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THE FAA'S $500 ADS-B HANDOUT TIGHTENS COMPETITION

As you probably heard, the FAA is offering a limited first-come, first-served $500 rebate for certain mandate-compliant ADS-B equipment installations. This isn't a generous gift to aircraft owners, of course. Obviously, it's the FAA's first effort (there could be more) to get owners into avionics shops to have ADS-B Out equipment installed before the end of 2019. While the ADS-B market has become sharply competitive, the decline in equipment prices hasn't exactly created a surge of upgrades. The FAA says about 18,000 GA airplanes and 500 or so commercial aircraft have equipped so far. That means as many as 150,000 still need to be equipped in the remaining 42 months. After paying for a basic $4000 ADS-B project, eventually finding a $500 check in the mailbox is better than nothing. But, there's a dilemma, which is stirring competition.

My local avionics shop, VIP Avionics in Hartford, Connecticut, told me the program is backfiring, at least on a shop level. The problem, according to VIP principal Barbara Rowley, is the timing of the incentive. Since the funds won't be available for a few months, many customers who committed to immediate ADS-B installations are putting the brakes on. "We can't close our doors for the summer while the FAA puts the program in action," Rowley said. A federally mandated waiting period means the program won't launch until September 2016. According to Rowley, roughly 75 percent of VIP's installs scheduled between now and September include an ADS-B solution. Several other shops I spoke with expressed similar concerns. Even manufacturers see the program backfiring, so some have created their own incentives. This is good.

"The last thing we need is another reason for ADS-B buyers to wait, which is exactly what this FAA announcement did—freezing the market for the next 90-120 days," Avidyne's marketing director Tom Harper told me. As a result, Avidyne announced its Don't Wait rebate program. It's offering a $500 instant rebate on its line of ADS-B Out compliant products on purchases made between June 17 and September 30, 2016, for installation in U.S.-registered single-engine piston airplanes. Avidyne isn't the only manufacturer stepping up.

FreeFlight Systems' $500 Bridge Rebate program covers products from the company's RANGR Blue ADS-B and WAAS GPS product families. Put a system in now and FreeFlight will send you 500 bucks. Already bought a FreeFlight solution? The company is going one step further and offers a $100 rebate to its customers who took delivery of eligible systems between January 1, 2016, and the present day. Unlike the FAA's program, FreeFlight says its Bridge Rebate extends to all U.S.-registered fixed-wing and rotorcraft makes and models and is not limited to one per owner. This might have appeal to fleet operators and flight schools. I asked L-3 Avionics and Garmin if they plan to offer similar programs, but as we go to press, they are not. Garmin said it's planning future incentives to make an ADS-B investment very attractive. NavWorx is collecting $190 deposits for its systems while buyers wait for the FAA's incentive to get rolling. The FAA's incentive program has specific rules and limitations.

Only U.S.-registered fixed-wing piston singles are eligible and the Version 2 ADS-B Out equipment must be TSO-certified. Begin by completing a rebate reservation application, which is valid for installations performed within 90 days. The FAA estimates that only 20,000 reservations will be available and once they're filled, the program ends. Once the equipment is installed, you have 60 days to fly the aircraft in ADS-B airspace for at least 30 minutes, with at least 10 aggregate minutes of maneuvering flight to validate a passing performance report and an incentive code for claiming your 500 bucks. For the official rules, go to http://tinyurl.com/jojmp9d. —*Larry Anglisano*

STATIC WICK TECH

I read with interest the static wick article in the July 2016 issue of *Aviation Consumer.* If I recall correctly from a long time ago, static wicks can be tested for proper operation. I'm thinking it is a resistance test performed with a meter.

Assuming there actually is a way to determine the condition of the wick, it would have been helpful if you had included that information. If there isn't, that information would also be useful. As it stands, the article seems to fall short.

Paul Burgette
via email

During our research, we asked static wick manufacturers about ICAW procedures (instructions for continued airworthiness) and all noted that aside from a preflight visual inspection, it's important to look for signs of corrosion where the wick attaches to the skin. Additionally, you'll want to inspect the tips. Testing rarely happens on the shop level.

TCO's Jon Snider told us the company measures the discharger with a megohmmeter during the production process, but noted that most shops don't have access to this type of meter. These things can wear out. Snider said TCO discharge wicks are worn out when the corona points (the conductive fibers at the end of the wick) are no longer visible. All manufacturers and shops we spoke with agreed that wicks break off the aircraft far more frequently than they wear out.

AERA 660 VERSUS IFLY GPS

The Garmin aera 660 GPS article in the July 2016 *Aviation Consumer* would have been a good opportunity to compare it to the iFly 740 GPS from Adventure Pilot. The company offers this dedicated GPS and also tablet apps for Android and Apple.

The iFly GPS device is more expensive than the Garmin aera 660, but the data subscriptions cost less. I fly with an iFly 720 on the left side of the panel, an iPad Mini on the right side running the iFly app, plus the iFly app running on my Android phone. The iFly 720 is mounted horizontally and the iPad is vertical; there is no need to rotate them in the mounts when flying east to west or north to south. If there is glare on a screen on one side, the other is clear. The apps and the iFly 720 are very similar in operation and can share flight plans.

I like the ability to plan and file from the tablet or phone wherever I find myself, then share the results with all the devices. The 720 is much easier to see in sunlight and is more reliable than the multi-purpose tablet and phone, though it's not as bright as the newer iFly 740.

I find the iFly GPS device is almost bulletproof, the apps convenient and the responsiveness of Adventure Pilot to its customers to be unparalleled.

Don Norris
Edmonds, Oklahoma

We hope you never get lost with all those devices leading the way, Don. We covered the current-production iFly 740 GPS in a flight trial article in the March 2015 issue of Aviation Consumer and it performed well, had a good display and we thought it was a big improvement over the older iFly 720 since it has an internal power supply.

As for the Aera 660 article, it was really a shootout between the GPS and Garmin's Pilot tablet app.

STICKY LIGHTSPEED HEADSETS

I went to the Lightspeed Aviation headset factory to purchase a new Zulu 2 model and while I was there, I asked how they remove the stickiness that develops on the surface of the earcups on older models like my 3G. Lightspeed told me the condition develops in five years or less, depending on the temperature. Worse, the stickiness makes dirt adhere to the surface. While Lightspeed is well aware of the problem, I was told there is no solution. I developed my own solution by cleaning them with cornstarch to remove the stickiness. When I showed them the headset, they were amazed that it looks and feels like it's new.

Worth noting is that while my 3G model came with a 5-year warranty, it doesn't cover finish or appearance items. The company also discussed a potential problem with the black finish on Zulu models when they aren't cleaned properly.

If you don't want to bother trying to spruce up a deteriorated older set, Lightspeed issues credit if you trade them in. I turned in an old David Clark passive model and received a $200 credit toward the purchase of a new Zulu 2.

Bob Hidley
via email

POOR PIPER WARRIOR FANS

That's what I love about *Aviation Consumer*—you guys include us poor folks by keeping affordable used aircraft in your coverage. That's why I was thrilled to see a report on the Piper Warrior in the July 2016 issue. My three partners and I would love something faster, sexier and more modern, but our late 1970s Warrior keeps us flying on the cheap.

Richard Pemberton
via email

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ICON A5: SOPHISTICATED, FUN

Will designing a spin-resistant amphib and instituting a mandatory training program safely turn people into enthusiastic pilots? We hope so.

by Rick Durden

If there's anyone in the aviation community who hasn't heard about the Icon A5 S-LSA, she or he probably lives under a rock. The two-place, Rotax-powered amphib has been the subject of more breathless excitement in the non-aviation media than we can conveniently recall. In the aviation world, the level of coverage and the fact that Icon is assertively targeting its marketing to induce non-pilots to discover the excitement of flying has resulted in a level of outspoken opinions about the airplane and company that we haven't seen since the hype and meltdown of Eclipse and the BD-5.

We were invited to find out for ourselves whether the "spin-resistant" A5 is just a remake of the "unstallable" Ercoupe and whether Icon's goal of producing a highly safe, and exciting, sport plane can help increase the pilot population.

We came away impressed. While Icon hasn't made a revolutionary breakthrough in aerodynamics, its engineers have nevertheless taken what is known about low-speed handling, stability and control and control effectiveness and created an airplane that dramatically reduces the risk of inflight loss of control to a level we think was previously unattainable without active computer/autopilot involvement. The combination of a cuffed outboard leading edge with VGs, appropriately located strakes, tightly controlled center of gravity and rudder travel selection have resulted in an airplane that has fully satisfactory control in yaw for all flight operations. Yet, when the wing is stalled, full pro-spin rudder will not generate an abrupt wing drop, incipient spin or spin.

AIRCRAFT FLIGHT TRIAL

We think that the aerodynamic design decisions incorporated into the A5, combined with emphasis on the use of angle-of-attack instead of airspeed reference for all pilot decisions regarding pitch inputs at speeds below cruise, make this one of the easiest to fly and safest airplanes we've experienced. We don't know if it will help increase the pilot population—we hope it does.

BACKGROUND

The A5 was developed as a recreational airplane targeted at people who just want the fun of flying whether or not they are currently pilots. That philosophy underlies the entire design of the A5—it is for fun, with personal transportation a lesser design goal—although it can be used for that purpose.

To meet the overriding recreational nature of the airplane, it was essential that it be designed to be flown safely by a very low-time pilot—the sport pilot ticket only requires 20 hours. That meant that the design must allow for the mistakes humans make in airplanes and not penalize them with a crash. The most serious of those mistakes is pulling back on the stick, hard, when faced with something that doesn't look or feel right—because the human is frightened and wants to get the nose up, away from the ground. As a result, the A5 is fully controllable at the stall and will generally either hold altitude or climb with the stick fully aft and full power.

It is a tricycle gear amphibian because a) seaplane flying is hugely fun and b) there's far less risk of losing control of a nosewheel airplane when on the ground than of a tailwheel machine.

Icon decided to integrate a focused

training program and stringent owner/operator purchase and operating contract with the sales of its A5.

