking forward out the window—as well as intercom audio and GPS flight path. These are all recorded on a netbook computer to be played back later as part of a flight training debrief.

Getting the Flyvie Pro cameras set up is a bit of a chore in that you must both mount them and then connect them to the netbook in a preview mode to ensure the picture is what you want. With that done, you have to find places to run and secure

The Flyvie Pro system has a camera trained on the panel and pilots and a second looking out the windshield. Two more cables come from the remote GPS and intercom. Stash the closed netbook somewhere and it will start and stop recording automatically.

AC TV

How can you know what a recorded flight looks like by staring at a printed page? For a better view, log on to www.avweb.com and select the video index. Look for the one on cockpit flight recorders.

cables from both those cameras, a USB GPS and an audio plug that run to the netbook. Flyvie supplies well-marked cables, clear instructions and all the Velcro you could want to make this work, but it's not something you'd want to move from airplane to airplane regularly.

Once it's all connected, you can stow the computer away and it will start and stop recording automatically once the GPS sees you're moving. Flyvie doesn't offer a power adapter to run the netbook off ship's power, so you can only have the computer on for about two hours unless you supply that power adapter yourself.

The flights are recorded in a proprietary format onto an SD card. After several test flights we had yet to half fill the 8GB card. The flights are played back using a web browser even though the files are stored locally on your computer. This is the one area where we had some trouble with the Flyvie system. We only saw consistently good results using Internet Explorer under Windows, although Firefox is supported (Windows only). We'd like to see it run as a standalone application.

Once the viewer is running, however, the system works basically as claimed. You can scroll to any point in the flight to see cockpit, cabin, forward and top-down Google Earth views, and hear the audio. You can also tag any point in the flight to quickly jump to it later. Video can be toggled to full screen for a better view. We did see occasional mismatches between the position shown in the Google views compared to the video. Both were reflective of the flight, but not perfectly in sync.

The potential for power debriefs is clear: Ground reference maneuvers or holding patterns can be picked apart in detail, showing every cockpit action and result. Problem landings can be dissected frame-by-frame with the pilot actions, outside view, and speed and altitude. Getting CFIs and students willing to do that is another matter, but Jeppesen recently partnered with Flyvie to try and make that happen.

All this comes at a price. The Flyvie system is $1995, plus $29/month ($290/year) for access to the viewer. Given that the system doesn't move easily from aircraft to aircraft, we could see this set up working for a premium-service flight school, but not for independent instructors or schools struggling to get by.

NFlightCam can be mounted at any angle. Two lasers project dots from a rotating lens adjust and set up for a level picture.

If you've got an iPhone and don't need the in-cockpit part of the video, Flyvie Lite is an app that's free for the iPhone. It just became available for the iPhone 4 at press time, so we haven't flown with it yet. A quick test showed it installed and recorded fine. You'll need an audio cable and mount ($55) to record audio and hold it looking out the cockpit. You'll also have to pay $9.80/month ($98/year) for the Lite viewer. It works like the Pro viewer, but with only one video source. You can view the flight on the phone's screen for free.

WI-FLIGHT

Pascal Gosselin created Wi-Flight after a double-fatal training accident at his local flight school that was the result of a low-level buzz. Gosselin felt there should be a device that could sit in a training aircraft and report improper behavior. That is, Wi-Flight was designed to be a snitch.

Given that mission, Wi-Flight has no camera and isn't so much a cockpit recorder as a datalogger. It records the GPS position and velocity, as well as both ambient and intercom audio. It turns itself on when it senses power coming from the cigarette plug (or from the master switch in installed versions) and stops recording when the power shuts off. Before it powers down, however, it scans the area for any open WiFi signals and automatically uploads the data from the flight. That goes to Wi-Flight's servers and gets processed.

If something questionable, like a low-altitude buzz or landing at an unknown airport, is found, an email alert is sent. The flights are then left on the server for later review and can be viewed in a browser showing the position in Google earth, much like Flyvie, including the cockpit audio but with no video. Wi-Flight also estimates engine RPM based on the cabin audio and the number of blades on the prop, and shows likely winds at each takeoff and landing based on the nearest METAR at the time.

The datalogger is $499 plus $59/month for the web subscription for one aircraft. Wi-Flight is finalizing an upgrade chip for these that would add an altimeter and basic AHRS for $199. The per-aircraft rates drop steeply as you subscribe for an entire fleet. In our tests, the datalogger performed flawlessly so long as it sat somewhere it could get a good GPS signal. We were also quite impressed with Wi-Flight's customer response and enthusiasm for further developing the product. Flight schools can apply for a free trial to see how well the system works for them.

CONTACTS

FlyVie
www.flyvie.com
866-313-0008

Wi-Flight
www.wi-flight.net
450-676-6299

Sporty's Pilot Shop
800-776-7897
sportys.com/PilotShop

The Wi-Flight recorder s smaller than the audio and power cables that tie it into the aircraft.

FUTURE FUELS

Why Is Two-Fuel DOA? It Works in Europe

Supporters of mogas would like to see E0 as a second or even third fuel. But it's a hard sell to cash-strapped FBOs who would have to invest in tankage.

by Paul Bertorelli

As general aviation moves bumpily along toward a replacement fuel for 100LL, there's a backlash brewing. Why, ask the owners of low-compression, low-output engines, do we have to settle on a single fuel? Why can't there be two unleaded fuels, a less expensive one for some users and a high-octane version for the rest? And why can't one of those fuels be mogas, which enjoyed wide popularity during the 1980s?

Two-fuel systems are in place throughout western Europe, although not every airport has dual fueling. Some—usually smaller grass and club fields—have only one fuel available, while others have a 91/96 (the equivalent of 94UL) and conventional 100LL. A handful even have three fuels, since mogas has a tiny presence in Europe. But even that is becoming problematical as ethanol finds its way into the European fuel supply chain. In the U.S., resistance to a two-fuel approach centers on the distribution and refining system. Although the specifications exist for lower-octane unleaded fuels (94UL was recently approved) and the ASTM is actually considering at least one other aviation low-octane possibility, these aren't seen as being viable for the U.S. market.

In the U.S., resistance to a two-fuel approach centers on the distribution and refining system.

WHERE'S THE DEMAND?

Although owners of aircraft capable of burning 94UL or its variants are beginning to make their voices heard, neither the oil companies nor the FBOs who sell the fuel are convinced there's enough demand to make the effort worthwhile. We recently interviewed more than a dozen FBOs and flightschools to seek their opinions on installing two-fuel systems and we asked readers to tell us about their experiences with mogas as a second fuel.

Bottom line? While FBOs hardly dismiss the interest in mogas or a second fuel out of hand, they're generally either not interested or not in a position to invest in the tankage necessary to dispense a second fuel.

"Look, this is a business," says Ken Nierenberg, who runs a busy airport and flightschool in Princeton, New Jersey. "I'm not going to put in another fuel tank, put up the money and not have the turnover that a gas station does. The money ain't there." Princeton moves a lot of avgas—about $20,000 in sales a month—and like most operators we talked to, Nierenberg sees investing in additional tanks as just splitting the same volume for less margin. In his view, the business case is weak.

But what about the build-it-and-they-will-come proposition? That, in fact, does work at some airports, although the return on investment may not be there.

"We're selling mogas as more of a service to tenants than anything else," says Scott Sheets, the FBO manager at Paige Field Aviation Center in Fort Myers, Florida. "We have some light sport aircraft on the field and we wanted to move forward with a product for them that we realized wouldn't be a revenue generator initially." We heard from several other FBOs who offer mogas as a second fuel for the same reason: service and convenience first, profit second.