Icon recently announced a delivery delay as it tools up for high-volume production.

When we visited the factory, it appeared to us that the company is in the midst of making the often painful transition from development to production. Company CEO Kirk Hawkins told us that Icon has 2000 orders on the books. We saw strong indications that it's on its way to establishing a production program that is intended to turn out 37 airplanes a month within the next two years.

The production facility covers 144,000 sq. ft. in two buildings adjacent to Vacaville, California's, Nut Tree Airport. The company has an additional 24 acres of land available for expansion.

One building is devoted primarily to creation of the carbon fiber fuselage. New CNC equipment had just become operational and, we were told, was helping to reduce the time involved with some of the steps of deburring, prepping and positioning the fuselage halves and composite components for assembly from hours to minutes.

In the second building, we saw a modern assembly line with 20 stations that had a supply system for getting the correct parts to the correct places at the correct times. It was similar to lines we've seen at Cessna, Piper, Beech and Cirrus after updates had been made.

We looked at six completed airplanes and were impressed by the quality of the fit and finish.

SPECS AND SYSTEMS

Certified in the S-LSA category, the A5 has a maximum takeoff weight of 1510 pounds—a dispensation from the normal limit of 1430 pounds for seaplanes because, per Icon's application to the FAA, of the weight requirements associated with the spin-resistant wing. Useful load, according to Icon's current materials, ranges from 430 to 550 pounds depending on equipment ordered and the type of paint. The top-of-the-line, automotive quality paint adds 15 pounds to the empty weight. In most cases, operation with two moderately obese adults aboard will mean going with something less than the full 20 gallons of available fuel.

Factory photo, top, shows excellent cabin visibility and AOA indicator prominently at the top of the panel. Cuffed outboard leading edges and VGs keep that section of the wing flying and the ailerons effective below stall speed—integral components of the spin-resistant design.

The A5's Rotax 912 iS can burn either 100LL or 91 octane mogas. The fuel is stored in a Kevlar box aft and below the occupants. From a crashworthiness standpoint, we think the tank design is robust and its positioning several inches above the base of the hull should minimize the risk of post-crash fire.

The gear retracts into the hull into "wet wells." The gear doors do not seal water out during operations on the water—the wells themselves are sealed off from the inside of the hull. Any water leakage into the hull is removed via a bilge pump.

The wings on the A5 can be folded for storage or trailering (on an Icon-designed trailer). The process takes about 30 seconds per wing to fold or unfold. We watched a first-timer take a minute to unfold a wing and lock it into position. To fold, a latching handle in the wing root is unlatched, the wing is pulled outboard via a handle at the tip, then rotated 90 degrees, moved aft 90 degrees and attached to the horizontal stabilizer inboard of its removable tip. To unfold, the process is reversed. The attachment latch will only lock if the wing is lined up correctly. The ailerons and flaps connect automatically through cam-type pushrod connections. An annunciator on the panel warns if the wings are not correctly locked into position. We've wrestled with time-consuming folding-wing mechanisms in gliders and were pleasantly surprised at how easy and fast the A5's system worked.

The triangular instrument panel is obviously designed for VFR, with a Garmin Aera796, plus a Trig Avionics comm and transponder. Starting with the AOA indicator, the most important stuff is at the top for easy viewing. When maneuvering or setting up for landing, eyeballing the

ICON FLIGHT TRAINING: MANDATORY

The second leg in Icon's approach to safely making flying more accessible to those who want to do it (after the design of the aircraft) is an on-purpose training program that it controls. We spent time with Greg Zackney, Icon's director of flight training, discussing the program it is putting in place and reviewing some of the training materials they have created.

The training program, via hard copy books and/or online study, is tailored for the individual's level of experience—from someone with no flight time who needs a sport pilot certificate with an endorsement for LSA-ASES through seaplane pilots who just need transition training. The materials we saw contained what we felt to be realistic syllabi for each type of training involved and were well-produced.

There is sophisticated supplementary material on aerodynamics and aircraft performance available for the pilot who wants more than what is required for the sport pilot certificate or transition training. The training material and syllabi have a definite military feel to them—professional and no-nonsense. That is only to be expected as Zackney was a Marine aviator flying Harriers and company president Kirk Hawkins flew F-16s in the Air Force.

Icon told us that the price for training at Icon has not been established but it will be on a per-hour basis.

The agreements that must be signed by the customer to even buy an A5 require that there be a managing pilot (it can be the owner) for the airplane and that the managing pilot agrees to assure that anyone who flies it only does so after completing the training program set up by Icon with an Icon-approved flight instructor. The agreement signed by the managing pilot allows Icon to go to court to compel the managing pilot to live up to the terms of the agreement. In all of our conversations with Icon and our review of the sales agreements for the Icon we consistently noted Icon's unwavering insistence that pilots who fly the A5 have solid training Icon's way before being turned loose.

There is no requirement for recurrent training in the managing pilot agreement; however, Icon personnel told us that they recommend recurrent training every year. They know that the reason that pilots err and crash is most often because they have not had adequate initial or recent recurrent training. Icon is taking steps to aggressively fight pilot error accidents at their source. Whether pilots will do their part is something we're going to be watching closely.

We asked how a brand-new sport pilot from Louisiana gets his airplane home after getting his rating in it at Icon's facility at Vacaville, California. We were told that Icon will make mentor pilots available for owners who want to fly their airplanes home, will arrange for delivery pilots to fly them to the buyer's home plate or will assist the buyer who wants to trailer her new airplane home (there's not a lot of assistance necessary for that process).

We think the program of specially trained CFIs used by Cirrus and the specialized instruction facilitated by the American Bonanza Society have increased the safety level of those lines of airplanes. Accordingly, we applaud Icon's even more aggressive approach to training for its customers.

AOA indicator requires only glancing down a short distance. We also liked that it is large and easy to interpret.

The skid/slip ball is tiny. In fact, we didn't see it until head of flight training, Greg Zackney, pointed it out. While the airplane doesn't require much rudder in most ops, there are times it does require a significant input, especially when maneuvering and climbing—and it can matter as uncoordinated flight can adversely affect rate of climb. We think a more easily seen skid/slip ball would be a good idea.

The annunciator panel is set up so that it should have all lights off prior to takeoff. We like that if there something is seriously wrong with the engine a "Land Airplane" light annunciates in red. No fooling around, no questions asked, land. Now.

The interior is attractive at a high level while being functional for a seaplane. There are no materials that can't be dripped on when stepping inside after wading out into the water to launch after beaching the airplane. To control the center of gravity, the seats are fixed and the rudder pedals adjustable. Our review pilot is 6 feet 4 inches tall and fit comfortably. We were told that pilots as short as five feet tall have flown it.

Rather than have wingtip floats for stability on the water, the A5 has fuselage sponsons it calls sea wings. We prefer sea wings over wingtip floats because floats create issues in congested docking areas, beaching and the risk of breaking them off when hitting a boat wake. With some effort, it's possible to stick an A5 wingtip into the water once the airplane is going fast on the step, so the wingtip is designed to deflect itself upward on touching the water rather than dig in and cartwheel the aircraft.

FLYING IT

Taxing on land is via differential braking, although the prop blast over the tail is effective for minor directional changes. Takeoff on land is standard issue nosewheel; rudder forces are predictable and responsive without being twitchy. All land-based takeoffs and landings are done flaps up. Raising the nosewheel slightly at 50 KIAS allows the Icon to fly itself off.

Water takeoffs are the easiest we've ever experienced in a seaplane. They

can be done hands off until time to rotate because the A5 gets itself onto the step without pilot input. All water takeoffs and landings are made with full flaps (30 degrees).

It was over 97 degrees the day we were flying. The A5 took what we estimated to be 1500 feet and showed no reluctance to unstick from smooth water.

Once in the air, the flaps are reduced by half, to 15 degrees, immediately (before reaching 50 KIAS). There is no pitch change with flap deflection or retraction. In nearly 100-degree heat at 2000 feet MSL and gross weight, the rate of climb varied between 300 and 400 FPM.

In cruise at 4800 rpm, we saw a true airspeed of 90 knots in level flight.

MANEUVERING

The controls are well-harmonized, with a moderate need for rudder to coordinate any rapid rolling maneuver. Steep turns are easy. The A5 is designed to forgive pilots who screw up a steep turn by entering an accelerated stall. The airplane clearly tells the pilot it is stalled via an unmistakable buffet, warning light, buzzer and AOA in the red. In the stall it remains fully controllable. All the pilot has to do is glance at the AOA indicator to know that the nose needs to be lowered to get out of the uncomfortable mess he's gotten himself into while rolling out of the turn.

Using the AOA indicator, astonishingly tight radius turns can be made safely. Rolling into a steep bank, sliding in full power and pulling on the stick until the needle was well into the yellow arc resulted in turns with a radius of less than 200 feet.

The stall is unremarkable in that no matter the rate at which it is approached, flaps up or down, the airplane flies straight ahead and stalls without rolling off so long as the ball is near the center of the race. Power off, holding the stick fully aft causes the airplane to remain stalled and sink at 800 FPM. The rudder and ailerons remain effective and turns can be made in either direction. However, the rudder is not effective enough to cause the airplane to enter a spin. The wings can be held level easily despite full rudder deflection in either direction.

We held the stick fully aft when stalling the airplane with power on as well. With the airplane near gross weight, at an altitude of 1500 feet MSL and a temperature of 97 degrees F, the airplane climbed at just over 100 FPM. It remained controllable in roll and yaw. The wings were easily held level with small opposite aileron deflection. We think this design characteristic is excellent in an airplane that is to be flown by inexperienced pilots—and experienced pilots—because everyone makes mistakes.

An inadvertent stall in the traffic pattern should not be fatal in an A5 if the pilot applies full power and gets the wings more or less level—even if he is panicked and continues to lock the stick all the way back trying to get the nose up. The nose will come up and the airplane will climb away from the ground.

Wing folding involves releasing a latch, pulling the wing outboard and rotating it 90 degrees, top. The wingtip is then walked aft and attached to the underside of the horizontal stabilizer, above.

LANDING

Using the AOA indicator to make precise, safe landings is something the U.S. Navy figured out decades ago and we think should have been applied in general aviation airplanes at the same time. Setting up for landing in the A5 means lowering the gear and keeping the flaps up for land operations and lowering all the flaps and keeping the gear up for water operations.

The approach is flown with the AOA on the approach line and adjusting power as needed to get to the desired touchdown point. That's it. The airspeed indicator is ignored. The AOA has no lag and automatically adjusts for the weight of the airplane—it tells the pilot what the wing is doing and any deviation

THE NEW PURCHASE AGREEMENT

When Icon released its original aircraft purchase agreement for the A5 the response within the industry was intense. While understanding that Icon was trying to control its product liability exposure contractually, the terms were decried as unreasonable.

Icon listened and in mid-June rolled out a newer, shorter agreement. It is a combined purchase and operating agreement that, we think, is designed to help reduce Icon's exposure to product liability claims over accidents where the pilot is at fault and to increase the level of safety of operation of the A5 by getting the owner to agree to certain operating and maintenance standards. It also has obligations that the owner must meet when selling the airplane on the used market.

We'll go through some of the points of the agreement, which is to be interpreted under California law.

The purchase agreement and the included operating agreement require that the buyer designate a managing pilot who has responsibility to assure that no one who has not completed Icon-approved flight training from an Icon-approved CFI fly the airplane and that only CFIs who have completed Icon-approved training give instruction in it.

Both the owner and managing pilot agree for themselves and their heirs to waive their right to sue Icon should they crash and the NTSB doesn't find THE probable cause to be due to something Icon did wrong in manufacturing or training. (The contract doesn't say if Icon may be sued if its wrongdoing was only one of two or more probable causes of the accident.) And, it won't be a lawsuit in the courts; the buyer agrees that the case will go to arbitration.

For an extra $10,000, the buyer can have the waiver of liability section of the contract removed. However, in another section that is not removed, the buyer and managing pilot both agree that there are risks involved with flying and that those risks include defects in the aircraft. The buyer and managing pilot then agree to assume those risks—which seems to us to give Icon a very powerful defense if the buyer or managing pilot ever crashes and sues.

The buyer is also obligated in certain circumstances to defend and indemnify Icon should it get sued—that is a significant exposure for the buyer. We are aware of no insurance a buyer can obtain to protect against that serious financial risk.

We like that Icon requires the owner and managing pilot to recognize and agree that it is their obligation to recognize and manage risks when flying.

We can't help but think that putting personal responsibility in writing may cause some pilots to make better operational decisions (to think twice, so to speak, before saying, "Watch this!"). It may also cause the high-risk set—those who don't give a fig about risk analysis—to take a pass and buy some other type of airplane. Those are sales Icon doesn't need.

The contract repeats the LSA requirement that maintenance is to be carried out in accordance with the manufacturer's procedures, but takes it a step further—the owner must agree, in writing, to do maintenance as directed by Icon, using maintenance personnel who meet Icon's requirements. The only way the owner of an S-LSA can avoid the manufacturer's maintenance requirements is to convert the airplane to an experimental—E-LSA. Under the purchase agreement, the A5 buyer agrees not to make that conversion.

We think the agreement is heavily slanted toward the seller. We recommend that anyone considering the purchase of an A5 retain a lawyer admitted to practice in California who knows California contract and product liability law to review the purchase agreement and get her or his advice on signing.

from the correct angle of attack can be corrected instantly.

One of the most common causes of runway loss-of-control accidents is approaching too fast. A pilot trained to fly AOA is less likely to do so because the ASI is ignored and the approach is made at the appropriate speed. Once flare height is reached, the flare is initiated, any power carried is wiped out and the airplane is landed near stall speed, so the risk of RLOC due to being unable to manage extra energy after touchdown is minimized.

We found the A5's water manners to be excellent. It will turn tightly on the step—full rudder deflection can be used. A turning takeoff followed by a tight circling climbout can be performed safely.

If a rapid stop is desired while still on the step, all the pilot need do is bring the stick full aft, apply full rudder and a little aileron in the direction of the turn. The A5 comes off the step while turning sideways and stopping in short order.

CONCLUSION

With the price for a well-equipped A5 approaching $300,000, the idea of buying an airplane as a purely recreational vehicle may take some adjustment. However, in speaking with Rod Rakic, principal of OpenAirplane (*Aviation Consumer* April 2015), his comment about looking forward to being able to go to a resort and rent an Icon A5 to do a bunch of fun flying stuck with us.

After all, families make extended resort stays so one of the members can go through scuba training—why not go to a resort to go flying for fun, especially in a seaplane? Why not do a group rental to go air touring, just as motorcycles are rented for tours?

We can't predict how Icon's decision to create an airplane for what is effectively the aviation motorsports market will turn out. Icon says 40 percent of those who have deposits on the A5 are not pilots. We think that the A5 is the easiest to fly and most forgiving of mistakes of any airplane we've ever flown. If there is a way to get nonpilots into the world of flying quickly and safely, the A5 should be able to do it. Technology has allowed development of the aircraft and Icon is mandating the training—we'll be interested to see how the market responds.

BendixKing AeroWave: Inmarsat-Based Data

For 40 bucks per hour, the AeroWave 100 cabin internet and voice system is suited for basic GA aircraft, but you'll have to accept bandwidth limits.

by Larry Anglisano

CHECKLIST

- ~ At $25,000, it's priced for high-end pistons and lower-end turbines.
- \+ The small antenna and built-in GPS tame the installation complexity.
- ~ Forget video streaming, large files and more than two devices—that'll tank the network.

To date, the trouble with cabin Wi-Fi systems has been two-fold: The hardware and data cost can be way too expensive for the market's lower end, plus bandwidth issues generally make them too lousy to be useful when compared to ground-based web surfing.

We'll cut to the chase and say up front that BendixKing's AeroWave 100 system succeeds in addressing the price thing, but doesn't quite conquer the bandwidth limitations. But compared to other systems we've used, we think it represents serious progress from an installation and cost perspective.

We recently went flying with the AeroWave 100 installed in a Beechcraft Bonanza to see just what it can and cannot do.

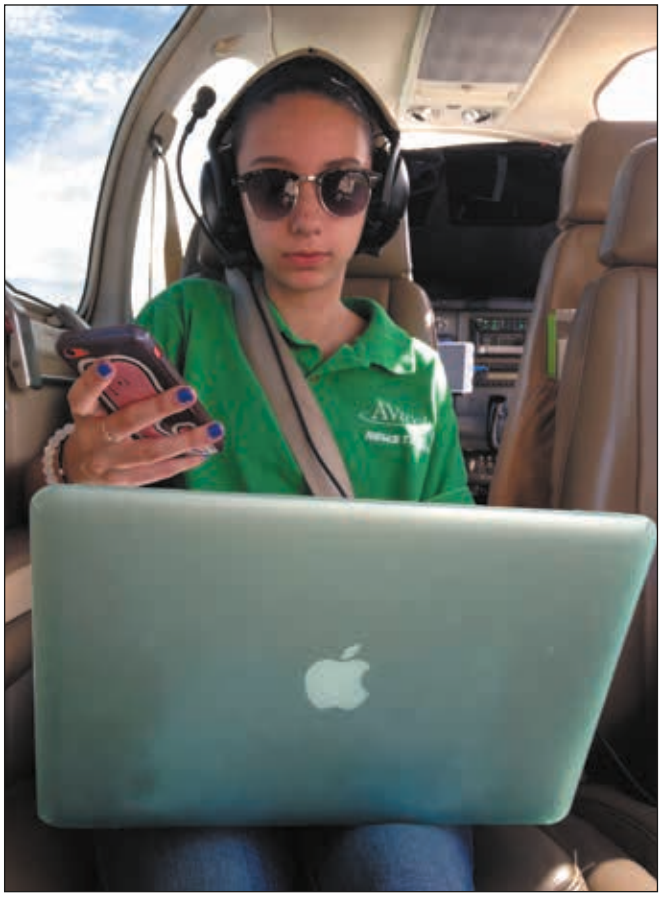
INMARSAT BROADBAND

The backbone of the AeroWave 100 system is Inmarsat's satellite communications network. Inmarsat is hardly a newcomer to the communications world. It has been a standard in maritime operations for more than 35 years and was set up by the IMO (International Maritime Organization) as a distress and communications network. And that network has grown.

Inmarsat owns and operates three constellations of communication satellites and a total of 12 spacecraft. Its satellites fly in geosynchronous orbit and are positioned in nine orbital locations. As for proven reliability, applications speak for themselves. Inmarsat is used by major airlines and was actually the first provider to meet ICAO global communications standards.

The BendixKing AeroWave has its roots in the original Aspire line that Honeywell produced for business jet applications. But unlike the Aspire, the AeroWave is focused at the high-end piston single, twin and small turbine aircraft market.

As part of a recent agreement with Inmarsat (an estimated $2.8 billion shot in the arm for Honeywell), the company is exclusively developing, manufacturing and distributing the hardware for cabin connection with Inmarsat's Global Xpress network. We're talking airline, bizjet and military applications. The AeroWave 100 is currently offered as an option in



You connect tablets, smartphones and laptops to the AeroWave through a cabin router. The one shown below is the AeroWave router with voice channel for smartphone talk.

The active antenna, top, installed on a Beech Bonanza. If you don't need voice capability, you can connect with a pedestrian portable modem, middle. That's the AeroWave HDU, bottom.

Pilatus PC-12NG turboprop singles, in addition to some Cessna Citation business jets.

But doing an aftermarket satcom retrofit in a business jet is much different than installing one in a Beech Baron, for example. In fact, a Baron was used for earning the original STC for the AeroWave 100 HDU with the Active LGA antenna. Speaking of STC approvals, the AML (approved model list) is growing, to include a variety of piston singles, twins, turboprops and jets.