In any case, making a profit on mogas is difficult because there's no headroom on the retail price. At Fort Myers, mogas actually retails for more than avgas does: $4.01 self-service, versus $3.75 for self-service 100LL. But not all airports can afford

to sell mogas as a loss leader. "We've had reasonable interest in mogas. We have sources for unleaded fuel," said Kurt Winker at Mid-Valley Airpark in Las Lunas, New Mexico. "But we can't get it as cheaply as the premium is across the street at a gas station," he adds. If the on-airport price goes pennies too high, mogas users will simply buy it elsewhere and bring it into the airport in five-gallon cans or truck-mounted tanks.

"You at least have to pay for your capital; you have pay for your card fees; you have to pay your insurance. All those things chip away at your margin," Winker explains. With the right mix of traffic, relatively high demand for mogas and a ready supply, that works at some airports. But at many, it doesn't.

"It's hard to say yes to that, to mogas. If I got a grant for the tanks, I'd be all over it. If it's going to come out of my pocket to justify it, I can't see that," says Jason Hauck of Silverwing Flight service in Sandpoint, Idaho. Plus, he asks, what about an assured supply of mogas without ethanol added, so-called E0?

SUPPLY ISSUES

And this is where the mogas question gets iffy. We asked Paige Aviation Center's Scott Sheets how confident he was of his mogas supply. "Not very," was his blunt response. Although all of the mogas sellers and users we spoke to and corresponded with were enthusiastic about its potential, most of them had some version of this comment: "I'm not sure I can continue to get this fuel."

To illuminate this conundrum, we followed the supply chain up from the airports selling mogas to the distributors delivering it. This investigation revealed a curious disconnect. The major oil companies are essentially uninterested in developing a niche market for E0, at least for aircraft. One company, Marathon, whose suppliers market ethanol-free gas extensively in Florida, told us, "We are not interested in participating in this." Was that selling mogas for airplanes or just answering questions about it? Both. A source inside a major oil company told us the company would actively seek to prevent E0 sales for aviation use because the fuels aren't intended for that purpose. They see it as a liability issue.

Yet the market persists because there's just enough E0 premium gas out there to sustain a tiny niche that's predominantly a local rather than a national market.

To soak up all the ethanol being produced, refiners deliver what's called blendstock for oxygenate blending or BOB. These fuels are specifically refined so that when ethanol is added, they'll hit the required octane numbers. Because ethanol is corrosive, it doesn't move through pipelines, but is blended with the BOB at the delivery terminal, just before being trucked to the retail outlets.

BOB is not a legal fuel because

DIY FUELING

A dedicated mogas user has to be made of strong stuff to find and get E0 to the aircraft. Only about a hundred of 3600 airport fuel outlets in the U.S. carry it. (Here's a list: http://snipurl.com/1lwsmd) That means most mogas users have to haul their own fuel and there are various ways of doing this.

One of the better ideas we've seen is this portable fuel system developed by Nick Myers and soon to be commercially available. (See www.portablefuelsystems.com.) The system consists of a steel cylinder mounted on a small roller cart. To avoid the hassle of an electric pump, there's a compressed air cylinder on the back of the cart that pushes the fuel out of the tank, through a filter and into the aircraft.

Depending on the size of the unit, you can buy a larger compressed air tank that can also inflate the tires. The rig holds 16 gallons and is designed to fit into a car or truck, although it can also be carried on a car with a receiver-type trailer hitch. Retail price for the system is expected to be in the $700 to $800 range. At the Copperstate Fly-in last fall, Myers told us the system generated plenty of interest and so did another of its features: a filter system that removes ethanol. We heard from several readers who are doing this. The process is simple: Just add water, forcing the ethanol/gasoline phase separation, then pass the mixture through a water block filter. The result, says Myers, is clear gasoline that starts out at 91.3 AKI octane and, when filtered, measures 88.7 AKI; sufficient for engines requiring 80 MON octane.

Legally, such a "washed" fuel wouldn't meet the terms of an STC for a certified airplane because it would no longer be an ASTM spec fuel. Owners of experimental aircraft face no such constraints.

Legal or not, quite a few owners who contacted us are filtering E10 for use in aircraft. "I built a separator that contains water. The gas is pumped through the water and collected into a tank that is used to dispense the gas into my airplane. (G-35 Bonanza). The alcohol will preferentially stay in the water and the gas floats on top. The water alcohol mix can be burnt or disposed through an anti-freeze recycling facility," one of several readers filtering ethanol told us. "I dispense through a 10 micron filter. A 50-gallon batch takes about two hour including clean up. My airplane burns 12 gallons per hour, I save about $20/ hour in direct operating costs."

The above-ground self-contained self-fueling system, above, is about as cheap as it gets for FBOs investing in fueling facilities. Typical prices are $20 per gallon of capacity, not including site work and permits. A trip through the Midwest will reveal about 160 plants producing ethanol, like the one at left. Current capacity is about 12 billion gallons per year. There's so much ethanol that refiners are expected to run out of gasoline to blend it with in 2011 or 2012, the so-called blend wall.

it doesn't meet any ASTM specs without the ethanol added, but this requirement varies by state. In 36 states, the E0 that distributors sell is supposed to be an ASTM-spec fuel, much of it as a 91-octane finished motor fuel meeting ASTM D-4814, sometimes called "regularly constituted gasoline." But we see other grades as well.

It appears that most of this gasoline is marketed by small, specialty refineries and is available as a niche product in some markets, but not in others. In any case, aviation represents a tiny slice of the demand, with agriculture, marine and recreational uses representing a greater volume.

It's unclear to us if these companies will stay in this market, but the downstream suppliers we spoke to told us they're committed to the E0 market as long as regulators don't eliminate it as an option. "It really depends on what the government does," says Sherry Lenz, director of operations at Hicks Oil in Avon Park, Florida, which supplies several airports in Florida, including Fort Myers.

Speaking of the government, as we go press, Congress was debating whether to extend the 45-cent per gallon blender credit for ethanol, a $6 billion federal program. The credit was due to expire at the end of December 2010 and although there's sentiment in Congress to allow that to happen, two corn state senators introduced an 11th-hour bill to lower the credit from 45 cents to 36 cents. But even if the credits end, the EPA still has in place Renewable Fuel Standard mandates that will require 12 billion gallons of ethanol to be blended into the U.S. gasoline supply in 2011.

That's a lot of ethanol and refiners are already talking about hitting the "blend wall;" not enough gasoline to absorb all of that ethanol. So it seems unlikely that the amount of ethanol-blended gasoline we're seeing in the retail fuel supply will decline. In fact, EPA recently approved E15 as an option. States are largely up to their own devices to regulate how ethanol is blended—some require it in all fuel while most allow exemptions for ethanol-free fuel in niche markets, such as marine, agriculture and aviation.

"It is entirely a market-driven niche," says Florida Department of Agriculture's Richard Kempsey.

WE LIKE IT

And what market niche that does exist for mogas in aviation loves the stuff. Despite the tiny fraction of airports that offer it, we heard from more than 100 owners using mogas. Obviously, the major driver is cost, but so is reduced maintenance.

"I fly a Lancair ES powered by a 350-HP fuel-injected Mazda Wankel engine. I had been using mogas with great results until the government mandated 10 percent ethanol in all auto fuels," says Mark Steitle of Lockhart, Texas. "Avgas shortens plug life, fouls the O_2 sensor, provides no benefit to the rotary engine and costs 33 percent more."

We heard variations of Steitle's story over and over again. Only a few of the owners we heard from have avgas available on the field, the rest roll their own supply.

"I have on-farm storage and I haul the mogas in myself. I always test the fuel that I am purchasing to make sure it does not contain ethanol. This fuel is used in several other vehicles as well and in some farm equipment," owner James Griffith told us. He doses each tank with an ounce of Marvel Mystery oil to keep valves from sticking, one thing that mogas users complain about. They also complain about vapor locking and sooty exhaust, but these are nits

that don't count against the overwhelming positives of using mogas instead of avgas. One owner stopped using mogas after an inflight stoppage due to vapor locking.

The largest complaint, next to the inability to find mogas, is the ethanol problem. But some owners just ignore that and burn the gas anyway. Ocean Air, a flightschool in California, runs E10 exclusively in its Rotax-powered Tecnams, hauling the gas in plastic cans since it isn't available on the field. (The Tecnams and engines are approved for E10.) But even some owners whose airplanes aren't approved for it still burn it.

"In the aircraft, the worst problem with E10 is operational, not mechanical. Ethanol blends take much longer to produce a clear sump sample due to their affinity for water. They continue to absorb water on the ground and in flight if the air is humid. Flights of longer than four hours can result in gascolators being completely full of water upon landing. I've kept company with many 172 pilots over the last eight years who are using ethanol-blended fuels because they can't get pure gas in their states. They report the same results: Just be extra cautious when you sump the tanks, and there are no other adverse effects. This is with blends in the three to 10 percent range which appear in most northern states," one reader told us. "So the concerns over vapor-locking and fuel system deterioration are largely unfounded. The prime concern will be water contamination and that can be properly managed."

We should note that STCs for autogas specifically prohibit use of E10 and research done by Cessna and others reveals that it can cause corrosion, damage to seals and other maintenance issues. There is an effort to push the industry to retain the E0 niche. See www. pure-gas.org and www.e0pc.com. The former lists gas stations selling E0, the latter represents a grass roots effort to force Congress to reconsider mandates or assure that a non-ethanol premium can stand in the market, protected by state or federal exemptions.

CONCLUSION

It's unclear to us how robust the pre-

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LED Flashlights: S&W's Are Top Picks

LED flashlights are better than ever with more choices at bargain prices. Smith&Wesson's mid-priced line offers the best feature-to-cost ratio.

by Paul Bertorelli

For the pilot of even modest equipage, a flashlight is something of a necessary fetish item, so much so that some pilots we know carry a half-dozen in the cockpit. Fear of darkness or just prudence? Both, we think.

A decade ago, most of us bought a D-cell bat handle with a penlight backup, but now the market is flooded with sophisticated LED choices. And in our view, LED is the only illumination type worth considering, given the variety of choice, low power consumption, durability and color choices.

And what choices there are. We shopped the popular pilot emporiums and Web sources for some practical choices and winnowed the field down to 15. You might pick an entirely different 15, but we have to start somewhere.

The high-priced models, left to right: XeVision XV-C2A, Surefire A2 Aviator, center, and polymer Surefire G2.

WHAT'S WANTED

We're skipping the large D-cell and C-cell models in favor of smaller two and three-cell LEDs. These smaller flashlights provide more than enough choice in illumination. The FAR requirement (91.503) applies only to large and turbine aircraft and is woefully outdated in an age when two AA batteries drive an LED for a week.

Some design criteria: Given the power illumination from LEDs, we think a smaller flashlight is more desirable than a larger one. It's easy to carry, point, aim and stow. Most of the models we examined are in the four- to six-inch range.

Second, batteries: The favored battery in these small LEDs is three AAAs in a carrier. The expensive flashlights have 3-volt lithiums ($7 to $9 a pair), but these are long lasting so the sting isn't so bad.

In the cockpit, AAAs don't play in other gadgets like GPS, so that means carrying more battery types. Also, the carriers can be a nuisance to load because polarities aren't always marked clearly. Again, you don't have to do it often, but you wouldn't want to load batteries in the dark. (Thus the argument for a second or third flashlight.)

How about color? More of the LEDs are now offering color choices,

PRODUCT	SIZE	BATTERIES	MEASURED BRIGHTNESS	STREET PRICE
SUREFIRE A2 AVIATOR WWW.SPORTYS.COM	5.5 X 1	2 3V LITHIUM	215[1]	$199
XEVISION XV-C2A WWW.AIRCRAFTSPRUCE.COM	5.7 X .8	2 AA LITHIUM	241	$87.95
SUREFIRE G2 WWW.SPORTYS.COM	5.0 X 1.1	2 3V LITHIUM	180	$69.00
COAST TAC TORCH WWW.MYPILOTSTORE.COM	4.0 X .8	3 AAA ALKALINE	157	$39.95
DORCY HAWKEYE WWW.DORCYDIRECT.COM	5.24 X 1.25	3 AAA ALKALINE	441	$39.99
100 LED FLASHLIGHT WWW.SPORTYS.COM	6.8 X 3	4 AAA ALKALINE	90	$37.95
ASA GREEN/WHITE WWW.MYPILOTSTORE.COM	3.8 X 1.0	3 AAA ALKALINE	22	$31.50
DORCY K2 WWW.BRIGHTGUY.COM	5 X 1.5	3 AAA ALKALINE	402	$28.00
SMITH AND WESSON 12 LED WWW.AIRCRAFTSPRUCE.COM	6.5 X 1.5	3 AAA ALKALINE	20	$27.50
SMITH AND WESSON GALAXY WWW.MYPILOTSTORE.COM	7 X 1	2 AA ALKALINE	7	$27.50
MINIMAG 3 LED WWW.AIRCRAFTSPRUCE.COM	8.5 X 1	3 AAA ALKALINE	44	$18.85
PELICAN L1 WWW.COOLFLASHLIGHTS.COM	2.5 X .75	4 1.5V ALKALINE COIN CELLS	8	$19.95
RECHARGEABLE LIGHTER LED WWW.SPORTYS.COM	2 X .7	INTERNAL BATTERY	3.7	$15.95
AIRCRAFT SPRUCE LED WWW.AIRCRAFTSPRUCE.COM	4.5 X 1.2	3 AAA ALKALINE	28	$8.95

[1]Brightness units are in lux, measured at 8 feet in the brightest part of beam.
[2]Colors available via filter or LEDs All have white colors.

The recharge-able light from Sporty's, above, lives in a cigarette lighter plug, ready to go. It's not bright, but it's a convenient backup.

either via snap-in filters or actually switches to energize a different color LED. Forget the filters; you'll lose them. See the sidebar at right for some advice on color choice.

Brightness? It isn't everything. In fact, too bright is a nuisance because even when night vision doesn't need to be preserved, too-bright flashlights just hurt the eyes and are usually unnecessary except in rare circumstances. Last, Soviet vs. Western. You can now drop $250 on a flashlight if you're inclined, which brings to mind the Western philosophy of weaponry (fewer but of higher quality) versus the Soviet model (cheaper but more of them.) This is largely a budget factor, in our view. The expensive lights work better, but maybe not eight times better to justify their prices. So cutting right to the chase, our chart at left ranks the flashlights roughly by cost, with the high-price cutoff at $70. You'd expect a $200 flashlight to be really, really good and the Surefire A2 Aviator is. It's the perfect size and superbly made of hard anodized aluminum in the tactical style. Detailing is excellent and it has both red and white LEDs, switchable by a twist cap on the back. It's not the brightest, however, but it's bright enough.

Smith&Wesson's 12-LED model, left, and the six-LED Galaxy, are both well-made flashlights that include onboard color capability.