The basic AeroWave 100 system is $24,995 with full installation kits—a price point we think hits the owner-flown high-end piston twin and turboprop sweet spot. While that's hardly inexpensive, consider Gogo's entry-level ATG 1000 cabin internet and voice system (previously AirCell), which starts at $35,000. It requires a more complex installation, including interface with an AHARS and larger antennas.

HARDWARE, PERFORMANCE

One way BendixKing keeps the AeroWave's installation costs under control is by using a small L-band low-gain GPS/Inmarsat antenna, which is appropriate for smaller airframes. It's essentially the same footprint as most common GPS antennas and is mounted on the top of the airframe. System performance is highly dependent on the location of the antenna. Shadowing from major areas of structure will create blind spots in reception, depending on the position of the satellites.

The AeroWave HDU (high speed data unit) is an 8.8-pound remote processor that measures 14.88 by 2.43 by 7.81 inches. It trickles down from the Aspire line, evident by its large footprint. If the HDU is installed outside of a pressure vessel or in an unpressurized aircraft, it requires forced air cooling. The other major system component is a Bias-T module, which is comprised of a power injector, a 48-channel GPS receiver, amplifiers, multiplexer and demultiplexer. The primary purpose of the GPS engine is to supply the system with course and groundspeed data. There is also an external satcom configuration module (ESCM), which contains SIM cards required to access the Inmarsat SBB network.

While installation downtime will depend on the complexity of the airframe, BendixKing's Jeff Kauffman told us installations in non-pressurized piston aircraft can easily be accomplished in significantly less than one week.

As for performance, Kauffman made it clear that the system is intended for texting (using iOS and Android devices), emailing (including smaller file attachments), smartphone apps and basic web browsing. It's not appropriate for video streaming or big graphics. We're talking about a data rate capability of up to 200 kbps.

"Think of using this system as if you're in a Starbucks cafe and connected to a Wi-Fi hotspot. You don't have GSM connectivity for SMS messaging, but you'll have basic connectivity," Kaufman explained.

As for joining the AeroWave, there are options, including BendixKing's provided router, which works for data only. You can also use a carry-on, off-the-shelf router for data connectivity. But for using Inmarsat's high-quality voice network, the system requires the permanently installed AeroWave modem with a voice channel. This enables you to make and receive phone calls with your smartphone. Dial as you would on the ground, in familiar 1-plus-area code format. You can make and receive international calls, too.

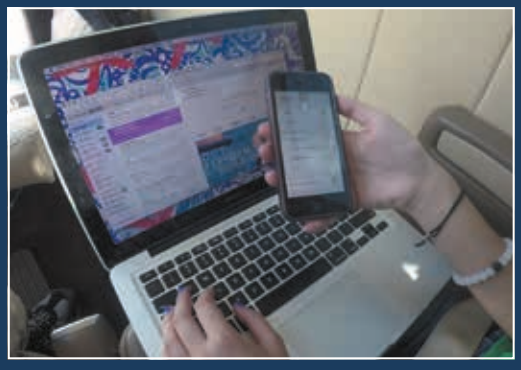
In our trials, we found the system's voice quality to be quite good at lower altitudes—no drop-out, interference or modulation issues. We connected via wireless through BendixKing's KMA30 Bluetooth audio panel. Don't expect GSM-like quality over the system's voice channel, but we think it betters most satellite phones we've used.

The Inmarsat network has four satellites positioned for around-the-world coverage. In the U.S., there are some limitations in the Northern and Southern hemispheres, includ-

FLIGHT TRIAL: SOME NITS TO ACCEPT

We set out for a flight demo in Jeff Kauffman's AeroWave-equipped Beech A36 Bonanza with enough smartphones, tablets and laptop computers to keep a teenager busy until the tanks run dry. As expected, the AeroWave showed some limitations that buyers need to understand.

Connecting a smartphone is easy. Put it in airplane mode so it doesn't try to connect to a ground network, look for the AeroWave network in Wi-Fi settings and type the password to join. We happened to have all Apple devices, including a MacBook Pro computer, three iPhone 5S smartphones and a latest-gen iPad running the ForeFlight Mobile app. All of the devices connected without issue, but the AeroWave wanted no part of delivering data to all of them at the same time. With all of them connected at once, we couldn't even send or receive a short iOS text message within the cabin. But, the system seemed happy with two devices connected. Text messages flowed more slowly than on traditional networks and simple webpages like Airnav.com loaded more slowly than we would have liked. We asked Kauffman—the AeroWave project technical lead—for an explanation. He had several.



Turns out there are convincing reasons for peaks and valleys in performance, aside from device load and having too many applications running in the device's background.

"You can experience a system slowdown that's similar to what happens when you are working at home and the neighborhood kids get out of school. The internet simply gets slow," he said. But it's more complicated than that.

Kauffman explained that the actual performance of a satellite datalink can vary over time and depends on many variables, including the available bandwidth, power and noise, as well as the number of users sharing the resource. There isn't a lot that can be done about noise (including background noise and possible ground interference from high-power radar), but by using spot beams, the satellite can increase the power to a particular area of coverage, thus improving the signal-to-noise ratio. The Inmarsat satellites have directional (and movable) antennas that cover a specific area on the earth.

Kauffman noted that having a directional antenna on the aircraft can increase the effective power, plus the output gain and allocated spectrum of the satellites can be tweaked. In the end, you'll get better performance when the number of people using the system consume less than the maximum bandwidth available for the satellite's spot beam. Worth noting is that our flight trial conducted in central New England is within the spot beam shared by the highly utilized Washington, D.C., area.

ing service voids when flying oceanic routes. There are no altitude or speed limitations, however, which means you can use the system on the ground.

SIMPLE FIXED PRICING

The airtime subscription plans are fixed at $40 per hour for all of the data you can use. The subscriptions are prepaid at $1999 for a 50-hour block of data.

For certain, this is real money and operators will need to decide if the mission can support the expense, in addition to the hardware, of course. By the time the dust settles, an installation well north of $35,000 won't be out of the ordinary for many aircraft. There are some alternatives, including portable solutions. We covered them in the December 2014 issue of *Aviation Consumer.*

To recap, we found that Globalstar's semi-portable Sat-Fi system has fast data speeds, but it just didn't work well enough to be useful in flight. Since that review, the company received an STC approval for an external antenna and we're planning another performance trial.

We also tried the Iridium Go, but found it was hobbled by pricey data plans. Plus, its slow data performance limits the system to small emails.

As for BendixKing's AeroWave 100, we think the system worked well enough in our flight trial to consider it for missions needing basic internet and high-quality voice capability. For lesser aircraft and for basic text messaging, we favor the $400 DeLorme inReach satellite communicator and tracking device, which was recently acquired by Garmin.

Contact www.bendixking.com.

The GoSatWatch app shows the Inmarsat satellites that cover the U.S. From Northern Connecticut, the bearing to the satellite is 216.7 degrees, with an elevation of 37.7 degrees. With a 10-degree look angle, coverage extends to Goose Bay, Canada.

Corrosion Prevention: Cheap Insurance

Corrosion presents a serious risk to legacy aircraft. Inspection cannot detect all corrosion. CorrosionX and ACF-50 effectively stop and prevent corrosion.

by Rick Durden

While researching information on aircraft corrosion and corrosion prevention, I ran across my nomination for understatement of the week in an FAA publication. It said, ". . . the amount of maintenance required to repair accumulated corrosion damage and bring the aircraft back up to standard will usually be quite high." No kidding.

The reality is staggering—some years ago I was shown the bills paid by an owner for corrosion repair. He had bought a Louisiana-based twin without a prebuy examination. Over the next two years he expended more than he'd paid for the airplane to repair damage to the structure and skins from corrosion.

About the same time, there was a Cessna 310 owner based on a tiedown at my home airport who was known for ignoring warnings from his shop about observed corrosion during annual inspections. He claimed to be surprised when the shop called him to say that the corrosion had reached the point where the airplane was unairworthy and their head of maintenance thought it was beyond economical repair. It was. The owner had to scrap it.

For those of us who fly legacy aircraft—post World War II era until about 15 years ago—we have to deal with the fact that the manufacturers didn't expect them to last much longer than 10 years. Accordingly, they did not do much in the way of corrosion-proofing them. The consequence is that even airplanes based in dry climates are at risk of damaging corrosion unless they are subject to at least careful inspection and, better still, corrosion-prevention treatment at regular intervals.

The bad news is that not all corrosion can be spotted during inspections without disassembling the airplane. The good news is that there are two excellent products that will stop—although not repair—corrosion that can't be detected during inspections.

I'll go into what corrosion is, what it does, the available treatments and pass along recommendations from those who know a great deal about

Corrosion on aluminum most often presents as a white powder—here on the inside of an upper wing skin.

CHECKLIST

- ✚ CorrosionX and ACF-50 are highly effective in resisting corrosion.
- ✚ At $300 to treat the entire aircraft, ACF-50 and CorrosionX are a bargain.
- ⛔ Neither product will repair corrosion-damaged metal.

Rolls of clad sheet aluminum alloy, right, are subject to corrosion where the cladding is breached as the aluminum is cut, riveted or scratched during manufacturing and in use. Fluid thin-film coatings (FTFC), such as CorrosionX and ACF-50, below right, are effective in preventing and removing corrosion.

corrosion and its treatment in general aviation aircraft.

SO, WHAT IS CORROSION?

An easy way to understand the process of corrosion of metal is to think of the process as a battery. A battery produces electricity by controlled corrosion of metallic electrodes submerged in an electrolyte. One metal, the anode, gives up electrons. Those flow through a conductive liquid, the electrolyte, to a dissimilar metal that will accept the electrons, the cathode. There has to be an electrical connection between the two metals, usually metal-to-metal contact.

The way this comes about in an aluminum airframe starts with the nature of pure aluminum. It's so soft that it's unusable for aircraft structure or skin. However, it is also quite resistant to corrosion because, once it's exposed to air, it forms an extremely thin layer of aluminum oxide on its surface. Aluminum oxide does not conduct electricity, so once the layer forms, it prevents the process of corrosion from starting.