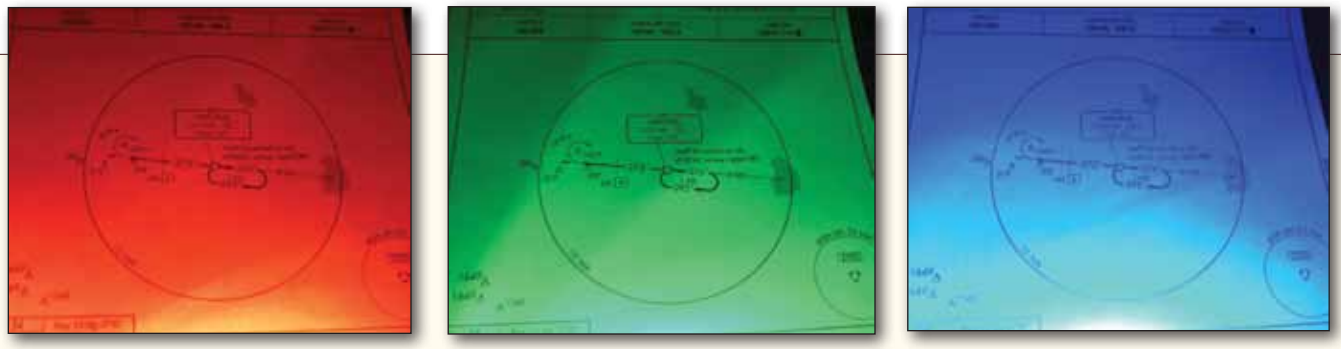
Unique in this group is the flashing strobe mode found in the $87.95 XeVision XV-C2A. This a penlight style with AA lithiums instead of the 3-volts, a plus. It's a little brighter than the Surefire, but has no other color options. The strobe activates by alternate pushes of the switch.

Not all of Surefire's products occupy the top price tier; the G2 sells for $69 and is made of a tough black polymer with a twist switch. Good brightness, but a single color and nothing special, in our view.

THE UNWASHED MIDDLE

Intense competition has settled the LED market into a nice compromise: Fairly sophisticated and well-made flashlights in the under-$40 range. There are a bunch. Our two favorites are from—surprise—Smith&Wesson. These are made under license by Powertech, which has a range of tactical-style lights.

Our top all-around best choice of all of these flashlights is the $27.50 Smith&Wesson 12 LED from Aircraft Spruce. It's well made of anodized aluminum and powered by three AAAs in a carrier that doesn't drive us completely nuts to load. Best of all, it has red, green and blue options and the white tends toward the dim range. Why is that good? As we mentioned,



RED, GREEN OR BLUE?

Well, dim white, actually. That's deemed to be the best color compromise for use in the cockpit across a range of tasks, such as chart reading, instrument interpretation and finding that loose battery cover you dropped between the seats. But most white flashlights don't dim enough to avoid trashing your night vision, so manufacturers of LEDs have begun to supply red, green and blue. This is sometimes done by filters, but also by LEDs of those colors with a dedicated switch. We say avoid the filters and go for the switch design.

Which color is best? Traditionally, red was the pick, probably due to its popularity in the darkroom. Although red preserves night foveal (center vision) because that's where the red-sensitive cones are, the rods in the eyes are used for night vision and they aren't sensitive to red. How about green or blue or green/blue combinations? These are considered to be best for rapid night adaptation, but dim white or a long-frequency (deep) red is better for night detail, such as chart reading. But red is also very fatiguing for many people.

The photos above show the same chart photographed under red, green and blue LED. Our pick would be green, hands down. The red drops too much contrast and dissolves red detail on a chart; the blue is a little worse. The green splits the difference. The reds on a chart are still washed out, but the contrast and readability are better.

too-bright is worse than too-dim. Middle range illumination gets the job done without the dazzling effect. We're not jacklighting deer, we're doing pre-flights and reading charts.

Second choice is also by Smith&Wesson. For a few bucks less, the $24.95 Galaxy is similarly well made, albeit longer and skinnier due to its two AA-cell design. It has both white and green options and green is our top choice for night chart reading. Neither of these lights have options for a lanyard, if that matters to you.

We found some other good choices in the mid-price range, including two models from Dorcy, the K2 and Hawkeye, the latter $12 more expensive, although we're not sure why, given their similarities and almost identical brightness. In fact, the Hawkeye was the brightest of the lot so if you need a second flashlight with a long throw, it's a good choice. The beam is hot, bright and well focussed. At the very bottom of our chart is the slam-dunk best value we found: Aircraft Spruce's $8.95 9-LED flashlight. It's at the low end of the brightness range, but has better fit and finish than some of the products costing three times more.

RECOMMENDATIONS

If you have $199 that you absolutely must dispose of, the Surefire A2 is a terrific flashlight, in our view, and sports a lifetime guarantee. At two bills, it ought to be a pleasure to use and it is. It's the right size and the dual color is a plus.

Otherwise, the two Smith&Wesson models stand out as the best overall choices in terms of quality construction and features, and they use readily available batteries. We think color choices are a must for night chart reading and these two have that.

Worth mentioning is Sporty's mid-brightness 100 LED flashlight, the 12-gauge shotgun of flashlights. The beam is diffused but it will light up the inside of a hangar like a torch and sometimes you need that. At under $40, it's a good value.

Spruce's bargain LED light stands out because you could buy five of them for under $50. If there's reliability in numbers, that's one way to get at it.

The 12-gauge shotgun of flashlights is the 100-LED light from Sporty's, above. A little bright for the cockpit, it's a good hangar inspection and worklight tool. Expensive flashlights require expensive 3-volt lithium batteries, right.

Cirrus SR22

Fast, comfortable and well-equipped, the SR22 is one of the defining aircraft of modern GA.

Photo by Andrzej Rutkowski/ Przeglad Lotniczy

The Cinderella general aviation success story of the 2000s must be Cirrus aircraft in general, and the SR22 specifically. Since the company first morphed from a quirky kit supplier to a full-blown aircraft manufacturer in 1998, it has consistently proven that it got the vision thing right. The SR20 and SR22 in their various iterations have proven hot sellers and good performers, with unusually loyal customers.

What explains it? We think there are several reasons. The airplanes perform well and generally deliver on the claim of being easy to fly for people new to the aviation game. Moreover, they offer the right combination of cutting-edge equipment and construction methods without becoming so weird or quirky that buyers are put off.

The whole-plane parachute, which Cirrus pioneered as a signature marketing feature, has been a factor. In a poll we conducted shortly after the SR22 appeared, we asked if the parachute was a driver in the purchase decision. Only a third of respondents said it was, but we think that understates the case. Perhaps the parachute is the pot sweetener that pushes buyers considering something else into the Cirrus camp. "The parachute is what sells the wife on the airplane," one commenter said.

For the 2001 model year, Cirrus announced the SR22 step-up model and immediately hit pay dirt.

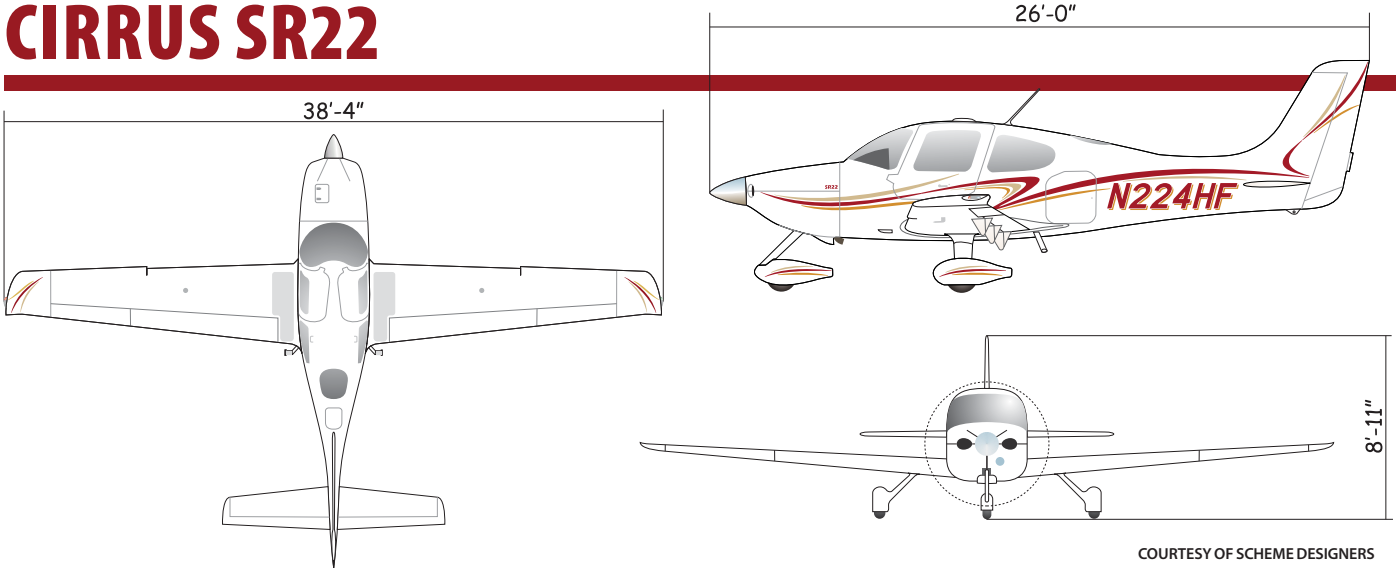
COMPANY HISTORY

Among homebuilders, Cirrus was well-known during the 1990s for its VK30 pusher kit, an innovative composite design that gained some traction but wasn't a major player in the field. By the mid-1990s, Cirrus principles Alan and Dale Klapmeier developed a new vision, reasoning that the time was right for a high-performance, composite fixed-gear single that anyone could fly.

On a variation of Cessna's famed "drive it up and drive it down" campaign of the 1970s, the Klapmeiers launched the company on the premise that it didn't take special DNA to be a pilot. Anyone could do it with the right airplane. And if you got over your head, you wouldn't have to die for your mistake; the BRS parachute would pull your fat out of the fire.

The company's first product was the SR20, which appeared in 1999, powered by a 200-HP Continental IO-360ES. At about $197,000 equipped, the airplane was a good

CIRRUS SR22

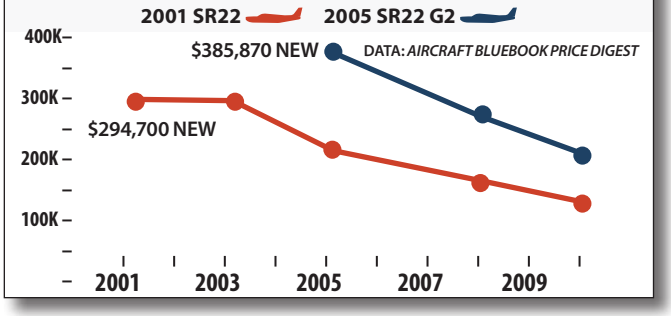


COURTESY OF SCHEME DESIGNERS

SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
2001 CIRRUS SR22	CONT. 310-HP IO-550-N	2000	$27,000	81	1150 LBS	180 KTS	±$140,000
2002 CIRRUS SR22	CONT. 310-HP IO-550-N	2000	$27,000	81	1150 LBS	180 KTS	±$150,000
2003 CIRRUS SR22	CONT. 310-HP IO-550-N	2000	$27,000	81	1150 LBS	180 KTS	±$160,000
2004 CIRRUS SR22 G2	CONT. 310-HP IO-550-N	2000	$27,000	81	1150 LBS	180 KTS	±$195,000
2006 CIRRUS SR22 G2	CONT. 310-HP IO-550-N	2000	$27,000	81	1150 LBS	180 KTS	±$245,000
2007 CIRRUS SR22 G2	CONT. 310-HP IO-550-N	2000	$27,000	81	1150 LBS	180 KTS	±$265,000
2008 CIRRUS SR22 G3	CONT. 310-HP IO-550-N	2000	$27,000	92	1150 LBS	180 KTS	±$310,000
2010 CIRRUS SR22 G3	CONT. 310-HP IO-550-N	2000	$27,000	92	1150 LBS	180 KTS	±$430,000

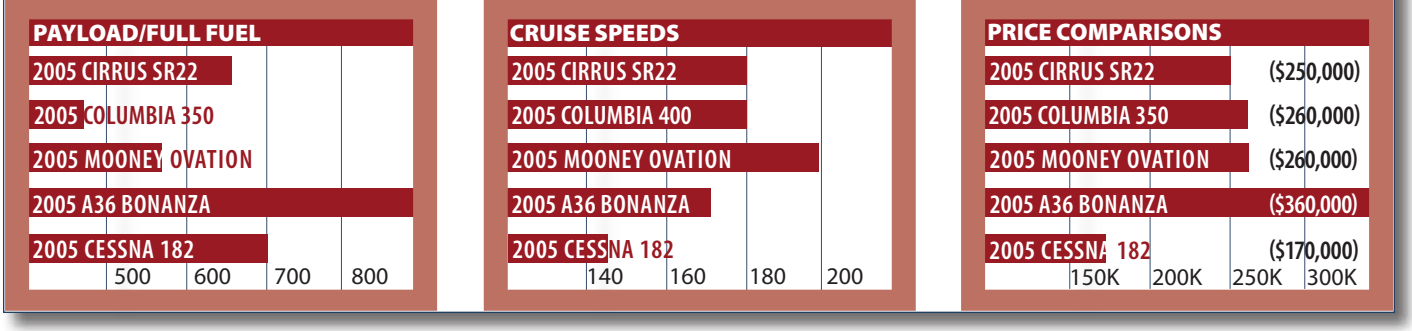
RESALE VALUES



SELECT RECENT ADs

2009-26-01	TKS SYSTEM FITTINGS
2009-05-05	AVIDYNE PFD INSPECTION/MODIFICATION
2008-14-13	DOOR-ROD END REPLACEMENT
2008-03-16	RUDDER, AILERON, AND INTERCONNECT RIGGING
2007-24-13	WING TIP DRAIN HOLE INSTALLATION
2007-14-03	CIRRUS AIRFRAME PARACHUTE SYSTEM MOD.
2006-21-03	BRAKE CALIPER PISTON O-RING SEALS

SELECT MODEL COMPARISONS



buy and proved a strong seller. It also gave buyers their first look at large-screen displays in an aircraft, ARNAV's ICDS 2000. By modern standards, this would barely rise to the level of rudimentary, but a decade ago, it did the job, even if the display wasn't as impressive as the Garmin GNS430s that drove it.

But going in, Cirrus knew what Cessna, Piper, Beech and others have always known: If you don't have a follow-on model, your success will be shortlived.

A NEW GAME

Two years later, for the 2001 model year, Cirrus announced the SR22 step-up model and immediately hit pay dirt. Although the SR20 was no slouch, its 150-ish cruise and limited payload left some buyers wanting.

The SR22 scratched that itch. It had a 310-HP Continental IO-500-N, one of Continental's best-ever powerplants, a three-blade prop and more payload, although the basic airframe is largely the same.

The IO-550-N brought some improvement to the front end. It's smoother, a bit more economical and doesn't have the altitude-compensating fuel pump that can be a maintenance nuisance in the SR20s.

Cirrus pioneered the two-lever control so the SR22 has a throttle and mixture lever, but no prop control. The RPM is handled by a cable-and-cam arrangement that sets the RPM at either 2700 RPM for takeoff or 2500 RPM for cruise. Most owners seem to like this arrangement, but for those accustomed to three levers, it takes some getting used to.