To make this light metal into a structural material, small amounts of other materials are added when it's heated to liquid state so that the resulting alloy meets the strength needs of an airframe. The alloy used in most aircraft applications is referred to as "2024" and is made up of 95 percent aluminum, 4 percent copper and bits of manganese and molybdenum. The mixture is heat-treated and rolled into sheets—and referred to as "2024-T3" to describe the specific alloy and heat treatment applied.

Of course there's no free lunch; when aluminum is turned into 2024-T3, it loses its resistance to corrosion in the tradeoff for strength. Aluminum is happily willing to give up electrons (anodic) to copper when they establish the intimate relationship of becoming an alloy. All they need to start the process rolling is the presence of an electrolyte. While pure water is not a conductor, water in the real world—typically from condensation—has chemical impurities that turn it into a conductor. The most effective of those impurities is salt, followed closely by acids found in air pollution.

To help protect 2024-T3 from itself by shielding it from electrolytes, the makers take advantage of the corrosion resistance of pure aluminum. They coat (clad) both sides of sheets of 2024-T3 with thin layers (0.001 inch) of pure aluminum. The finished product is called "2024-T3 Alclad."

Of course, nothing's perfect. Once Alclad is cut, has a rivet driven through it or is scratched, an electrolyte can reach the 2024 inside and start the process of corrosion. That's why corrosion is most often found at seams, joints and rivets on aircraft.

The second major cause of corrosion in aircraft is a result of dissimilar metals coming into contact, such as when steel fasteners are used to attach aluminum parts. Called galvanic or dissimilar metal corrosion, it is usually avoided by a manufacturer selecting the types of metals that will come into contact with each other, making metals that will come into contact with aluminum compatible by electroplating them with a thin layer of cadmium and by applying coatings to seal out electrolytes.

DAMAGE

When corrosion is detected, it must be removed following approved techniques and the amount of damage to the underlying metal determined. Once a certain percentage of the skin or structure is gone, it must be repaired or replaced. Naturally, that means corrosion can and does weaken an airframe and has caused inflight breakups.

Paul New, the owner of Tennessee Aircraft Services, told us that his company had recently replaced one wing of a Cessna Cardinal because corrosion had developed between the spar cap and wing skin. By the time it had grown to where it could be detected, it had destroyed 30 percent of the spar cap in the area.

FIGHTING BACK

In the late 1980s, a hugely valuable tool for fighting corrosion was de

TREATMENT: WHEN? HOW MUCH?

Whether and when to apply CorrosionX or ACF-50 depends on the age of the airplane and where it primarily flies. Over the last 15 years, manufacturing changes have meant that new airplanes come out of the factory with far superior corrosion-resistant treatments than previously. Based on what I learned preparing this article, if your airplane is older than 15 years and it has not had an FTFC treatment in at least five years, it would be wise to seriously consider fogging it at the next annual. Paul New of Tennessee Aircraft Services got my attention when he said bluntly, "If your airplane is 40 years old, it's corroding."

The second, and equally important, risk factor is a combination of where your aircraft is based and where you fly it. The worst places in the U.S. for aircraft corrosion are along the Gulf Coast, the southern Atlantic coast and the state of Hawaii—due to the combination of salt-laden air, heat and humidity. New England is second in line for corrosion risk, having salt air, acidic rain and humidity, but less heat.

However, just because your aircraft is based in a low humidity area such as central Colorado does not mean you can ignore the risk of corrosion on a legacy machine. Where your aircraft lived before you owned it has to be considered along with whether you ever fly to higher corrosion risk areas, such as the Midwest during a hot and humid summer day.

Scott Utz, proprietor of Arapahoe Aero at Denver Centennial Airport, told me that it's rare for his shop to see evidence of corrosion on his customers' aircraft. Nevertheless, what matters is what is happening between the parts of the airplane that cannot be easily seen. Accordingly, on older airplanes, inspection may not be an adequate method of preventing serious damage from corrosion. An FTFC treatment is inexpensive insurance.

For airplanes based in high-risk areas, shops recommended treatment at least every two years—for progressively cooler and dryer climates, the frequency dropped to once every five to seven years.

Fogging a piston single requires no more than two quarts of CorrosionX or ACF-50. Both manufacturers have pointed out that a little goes a long ways during treatment, although shops we spoke with tended to say that they want to err in slightly over- rather than under-applying.

It's important to treat the entire aircraft, not just the wings and tail. Cabin windows are notorious leakers and that water is a superb source of electrolytes to spur corrosion. That means pulling the interior and treating all of the fuselage.

Some of the mechanics we spoke with said that a number of their customers do some sort of treatment of their airplanes any time the interior is out, even if it's just using CorrosionX or ACF-50 in a spray can or putting it on a rag and wiping it on metal parts.

Shops I spoke with also gave some manufacturer-specific risk areas: Cessna—interior sidewalls, notably the area where the black nylon/lead panels may touch the skins and the inboard wing spars on 210s and Cardinals; Mooney—areas around fuel drains and lower fuselage; Piper—wing attach fittings.

Smart homeowners treat for termites prior to evidence of an infestation—at only $300 for a treatment that can last years, I think smart legacy aircraft owners should have theirs fogged with ACF-50 or CorrosionX regularly.

veloped by Lear Chemical Research of Ontario, Canada—fluid thin-film coating (FTFC). Its product, ACF-50, has become a mainstay in the ongoing battle against aircraft aluminum returning to its original bauxite. Not long afterward, it was joined on the market by CorrosionX from Corrosion Technologies in Texas.

The effectiveness of FTFCs has caused them to supplant virtually all other methods of corrosion prevention for aircraft owners (not manufacturers—different prevention techniques are used when assembling airplanes).

FTFCs are compounds created by clever scientists and that consist of complex molecules that have one end that attaches to metals and the other that blocks moisture and electrolytes. FTFCs are not like previous barrier products in that they do not remain on top of existing corrosion and keep further moisture out—they penetrate through existing corrosion to the metal. Once there, the engineered molecules bond to the metal and often displace the existing corrosion so that it eventually falls off.

FTFCs do not repair corrosion damage. Metal that has been eaten by corrosion is gone for good, despite what you might hear on some internet forums.

By design, FTFCs migrate. They penetrate into lapped skin surfaces and around rivets, and they do so remarkably quickly. Five years ago, an *Aviation Consumer* editor was given a demonstration in which CorrosionX was sprayed on one side of pieces of aluminum sheet that were riveted together. Within 60 seconds the FTFC could be seen around the rivet heads on the other side of the aluminum.

Because FTFCs migrate it means that you're going to be cleaning them off of the exterior of your airplane for some time after a treatment. You can expect to see it streaming back from rivets and lap joints (see the photo in the sidebar). It's easily removed with a cloth or paper towel. CorrosionX and ACF-50 will not harm your aircraft's paint, wiring, rivet integrity or avionics. Because of the penetrating and lubricating properties of an FTFC, you may find that your control system pulleys and cables operate a little more easily.

If you have corrosion around rivets that is temporarily holding them

Applying ACF-50 using a wand and fogging the inside of the wing, right. The owner of the Cessna 185, lower right, being lifted out of the water at Seattle's Kenmore Air Harbor said he'd fogged it prior to leaving his home base in Michigan because he was planning on extensive operations in salt water in Alaska.

tightly in place, it is not uncommon for the FTFC to break that corrosion loose and the underlying loss of metal to manifest itself in smoking rivets. The FTFC has thus given you an early warning of existing corrosion damage so you can get it fixed—having your airplane held together by corrosion-bound rivets is not a good thing.

THE BETTER PRODUCT?

ACF-50 and CorrosionX effectively own the FTFC field. In talking with aircraft owners and maintenance shops I asked which product they preferred. Almost universally owners said they went with whichever product their shop offered. The shops said that they used whichever product's salesperson got to them first. The application equipment for fogging the aircraft is pricey and unique to each product. Once a shop bought equipment to apply CorrosionX or ACF-50, it was my observation that it stuck with that brand.

In my conversations, I did not have anyone tell me that he or she had gotten poor results with either product. No shop told me that it had switched from one to the other.

Prices for a full treatment of a single the size of a Cessna 182 were in the $300 range at the shops I spoke with. All said that fogging an airplane with an FTFC is most inexpensively done when it's opened up and the interior is out—such as during an annual or 100-hour inspection. They also said to do the FTFC fogging after all of the other work is complete as a last task before putting the airplane back together.

Derrick DeRuiter, owner of Northwoods Aviation in Cadillac, Michigan, cautioned about overspray when applying an FTFC, noting that it doesn't do brakes any good at all. I was also told that if an owner is considering painting his or her airplane that it would be wise to wait at least a year or so after the last FTFC treatment because there may be difficulties with paint adhesion.

CONCLUSION

In a world where aircraft owners often express frustration with product quality, reliability and longevity, it's a pleasure to look at a product that does exactly what it says it will do and its effects are long-lasting. In researching FTFCs in general and CorrosionX and ACF-50 specifically, I found myself in full agreement with a statement made by Paul New: "They are the least expensive preventive maintenance you can do on a legacy aircraft."

CONTACTS

Lear Chemical Research Corporation
905-564-0018
www.learchem.com

Corrosion Technologies Corporation
972-271-7361
www.corrosionx.com

Diesel Reset: Improved Economics

Continental's longer engine replacement cycles significantly lower operating costs. But high capital costs still make diesel a tough sell in the current market.

by Paul Bertorelli

When modern aerodiesel engines made their surprise appearance at the Berlin Airshow in 2002, the numbers didn't add up once the costs ultimately came to light. The engines were certainly economical, but they were twice as expensive as gasoline engines, had half the TBOs and required pricey gearboxes and other components at short-run hours intervals. A decade and a half later, these automotive-based engines may finally be turning a corner of sorts, with the announcement by Continental Motors last spring that its CD135/155 series engines will have replacement intervals increased to 2100 hours from 1500 hours.

Although this dramatically improves the operating economics of diesel engines against their gasoline counterparts, it's not yet clear if that will be enough to expand the market much. Initial indications based on our interviews are that it will not, at least for the short term, simply because new airplanes are so expensive and conversions similarly require large investments.

Piper's Archer DX, below, has the Continental CD155. Although a good performer and economical, it hasn't proven a strong seller.

By our calculation, diesel currently has a 10 percent niche in the piston general aviation market, with most of that belonging to Diamond Aircraft. Other new product entries, notably Piper's Archer DX, haven't found overwhelming market success, even in Europe, where diesel engines in general are more of a mainstay in the transportation system than they are in the U.S.

In this analysis, we'll examine the details of how Continental's longer replacement cycles impact operating economics and add a glimpse of how they compare to Austro, Continental's main competitor.

CHECKLIST

- Longer TBRs and lower fuel prices significantly reduce operating costs.
- Engine smoothness, flyability and serviceablity remain strong plusses.
- For all buyers, but especially in the U.S., high capital costs still make diesel lukewarm.

LONG ROAD

When we reviewed the then-new diesel-powered DA42 in 2005, the Thielert Centurion engines had but a 1000-hour life limit and the company was sketchy on replacement costs. Instead of a TBO, the engines would have to be replaced (TBR) and they also required expensive gearbox overhauls at 300-hour intervals, plus alternator and fuel pump replacements. We were assured that within a year, the TBR would reach 1200 hours and the gearbox intervals would also increase. Shortly thereafter, 1500-hour TBRs were promised. It didn't happen.

We're not quite sure why, but by 2008, Thielert had fallen into bankruptcy and engineering and development work came to a halt. Continental acquired Thielert in 2013 and although it infused capital into the business, it took another three years to bump the engine TBRs to what had been promised more than a decade ago. What took so long?

"I think it was an engineering mindset and a regulatory caution," says Rhett Ross, CEO of Continental. "When we acquired them, there was a level of a confidence in the engine, but there were some technical changes that had to happen. We had to change some components to beef them up. Actually, the engine as designed could have run out to the currently announced TBR, but you'd have had a higher risk of problems and maintenance issues," Ross adds.

With more than 3300 diesel engines manufactured, Continental certainly had the fleet data to support

the higher TBRs, but it still had to jump through EASA regulatory hoops to gain the formal approvals. The new, longer-life engines themselves have some improved components, but are essentially the same as the improved Centurion 2.0 Thielert introduced even before its bankruptcy.

ENGINE	OVERHAUL/ REPLACE COST[1]	MIDSTREAM COSTS[2]	PER HOUR/U.S.[3]	PER HOUR/ EUROPE
CONTINENTAL CD135	$35,520	$17,959	$47.70	$55.71
CONTINENTAL CD155	$42,180	$17,959	$51.01	$58.88
AUSTRO AE300	$23,647	$6945	$39.28	$42.84
LYCOMING IO-360	$25,000	$10,000	$55.10	$89.50

[1]Price for Continental engines is based on full replacement at 2100 hours. Austro price is based on published overhaul costs at 1800 hours, while Lycoming is Bluebook price for typical overhaul.
[2]Midstream costs include fluid and recommended filter changes for all engines and mid-time gearbox, alternators and timing chains for Continental engines. Austro engines require governor and accumulator overhauls.
[3]Fuel prices for U.S. were based on $4.07 for Jet A and $4.70 for 100LL, as of June 2016.

THE NUMBERS

The chart at right summarizes the changes. For all engines shipped after about December 1, 2015, the approved TBR increases to 2100 hours from the previous 1500 hours for the CD135 engine and 1200 hours for the higher-output CD155 that finds application in the Piper Archer DX and the announced Cessna 172TD. ("Announced" is the operative word because Cessna isn't promising delivery dates.)

Ross said the larger TBR leap on the CD155 was a deliberate part of the program because Continental didn't want to incrementally increase replacement intervals by 200 or 300 hours a pop, as Thielert had done.

"We did good homework on this to get there. What we did was to build a roadmap for future actions of this type. Right now, we're looking at improvements in line-replaceable units and we're concentrating on the CD300," Ross said. The CD300 is a 310-HP Mercedes-based six-cylinder engine that Continental announced two years ago. Certification is expected by early 2017 and Continental has revealed at least one minor OEM (Stemme), but no mainstream companies have announced or even hinted at new diesel-powered aircraft.

Line-replaceable units are the gearbox, the fuel pump, the alternator and the timing chain. Under the new maintenance schedule, all of these have 1200-hour replacement intervals, up from 600 hours. That means they're basically required at mid-time and at exchange rates current in July 2016, these items totaled about $3656, a substantial decrease from the previous requirements. As shown in the chart, when other items are added, the CD-series engines require additional service items beyond the major gearbox change. When all of this is taken together—including oil and fluid changes—the engines require $18,000 in care and feeding on the way to TBR or about $8.60 per hour at current post-Brexit exchange rates.

The core engine replacement itself is currently priced between $35,520 and $42,180, according to Continental. Adding it all up, including oil changes and other required replacement items, yields a total direct operating cost of $100,430 for the CD135 or $47.70 per operating hour using data provided by Continental and a Jet A average price of $4.07 a gallon in the U.S. as of summer 2016. The CD155 is higher by an amount equal to its engine cost Delta against the CD135 for a to-TBR cost of $107,080 and $51.01 per operating hour.

The closest direct comparison is the Lycoming IO-360 or perhaps the O-320 used in the Cessna 172, a competitor in the core training market. These engines are significantly less expensive to overhaul and maintain mechanically on the way to replacement, but they also burn more fuel that's also more expensive, especially in Europe.

The Lycoming overhaul market is far more competitive than the diesel replacement market is, but by our calculations, the IO-360 will burn through about $111,000 on the way to its 2000-hour TBO, to include oil changes and $2000 in midstream maintenance. If the engine requires a top, and some do, then add another $8000 and the hourly costs work out to between $53 and $59 per hour.

If that doesn't look like a huge difference against the diesel, you're not the only one to notice. Three shops doing diesel conversions we spoke to observed that cheap fuel prices in the U.S. are keeping conversions and even new OEM diesels from gaining a foothold. "Cheap" here is relative. While avgas prices are down considerably from two years ago, the national average price as of early July was $4.70, according to airnav.com. Jet A is cheaper, at about $4.07.

MARKET REALITIES

While the new higher TBRs for Continental diesels significantly improve their operating economics, it may, in the end, make little difference in market penetration. We spoke to three companies doing diesel conver

Miami-based Africair, below, has converted about 75 172s for the airline training market. That counts for high volume in the diesel world, but further growth is elusive.

sions using the CD135 engines and none were particularly bullish that longer TBRs will nudge loose latent demand.

Even Continental's Ross is realistic about the market. "It's not easy making money in the aviation segment now. We're seeing deferred fleet orders and it's not that they're running bad businesses, it's just that the confidence isn't there," Ross said in an interview in late June. "Where I see the volume coming from is when the international market opens up and starts buying a lot of airplanes," he adds.

That demand might come from Asia, but thus far, China has proven to be somewhat of a disappointment. Every major manufacturer has in place a China plan, but the country, despite strong potential, still has fewer than 3000 general aviation aircraft, almost all of them used for training. Ross said Continental has about 200 diesel engines operating in China and although usage is very high, fleet expansion is not.

Diamond Aircraft continues to be the leading OEM in diesel. Of 144 aircraft it shipped last year, about half were diesel, powered by the Austro 300 series engines Diamond developed on its own after a tense divorce from Thielert. Last year, Mooney announced the M10 series trainers, which will also have Continental diesels and although Ross says other companies have diesel projects in the works, he declined to offer any details other than to say there may be announcements later this year or early next.

Cessna's proposed diesel Skylane, top, drew gaggles at AirVenture in 2014, but Cessna says the project now remains "undefined." Austro AE300 is converted from Mercedes Benz automotive engines, below.

Meanwhile, the aftermarket conversion business remains anemic. Recall that three years ago, just after Continental bought Thielert, Redbird Flight Simulations introduced its RedHawk trainer, a diesel refit of vintage 172s. Thus far, it has sold 14, which we would call moderate success. But as of early July, it has no more orders in the pipeline.

"We have proposals out waiting on signatures, but everybody just seems to be sitting on their hands," says Jerry Gregoire, CEO of Redbird. "The RedHawk is great airplane, but a quarter of a million dollars is a lot of money. I wish we could build them cheaper, but I'm not 100 percent sure it would make a difference right now. I think we're headed for a rough couple of years in GA," he adds.

We heard a similar story from Premier Aviation, a Ft. Lauderdale sales and mod house with a well-established upper-tier clientele. Premier developed its own diesel conversion of 172s similar to the RedHawk project. "Sales have not been good for us. I don't know what to make of this market," says veteran sales executive Fred Ahles of Premier. He said that when Premier planned the project three years ago, the price difference between avgas and Jet A made it a mathematical no brainer. "No one should be flying a gas trainer today, but capital isn't there," Ahles says. When we asked Ahles if he sees a market turn ahead, the response wasn't encouraging: "Tell me what the price of fuel is going to be and I'll have an answer."

Down the coast from Premier Aircraft, Africair has had good success selling diesel-converted 172s on the African continent for use as airline trainers. To date, according to the company's Travis Tinsey, about 75 have been placed. And while he says the recently announced higher TBRs are a strong plus in the market, he has no illusions about a quick market bump.

"There's been no increase in business yet because the program is too new," Tinsey told us in June. For Africa, where avgas is scarce, the diesel economics were already slam dunk. The buyers don't need convincing, they need more training activity. For the U.S., he says, diesel remains a hard sell.

"There's just not enough difference between avgas and Jet A prices to make it attractive yet. The new TBR may make a difference, but the conversion is still almost $100,000," Tinsey said.

As Continental's Ross said, the company's best hope for higher volume in the diesel market may be training fleets in the international market. If that's coming, it's not in sight yet and it's not clear what market trends will make it happen.