The SR22 airframe is slightly different than the SR20. The wingtips are 18 inches longer, the rear elevator is larger and the landing gear was moved inboard to give more ground clearance for the prop. Although identical in section to the SR20, the SR22's main spar is substantially beefed up and accommodates more fuel, 84 gallons in the SR22 compared to 60 gallons in the SR20. The SR22's energy absorbing seats were modified to account for the airplane's higher weight.

Speaking of weight, the SR22's gross is obviously higher and so is its payload. When we flew one of the first factory demos in 2001, the aircraft had an 1152-pound useful load or 648 pounds with full fuel on a 3400-pound gross. When the SR22 appeared, Cirrus had just certified a 100-pound upgrade for the SR20, giving it a 3000-pound gross weight with a useful load of about 1030. On equivalent fuel, the SR22 enjoys a 120-pound advantage. We're told by most owners, however, that the SR22 is typically flown with one or two people aboard, full fuel and all the baggage you want.

The SR22 will blister along at 170 to 180 knots on about 18 GPH rich of peak. But not many owners run the airplanes that way, given the reality of $5 avgas. Throttling back to 65 percent on the lean side gives about 15 GPH and 172 knots. You can easily push that up to 80 percent power on 17 GPH and recover some of the lost speed. This appears to be where most owners operate the SR22. The IO-550 is smooth and perfectly happy in this regime. It will run even leaner for max-range cruise.

The 17 GPH setting yields about four hours of endurance for a still-air range of 700 miles, with reserves. At the max range setting, 1000 miles is doable.

CONSTRUCTION, SYSTEMS

Along with Diamond, Cirrus pioneered high-volume composite construction for light aircraft. When this technology was on the horizon, the aviation press

The impressive avionics suite is an important draw for many buyers. Recent models may have the Garmin Perspective system (below), but the vast majority on the used market will have the intuitive Avidyne Entegra PFD/MFD driven by duel Garmin 430s (right). Know that these screens wear out over time and are expensive to replace. Avoid aircraft that seem to have screen issues. WAAS upgrades are also pricey.

was allowed to believe it would be stronger, lighter and cheaper than metal, even if Cirrus didn't say that exactly. Well, it did say stronger and the Cirrus airframe demonstrably meets this claim, according to static structural tests. Cirrus did full-scale crash testing of prototype fuselages at NASA's Langley, Virginia, facility that revealed that even at high impact loads, the composite fuselages remain relatively intact.

The fuselages are laid up in molds in two halves, with the two shells joined and then cured in an autoclave. The wings are similarly constructed and are of a single-piece built around and bonded to a massive spar. This forms a strong torsion box that has proven well in the rigors of real life service. But unlike Cessnas and Diamonds, de-winging is a challenge, given the single-piece structure. Control surfaces are conventional riveted aluminum, with a combination of push-pull tubes, cables and bellcranks and a sidestick controller rather than a yoke or center stick. Most of the control circuitry lives under the floorboards, where it's accessible via generous inspection panels.

As with the SR20, trim is entirely electric via a single coolie hat on the side controller, fore and aft for pitch, side-to-side for aileron. A few, early SR22s also had electric rudder trim, but that was later deemed unnecessary. Because the pitch trim motor is aggressive, mastering smooth pitch trim changes requires a deft touch to avoid bobbles. We wouldn't mind a slower turning servo motor or even manual trim with an old-fashioned wheel. But that goes against the grain these days.

That's also true of the SR22's nosegear and main gear system. It has a castering nosewheel and steering is via differential braking, the weight-saving design philosophy that every major manufacturer seems to follow these days. This works well enough in the real world, but has the downside of chewing up brake pads and, in the case of the SR22, leading to several brake-induced fires. This led to an AD requiring periodic O-ring replacement and a brake temperature inspection hole. Some owners say brake wear isn't an issue if you stay off the binders during taxi.

The wing section and planform is uniquely composed of varying sections, thus the leading edge has the characteristic split on the outer panels. Because the outer panels have a lower angle of incidence, they remain flying while the inner sections have stalled, improving control through the stall and theoretically adding spin resistance. The Cirrus aircraft aren't approved for spins and in place of proving spin recovery, the BRS parachute is provided as the equivalent level of safety.

The fuel system in the SR22 consists of wet cells in each wing. These are plumbed to a single tank switch located on a console between the two pilot seats, which is in plain view and situated near the fuel level gauges. Although the fuel is relatively well-protected in the wings, it appears to be not as well protected as in other aircraft, specifically the Diamond line. Our review of accidents reveals a higher incidence of post-crash fire in the SR22 than in Diamond aircraft.

In keeping with its new-age approach to safety, Cirrus ridded its models of vacuum instrument systems as soon as it could. Although the early SR20s had vacuum pumps and later became all-electric, SR22s were all-electric right out of the blocks. It has two alternators and two batteries, each electrically isolated from the other and either capable of powering essential electrics. The main alternator is 60 amps, the secondary is 20 amps while the main or starting battery is 10 amp hours. The secondary is composed of two smaller 12-volt batteries connected in series.

As do transport aircraft, the SR22 has more than a single electric bus; two in fact, a main and an essential that, in the event of a battery/alter-

This SR22 G2 cockpit retains the analog engine gauges, even though most systems have the same data on the MFD. Later G2 and all G3 models lack these backups. Note the different environmental controls between this G2 and the G3 (left), which also has air conditioning.

Photo by Alex McMahon

nator failure, will power sufficient avionics to continue the flight. Either alternator can power the essential bus.

On the downside, both alternators are gear driven, one on the front of the engine and one on the rear accessory case. Given the service history of Continental alternators, our druther is to have one belt driven. In any case, we think the all-electric airplane is a significant advance over anything to do with vacuum instruments, which owners have tolerated for years because there was no choice.

Turbonormalized SR22s will give an honest 190 knots if flown in the teens, which can be worth the trouble if the winds are right.

The two models share the same CAPS ballistic parachute but with its 3400-pound gross weight, the SR22 can be up to 500 pounds heavier. That means descent under canopy could be as high as 28 feet per second compared to the 24 feet per second typical for the SR20. That's a vertical descent of 1680 FPM/19 MPH versus 1440 FPM/16 MPH. Cirrus has said it and we'll say it again: A ride to touchdown under the CAPS canopy won't be something you'll want to repeat, although the vast majority of real-world deployments have yielded no or minor injuries.

While relatively simple to fly by high-performance airplane standards, landing the SR22 well requires good speed control and resisting the urge to overflare.

MODEL PROGRESSION

Buying a used SR22 is not like buying an older Cessna 182 or a Saratoga. That's mainly because you won't see much post-factory equipment variation on Cirrus aircraft. They emerged from the factory fully formed and the panels don't allow many options to mix and match, although some of the early steam gauge airplanes are getting Aspen Evolution systems or were converted to Avidyne glass.

The original SR22s had an "A" and "B" option list. The A airplanes, which retailed for $276,600, had a Garmin GNS430/420 combination, and S-TEC System 30 autopilot and a Century NSD-1000 electric HSI. The B airplanes ($294,700 retail) had dual GNS430s, a System 55 autopilot, and a Sandel 3308 color HSI. Both options had the ARNAV ICDS-2000 color MFD. The only other option in the early airplane was a WX-500 Stormscope and, later, the Goodrich Skywatch system. At the time, we liked the panel but predicted the ICDS-2000 wouldn't be long for the airplane.