Checklist Apps: Limited Utility

We like sureCHECK's audible capabilities and AudioCoPilot's simplicity, but we're waiting for a program with reliable speech recognition.

by Frank Bowlin and Larry Anglisano

CHECKLIST

All of the checklist apps we tried are better than static text checklists.

If you want major customizability, most dedicated apps fall short.

GPS navigators and MFDs with built-in checklist utilities may actually increase workload.

Aircraft manufacturers provide checklists in their POH/AFMs and we've dutifully copied those into separate—usually laminated—checklists for use in the airplane. Various third parties, including sureCheck and CheckMate, have attempted to improve on that physical format by taking much of the same information and condensing it to a few dense pages.

Now we've got various tablet and EFB checklist apps, plus utilities in our panel-mount devices. Instead of laminated paper, the same static information is available on a high-quality screen, but the operating paradigm is unchanged: Read the challenge; read the response; repeat. (Although, some apps allow a checklist item to be actually checked off, making it easier to keep your place.)

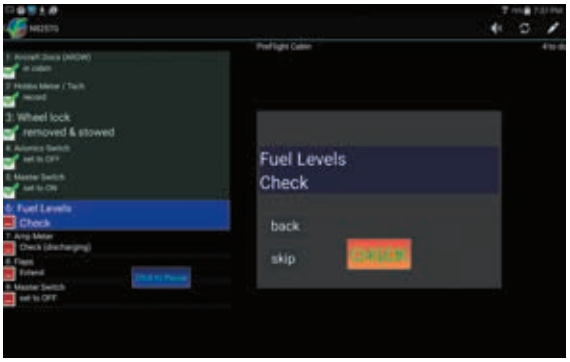
Can't we do better these days? To find out, we gathered several checklist-purposed tablet apps and gave them a try.

WHAT'S WRONG WITH PAPER?

In our experience, most pilots have good checklist habits on the ground, but struggle to rigorously use a checklist in the air. While that's better than nothing, checklist use in the air is just as important as on the ground.

The difference is likely convenience and workload. On the ground, the pace is slower. In the air, you must stay ahead of the airplane, ATC and the weather. As a result, checklists often lose priority. In our view, today's paper and electronic checklists simply require too much attention. Our gaze is diverted to paper or a tablet in our lap or possibly to a big-screen device on the panel, but that could be well out of our

From left: AudioCoPilot has no canned checklists—you make your own. Voice-Check for Android has a simple operating logic and plenty of emergency checklists. smartCHECK runs checklists in text or audio formats.



Voice-Check, top, worked well in text mode, but fell short in audible mode. Like Voice-Check, smartCHECK, bottom, clearly shows checklist progress. Items already read are shown in green, with the current item highlighted.

normal instrument scan.

Additionally, we think written checklists require far too much attention. It takes mindshare we often don't have to read and interpret a line on paper or on a screen, and think it through to confirm it's done. Add the buttonology required of some devices, and our goal becomes getting through the checklist, not the actual checking that's supposed to be happening.

In a perfect world, every pilot has a copilot who reads the checklist to the pilot. This way you get the traditional challenge-response where the copilot reads a challenge to which the pilot responds. The copilot challenges "Lights" and the pilot responds, "Set." This challenge-response process still stimulates thought, but requires less mindshare and is easier to assimilate by voice than by reading it.

That's fine, but we don't all have a copilot. Perhaps technology can come to the rescue. With that in mind, we have a prescription for the perfect electronic checklist.

Manufacturers' checklists are fine to learn a new type, but they're often too lengthy for practical use. The best checklist is one you write yourself, based on your experience and background in the aircraft type you're flying. The app should let you write your own. We'd like the program to operate in the background of the host device. Our reasoning is simple: We don't want to dedicate another device for the checklist app. Instead, we want to run our favorite inflight app in the foreground and still have access to the checklist running simultaneously in the background. While we didn't find any such checklist apps, advanced iOS users might be able to make this work.

Perhaps most important, normal operations would be entirely by voice. The device should tie in to the pilot's headset (with Bluetooth or via the audio panel) and listen for a command like, "Checklist: After Takeoff." It would then find the checklist and read the first challenge, "Flaps." It would wait for the pilot to respond "Up" and would read the next item, "Fuel Pump." It would wait for the correct response, "Off," and so on. When the checklist is complete, it would say so and go back to listening for the next checklist command. This way, a checklist application is as unobtrusive as possible. It's there and it will walk you through the checklist items, but only at the time of your choosing and in the pace you set with your responses. With that checklist app, we think checklist use in the air—and thus safety—would be improved.

Do any apps behave as we've described? No, but we found three that are somewhat promising.

VOICE-CHECK

Since it only works on Android, we think Voice-Check is at a disadvantage. Still, we tried it on a Samsung Galaxy tablet and liked its simplicity.

Voice-Check speaks the checklist challenge in a somewhat metallic computerized voice and waits for your response. It has voice recognition of a small number of responses, and using it without being connected to the internet requires Android version 4.1 or later and some fine tuning. After a frustrating amount of fiddling, we never achieved reliable speech recognition of our responses.

You can turn the talk and listen functions on or off, plus the app has an extensive list of emergency checklists—from overvoltage conditions to electrical fire. It has an editable V-speed section and a dedicated note-taking section for editing items.

Voice-Check is the most expensive of the three checklist apps we evaluated. It's free for the first seven days (the others should have an evaluation period), but uses a $2.29 monthly subscription model.

AUDIOCOPILOT

Think of AudioCoPilot as little more than a $9.99 audio note taker for iOS that's optimized for checklists. There are no canned checklists; you make your own. You start by adding an aircraft, optionally even with a photograph. You add each checklist by typing its name, then within that checklist, you type in each item and record what you want it to say. That's it.

In use, you select the aircraft and it offers you the first checklist in order. You push play, and it starts playing the items as you recorded them. It'll play each item in that checklist until the end, and sequence to the next checklist and wait for you to tap play again. You can pause at any time or access checklists out of order.

At the bottom of the screen, there's an "Emergency" button. Tap that to go directly to a menu of emergency checklist procedures that

GPS CHECKLIST UTILITIES

It's often said that users of panel-mounted GPS navigators use only 20 percent of the available functions. If that's the case, then the remaining 80 percent of the unused functionality contains a checklist utility.

Garmin's integrated checklists have been standard in systems dating back to first-gen GNS430 and GNS530 navigators and early G1000 suites. The checklist utilities in the current GTN750 and GTN650 navigators are the most advanced yet, but don't have a voice function—even with Garmin's latest voice-activated audio panels.

In the GTN, checklists are created using the Garmin Checklist Editor software that's available online and stored as checklist files on the navigator's datacard. You'll need software version 5.10 or higher. Accessing and using the checklist is easy. Touch the Checklists key to launch the stored checklists, while the Menu key calls up checklists from a "group"—normal or emergency, for example.

Garmin's free checklist software also works with the G3X and G3X Touch experimental avionics suites, the GPSMAP 695/696 and aera 795/796 portable GPS systems. Surprisingly, Garmin doesn't have a checklist utility in its Pilot tablet app for iOS and Android tablets.

Avidyne, in its IFD540/550 and IFD440 navigators, included the ability to create and store up to nine custom checklists, each with up to 50 steps and as many as 30 characters long. Once you've created and named a checklist (all done in the navigator), it is simply recalled from the checklist directory. To run through it, either touch a highlighted step or push the IFD bezel knob until the step turns green and a checkmark appears.

As much as we think checklists have improved since they appeared in early-gen navigators, we don't see them as workload reducers, especially in single-box installations where you have to hop menus. As with app-based checklists, what we really want is speech recognition. Avidyne hinted that could be coming as a function of its new app.

you created as before. Tap the one you want and it's read to you in the normal fashion. However, at this point, once that checklist is finished, button presses seemed to usually exit (crash?) the program rather than return you to normal procedures.

Overall, we liked AudioCoPilot. It's inexpensive and quite straightforward in its operation. It's still a little rough around the edges and could benefit from some refinement. For instance, when running, the checklist text you entered should be but is not visible. Then there's that navigation oddity in the emergency checklists.

SMARTCHECK

smartCHECK is the newest of the apps we found. It came to us a few months back via a media announcement, suggesting to us they're serious about making this work and gaining market for it.

We evaluated the just-released version 1.1. It behaves sufficiently, but suggests that further bug-fix and refinement versions would be helpful. The iOS (Version 9.0 and later only) app sells for $8.99 and comes with a checklist for the Cirrus SR-22-G2/G3. Checklists for the Cessna 172N and 182P, Cirrus SR22T-G5, and Piper PA-28-151/161 Warrior and PA28-181 Archer may be purchased for $5.99 each. They also have a fuel tank timer/reminder ($0.99) and an oil consumption log ($3.99).

Checklists are grouped into phases of flight such as ground, after takeoff, etc. that automatically sequence or are directly accessed. Within each group, individual checklists are shown as tiles further subgrouped and color-coded into normal, abnormal and emergency. Touch a tile and the checklist is run.

smartCHECK can run as a text app, but can also audibly read checklist text. Once a checklist is running, the app can speak the challenge and response text and can be set to wait for the next tap or sequence to the next item after a user-settable pause. Progress can be paused by touching the screen. While a checklist is running, the text also appears and the progress is shown on screen.

Individual checklist items may be edited in the app, but in this version you cannot add airplanes, groups or checklists within a group. If an available aircraft checklist structure comes close enough to your needs that you can merely edit the items, you're in luck. If none do, you're out of luck until a planned upgrade provides the user ability to create new checklists.

We think navigation in smartCHECK is superior to the others, but the behavior is still a bit quirky in places. For instance, if editing a checklist item, your edits might not take when it's read. Instead, you must delete the item and add a new one. In time and with revisions, this might well become the best checklist app, and is quite usable today if your aircraft fits within the framework of the available six.

TALKING CHECKLIST PRO

On the surface, Talking Checklist Pro looked promising. From its description, this free iOS app seems somewhat similar to smartCHECK, but many reviews in the app store talked about it crashing when editing a checklist.