We were right. Within a year the ICDS-2000 was replaced by the Avidyne FlightMax MFD and most of the early aircraft have been converted. By the 2003 model year, SR22s with full Avidyne's Entegra PFD/MFD glass cockpits found their way into customer hands. The Avidyne airplanes had GNS430s, a System 55 and Avidyne's E-max engine monitoring. TKS was available as an option in the earliest SR22s, but it wasn't approved for known icing. That option didn't appear until 2009.

In the 2004 model year, the SR22-G2 emerged, which featured a redesigned cowl, a new prop, a spiffed up interior, an improved door latch design and a six-point engine mount that addressed vibration issues in the first SR22s.

Early on, Cirrus discovered something unique about its buyers: A substantial number of them would replace a recent model SR22

if a newer model had noticeable improvements. We know of many Cirrus owners who have bought two or three new airplanes in the space of five years or less.

Not one to let this opportunity pass by, Cirrus rolled out one of its best sellers ever in the form of the turbonormalized SR22 for the 2007 model year. Cirrus had heard its customers ask for a turbocharged SR22 and Dale Klapmeier told us the company had considered it from early on. Unfortunately, Cirrus couldn't get its in-house developed turbo to run cool enough, so it never brought the product to market.

To address the demand, it did something unusual: It contracted with Tornado Alley Turbo to install a turbonomalized system under STC. These airplanes proved so popular that for a time, they outsold the normally aspirated version by a margin of two to one. Many owners traded up to the turbo model.

Some of them traded up again a year later when Cirrus announced the G3 model with several improvements, including a redesigned wing with 92 gallons fuel capacity and a carbon fiber spar, the removal of the aileron-rudder interconnect found on earlier models and improved environmental and interior options.

Hot on the G3's trail the next year was the Perspective model, a version with the Garmin G1000 EFIS suite adapted specifically to the Cirrus including synthetic vision, a flight director and the GFC700 autopilot with a unique save-my-bacon button that, when pushed, automatically returned the aircraft to wings-level flight. Perspective-equipped airplanes soon displaced the Entegra, which was showing its age, though there was a slight weight penalty for the Perspective models.

Even as aircraft sales hit the skids in 2008 and 2009, Cirrus continued to introduce improvements to the SR22. In 2009, it began offering a known-icing package based on the TKS system that had always been available as an uncertified option. In 2010, it finally got its in-house turbo installation sorted out and introduced the SR22T, to sell alongside the turbonormalized model.

The SR22T has a 315-HP TSIO-550-K that Cirrus claims "provides a path to burning low-octane fuels." Although it hasn't said in detail what that means, we take it to mean that the engine can operate on 94UL or the equivalent, perhaps with the installation of Continental's Power-Link FADEC system. Performance wise, the SR22T is comparable, but our flight test seem to suggest it's not quite as fast by a handful of knots. Cirrus insists the two cruise at the comparable speeds. We also noted that CHTs in the SR22T were higher on a slightly higher fuel burn.

MAINTENANCE ISSUES

When composites hit the market, one selling point was that they wouldn't corrode, parts wouldn't break and they would be cheaper to maintain. This might have proved somewhat true, but whatever savings were lurking in the statistical noise got chewed up in higher avionics costs and, especially, database costs.

It's not that the avionics in the SR22 break more often than other aircraft, but there's more of them and owners report that once off warranty, flat repairs run into dollars. Recurrent database and datalink weather subscription costs are also something owners of a decade ago didn't spend as much on. You get more with these systems, but you pay more to keep them up, too.

On the plus side, the IO-550 has proven to be a durable and economical engine. We're not seeing many complaints about soft cylinders or premature failures. We don't see a widespread pattern of the engines not making TBO.

A scan of the FAA's Service Difficulty Reports revealed some complaints. Door fit and inadvertent opening is a problem in the early models. Cirrus addressed this with a redesign of the latch. Front wheel shimmy can be a problem. In one case, the wheel pant departed the airplane. A few other SDRs dealt with nosegear wear issues. There were also a handful of alternator and starter drive adapter failures. These are common in Continental engines and not unique to the Cirrus.

The SDRs revealed some avionics failures, but we suspect most of these aren't reported. The boxes are simply shipped to the factory for repair, then returned to service.

The SR22 has a total of 14 airworthiness directives, a fair to middling

score. None of these are especially onerous or expensive, but some do impact safety, such as 2008-14-13 which requires door hinge replacement to prevent the door from departing the airplane, 2008-06-28 which addresses significant PFD issues and 2007-14-03, which requires a modification of the CAPS activation system.

And speaking of CAPS, the earliest airplanes are now at the point of needing the 10-year repack/recertification. How much? Plan on about $12,500 all in, if you go with an overhauled unit, but close to $15,000 for a new one.

MARKET SCAN

Because of the aforementioned habit of buyers to upgrade with each new model, Cirrus has been a victim of its own success. This became especially obvious in the fall of 2008 and spring of 2009 when a flood of SR22s of various vintages came on the market. At one point, we estimated as many as 200 might have been on the block. As of late 2010, the Cirrus Certified site shows about 50 used SR22s across a range of model years, but one broker told us the total is actually about 150.

Good deals? By all means. We think the best buys are the 2002 to 2004 aircraft with Avidyne avionics—particularly an early G2 model. The Bluebook lists these for under $200,000 retail and we don't doubt bargains are out there. The 2001 to 2003 SR22s are even cheaper, with retail prices at a firesale $140,000. Some have the Avidyne Entegra, others steam gauges with an Avidyne MFD. The interiors on these first-generation SR22s was never a high point and many of these older SR22s have tired seats and carpets.

The Cirrus airplanes are exceptionally well supported in our view, both by the factory and by one of the best owners groups around, the Cirrus Owners and Pilot's Association at www.cirruspilots.org. For a detailed look at real-world performance numbers on Cirrus aircraft, see www.cirrusreports.com.

OWNER FEEDBACK

We operate a Cirrus Aeroclub at Megara Aerodrome, in Greece, called Flight Experience (www.flightexperience.org) where we have a 2004 SR22 and a 2007 SR22 Turbo. Both are G2s, with Avidyne, Garmin, deicing and oxygen and are kept on the American registry. We use them to fly around the Greek islands, Turkey, Italy and beyond.

The cost of a 50-hour check is approximately 1000 Euros ($1300); the cost of a 100-hour check or annual is 2000 to 3000 Euros ($2600 to $3900). Our annual insurance is 4700 Euros ($6110). The main problems so far have been nosewheel shimmy, which got fixed but not immediately and an EGT false reading, which was fixed with the implementation of an optional Service Bulletin. There was also a one-off maintenance pipe fitting issue with the turbo and a slight problem with an oxygen malfunction. Both are now fixed.

We have been delighted with the qualities of the airplane (speed, comfort, visibility, avionics) and the problem is that now we can fly nothing less than a Cirrus.

Chris Leontopoulos
Flight Experience Aeroclub

I'm part owner in a 2004 SR22-GTS and have owned shares of a couple other airplanes. Overall, I'm quite happy with the airplane.

The number one pro is the avionics. In addition to the overall situational awareness, I have had cases where I maneuvered to avoid an aircraft solely based on the traffic warning and display. I have used the Stormscope to avoid thunderstorms when I was 25-50 miles away, and I regularly use the NEXRAD for long-range strategic planning. The METAR info is great for planning purposes, both for my destination airport and alternates.

I have not used the TAWS as much because I rarely fly in the mountains, however on IFR departures or night departures, I'll usually put the TAWS display up on the top Garmin GNS 430W (it came with the WAAS upgrade). I'm glad that we did the WAAS upgrade. I have needed it for a few LPV approaches and I like how the autopilot will now track a hold.

Occasionally, the autopilot and the PFD don't communicate at startup. If you don't notice it on the ground, resetting the PFD in the air (by pulling the circuit breaker) fixes the problem. We get occasionally lose EMAX data when flying in the clouds. We're pretty sure this is due to P-static. Also, the Avidyne MFD can get overloaded with XM data, which causes the MFD to pause on screen changes and generates "Stormscope Heading Failure" messages.

I give the cockpit high marks overall. The visibility and the side joystick are terrific and it's a comfort-

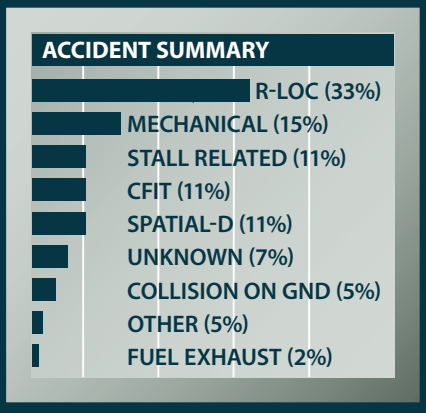

Photo by Michael Kerber

At 49 inches wide, the Cirrus cabin is spacious. It's even comfortably wide in the back seats.

ACCIDENT SCAN: THE 'CHUTE WORKS, LANDING HOT DOESN'T

Looking over the SR22 accidents for the past 10 years, runway loss of control (R-LOC) is the runaway winner for how Cirrus pilots get into trouble—and almost always on landing. Just landing R-LOC accounts for 31 percent of the total accidents and is twice as likely as the next most common cause. For all the talk about the technologically advanced cockpit and aeronautical decision making in the Cirrus, the biggest issue is plain ol' stick-and-rudder work. But that's not unique to the Cirrus, and 33 percent R-LOC is barely the high side of average.

Many of these accidents have the signature "too high, too hot" combined with porpoising and/or failure to stay anywhere in the vicinity of the centerline. Three of these resulted in fatalities when the pilot tried to go around and lost control at high power and barely airborne rather than at idle and heading for the weeds. In fact, 13 percent of the total accidents involved a botched go around or missed approach. We appreciated the comments of one pilot who walked away uninjured after an overrun: "I then chose to remain committed to the landing and began heavy braking that was resulting in skidding …"



Mechanical failures took second place, but this ranking is a bit artificially high from cases of wheel fires due to overheated brakes. Other than that, there were no smoking guns of problem systems.

Low altitude stall/spins ranked high as well (with a 90-percent fatality rate) proving that even though the SR22 wing design is spin resistant, it's not spin proof if the pilot combines high Gs with high bank angles and low airspeeds. Controlled flight into terrain took an equal share (and a 100-percent fatality rate). These may diminish over time as terrain warning is now standard.

Loss of control due to spacial disorientation was

another big-ticket item, but with an interesting takeaway: Half of the cases were fatal—and the other half involved a parachute deployment. The parachute was activated in 13 percent of the accidents and almost always resulted in a minor or no injuries. While some of these cases might have turned out fine sans chute, others were clearly lifesavers. "I eventually got the plane into a stall, then into a spin that I could not recover from. At that moment the parachute was engaged and we floated safely to the ground."

It's worth noting that nine percent of the accidents we saw involved a post-crash fire. We can't say if this is statistically significant stacked against comparable aircraft, but it struck us as more than we normally see.

The 19 percent of the cases that remained showed the usual suspects, such as flight into icing conditions, running into parked objects and attempting continued flight without continued fuel. Reading the NTSB report on one of the fuel exhaustion cases pointed out an interesting consequence of the glass cockpit: "Data downloaded from the primary flight display unit, remote data module, and the multi-function display unit card, along with fueling records, revealed that the airplane departed with approximately 38.2 gallons and not 62 gallons [which he thought was on board]." There was also this tidbit on one of the brake fire cases: "The data also revealed that during the taxi, the pilot reached speeds up to 29 mph and often reduced speed without reducing the engine RPM."

Note to self: The airplane is watching.

able ride. However, the environmental controls are a bit crude on the older model that we have. The plane is very responsive, but I use the autopilot on virtually all flights.

The door trim and rubber seals are a poor design. Passengers usually grab the rubber seals and pull them off as they are getting in. Also the doors require a lot of pressure to unlatch from the outside. Speaking of the doors, there is a lot of air noise on our model. The passenger door is tighter, so most of the noise is coming from the pilot's door, which has been difficult to adjust.

We had a fair amount of issues early on with starter and alternator-two failures. But after we replaced these they lasted for over 1000 hours. Our plane has about 1940 hours on it, and we have replaced two exhaust valves on the number five cylinder and one exhaust valve on number three. The other cylinders still have decent compression.

Cirrus support used to be great but now it's not so good. It's more difficult to get parts or to get a live person to talk to.

Alan Lukas
Portland, Maine

The Aviation Consumer

Fuels

(continued from page 21)

mium E0 market will be, facing as it does rising quotas for ethanol blending. Although it's a high-margin product for refineries, it's also very low volume with minimal demand. Doubling aviation and marine use wouldn't change the equation much.

From what we're able to determine, the two-fuel approach works in Europe because the proportion of avgas usage is exactly the reverse of the U.S. pattern: Most of the volume—or at least an equal volme—is burned by aircraft requiring low-octane, while in the U.S. high-octane users account for most 100LL usage. The larger factor may be that in Europe, distribution is vertically organized. The gasoline supplier provides the tankage, not the FBO, making it painless for airports to carry both fuels. That's a different model and one that U.S. FBOs might like.

"If the tanks magically appeared, it would be a different story. Otherwise, I doubt the city would go for another fuel," says Kent Marshall, who manages the Suffolk, Virginia, airport, where mogas has been a popular fuel for years, but which moves only about a tenth of the avgas volume.

Although the blender credits may go away and the bloom is definitely off the ethanol rose, it seems unlikely that with excess ethanol capacity, the EPA will reduce the mandates for blending it, thus E0 premium will be under growing market pressure.

Numerous readers told us that once-reliable supplies have dried up because states have pressured refiners to use more ethanol. In some regions, ethanol-free gasoline may remain available, but it's likely to be subject to the whims of local demand and state laws. In our view, that's not a trend that points to a sustainable two-fuel system for the entire GA fleet.

Letters

(continued from page 3)

it. When I add on another goodie, I don't think about how much it will be worth when my wife sells it at estate. I think about how much fun my next trip to Atlanta or Chicago will be.

Brian Peck, MD
Waterbury, Connecticut

More iPad

I just finished reading your article on the iPad and agree that it's a terrific digital chart replacement. I have been using Foreflight and like it despite my Jeppesen upbringing. Foreflight or WingX on the iPad is just too easy and cost effective to use anything else.

My one big concern comes from what to use as a backup. iPads have been known to quit in the cockpit from overheating or other reasons, so a backup plan seems prudent.

I carry an iPhone with Foreflight loaded. I bring a paper enroute chart and print approach plates for departure and arrival airports from the Web. For a long flight, I also bring plates for an intermediate and diversion airport. I feel this is adequate (perhaps overkill?), but was wondering what your thoughts are on appropriate backups for the iPad and if you think they're necessary.

David Landset
via e-mail

We think the likelihood of a critical iPad failure is low. If that does happen, paper charts are adequate backup.

We've heard from a number of readers who experienced iPad failures due to overheating, but it appears that this can be avoided by simply keeping the device out of direct sunlight. We recently saw one failure due to a dead battery, something you can't directly address in the cockpit without an external power source.

FEEDBACK WANTED

CESSNA 182RG

For the April 2011 issue of *Aviation Consumer,* our Used Aircraft Guide will be on the Cessna 182RG, a load-hauling single. We want to know what it's like to own these retracts, 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 182RG by February 1, 2011, to:

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