Although use of a provided checklist operated simply and reasonably,

it also crashed for us when we tried to edit a checklist. When it didn't crash, we got hopelessly lost trying to make our edits. We went to the developer's webpage and the app isn't even mentioned, so we weren't able to find any instructions or other guidance. There was even mention of a video tutorial on YouTube, but we couldn't find it. Our takeaway is the app might offer some capability if you're patient enough with it. But you get these apps to make cockpit life easier—not more complicated.

OUR CONCLUSION

Do any of these dedicated checklist apps behave as we would like them to? No, but Voice-Check, smartCHECK and AudioCoPilot are three that are somewhat promising. Voice-Check does have full voice control, but it's only available on Android. The other two will talk, but not listen.

All these apps use the platform's built-in Bluetooth to communicate with your headset, making a headset or audio panel with Bluetooth a near requirement (although you could wear an earbud in one ear with a regular over-the-ear headset). We suggest you experiment on the ground before going flying.

The app world is fragmented and entrepreneurial. That's a polite way of saying most of the apps are written by one or two people, usually as a fun off-to-the-side project. If the app proves popular—few do—a real company might emerge to provide support and enhancement. If it doesn't, well, the app can be orphaned or never see any enhancements.

We feel that an electronic text presentation of a printed checklist simply puts the same limitations into a modern format, without any real advantage. A talking checklist is required.

We had sufficient trouble getting Voice-Check to work properly, so we really can't recommend it. If your aircraft fits within the framework of one of the six aircraft available for sureCHECK, we'd probably choose that one, although the simplicity and versatility of AudioCoPilot is quite compelling as well.

Contributor Frank Bowlin, a confessed gadget geek always seeking a better checklist solution, is editor of our sister publication, IFR.

FIELD REPORT

Faro Air In-Ear Headset: Comfy, But No Bluetooth

If they can live without Bluetooth connectivity and can tolerate earplugs, the Faro Air could work for pilots and passengers not spoiled by high-end ANRs.

by Larry Anglisano

One perk of the job is trying out a wide variety of headsets. Two models that impressed me enough to fork over my own cash to own are the Bose A20 and the Clarity Aloft in-ear headset. In fact, I like the Clarity so much I find myself flying with it more than the Bose. That's why I was anxious to try the new Air in-ear model from Las Vegas, Nevada-based Faro Aviation.

Company principal Kevin Faro has been designing a series of aviation headsets since 1999, the result of his dissatisfaction with other headsets on the market. The company currently offers four models, to include the $190 passive G2, a $390 ANR version of the G2, the $690 flagship G3 and the $390 Air. I've been flying with the Air for nearly a month, while also offering it up to passengers and other pilots to try. Here's a field report.

FEATHERWEIGHT

I was initially impressed with the Air's overall build quality. On the other hand, it's priced at nearly $400, so buyers will expect good fit, finish and feel. Still, at that price point I think Faro should include a carry case, but it doesn't. But, the headset proved durable enough to throw (literally) around the cabin and survived my overstuffed backpack.

Compared to the Clarity Aloft, I found the Air had an edge in comfort. For one thing, at 1 ounce, it's .5 ounces lighter than the Clarity. This might seem nominal, but the Air just felt easier to wear on longer hauls and there were no pressure points where the earband rests on the base of the ear. It helps that the headband doesn't need to fit tightly on the back of the head to stay firmly in place.

There aren't slide adjustments to the metal headband and earloop frames. Instead, you simply bend the metal (expand or contract) to get the right size for your head. Faro says you won't break the structure by making these adjustments, and if you do, the company will exchange the set. Use caution, however, not to pull on the speaker wires when adjusting the earloop. I was able to achieve a perfect fit.

We think the Faro Air has decent build quality, but we hoped for better noise reduction and more audio gain. It comes with medium and large eartips.

Faro says the Air provides up to 50 dB of noise reduction. Compare that to the Clarity Aloft, with specs rated at 29.5 dB of noise attenuation.

STICK EM' IN

In our trials, I found the Clarity outperformed the Air when it came to taming noise in the cabin of a Bonanza and an older Cirrus. But, my passengers had mixed reactions. "The airplane noise was louder than the radios and your voice," one non-pilot remarked of the Faro. Another pilot who spoke the lingo thought the Clarity and Faro performed nearly the same and found the Faro more comfortable and easier to put on the head, but the Clarity had louder sidetone. One passenger spoiled by the Bose A20 couldn't wait to ditch the Faro on a long haul.

My takeaway is that the performance of either in-ear model is greatly dependent on the fit of the slow-recovery composite foam earplugs. Faro provides two sizes to choose from: medium (Faro says the medium fits the majority of users) and large. Both are designed slightly longer than a typical earplug to fit deeper into the ear canal. I wonder if shallow, fatter plugs might work better, perhaps creating a tighter seal around the outer perimeter of the ear.

Regardless, you have to use them properly and there's a correct way to insert the eartips. The drill is to compress the plugs by squeezing them into a ball with the fingers, while using the opposite hand to pull the ear back and upward to open the ear canal. Quickly insert the entire compressed eartip into the ear canal and then release hold of the ear, but hang on to the tip until the foam expands. Do it correctly and there won't be any of the foam visible. This process might make any in-ear model a deal breaker for folks with sensitive ears, small children or those wigged out by earwax.

CHECKLIST

- The Air has good build quality, plus its lightweight headband increases comfort.
- With a $400 price tag, we think the set should have Bluetooth connectivity.
- In our flight trials, the set didn't quite match ANR-level performance.

The Air's bendable earband worked well with thin-templed sunglasses and the flexible microphone boom stayed perfectly in place. The compact control module, bottom photo, is refreshingly simple and has linear volume adjustment.

MUSIC AND MIC

The Air's noise-cancelling Electret microphone is a good performer. It never clipped and has good sensitivity when placed where it should be—which is just touching the lips.

One thing that impressed me is that the microphone is easy to adjust, where it stays in place for the rest of the flight. I just can't seem to find a happy position with the microphone boom on my Clarity.

The headset's control module couldn't get any simpler. It has slide volume controls for each ear and the volume seemed linear throughout its travel. Saying that, I wasn't the only evaluator who wanted more phone audio gain, even with the volume pots maxed out. The only way to get more volume was to crank up the aircraft intercom and comm radio, but that certainly wasn't an option for other headsets (including high-end ANR models) that were also plugged in. If you had an intercom with independent volume controls for each station, you could compensate, but that isn't always practical.

When it comes to intercoms, the Air can accommodate stereo or mono systems. There is a mono and stereo selector switch nicely positioned on the face of the control module. What you won't find on the module is controls for Bluetooth. The only way to pipe music into the set is to connect an audio patch cable from the music device to the module. I suspect users will expect wireless capability for the price. The Clarity Pro Plus with Bluetooth is $725—a $200 premium. Still, I found the Air's music audio quality to be quite good when connected to my iPhone. A nit I had was the length of the audio plug pigtails on the module—they were too short—making the module barely accessible when plugged into jacks located under the panel.

As with any headset, I suggest trying before buying, especially for use in louder cabins. They may be fine in a turbine aircraft, but not so fine for louder pistons, for example. Faro provides a three-year full-coverage warranty and has free shipping within the continental U.S. It sends three pairs of standard and three pairs of large eartips with each set.

Contact www.Faroaviation.com.

Cirrus SR22

Take your pick from several generations of SR22s, but prepare to pay big for later ones.

The good news for buyers who can't afford the eye-popping price of a brand-new Cirrus is the healthy supply of used ones for sale. For as little as $100,000, you might score a first-generation G1 SR22. That's no chump change, and to be sure, an early SR22 might seem stark compared to the current G5 series. But for an owner stepping up from a Cherokee or Skyhawk, for example, an SR22 will be a major leap ahead in speed, technology and mission capability.

Since Cirrus Design 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 entry-level SR20 and flagship SR22 in their various iterations have proven hot sellers and good performers, with unusually loyal customers. This seems the perfect setup as the company moves closer to delivering its seven-seat, single-engine Vision SF50 personal jet—a logical step up from an SR22.

What explains the brand loyalty? 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 flying. Moreover, they offer the right combination of cutting-edge equipment and construction methods without becoming so radical or quirky that buyers are put off.

The CAPS (Cirrus Airframe Parachute System), which Cirrus pioneered as a signature marketing feature, is a continuing selling 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 even more so in the current market. We suspect the parachute has always been a pot sweetener that pushes buyers considering something else into the Cirrus camp. "The parachute is what sells my spouse on the airplane," one commenter said.

The SR22 will blister along at 170 to 180 knots on about 18 GPH ROP.

COMPANY HISTORY

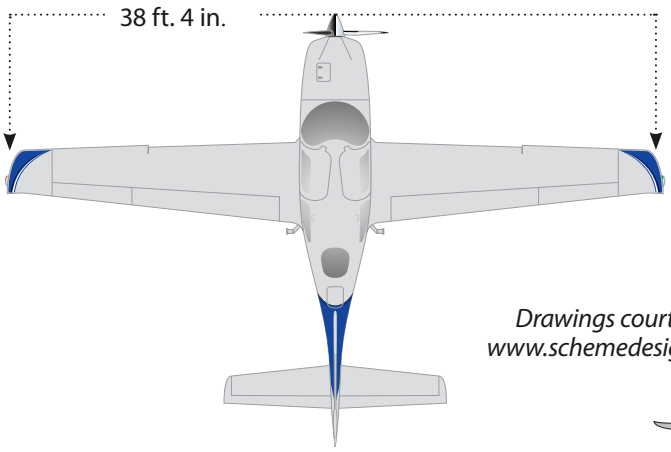
Among homebuilders, Cirrus was well-known during the 1990s for its VK30 pusher kit, an innovative composite design that gained some traction, but wasn't a major player in the field. By the mid-1990s, Cirrus principals Alan and Dale Klapmeier developed a new vision, reasoning that the time was right for 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 in over your head, you wouldn't have to die for your mistake; the BRS parachute would pull your fat out of the fire.

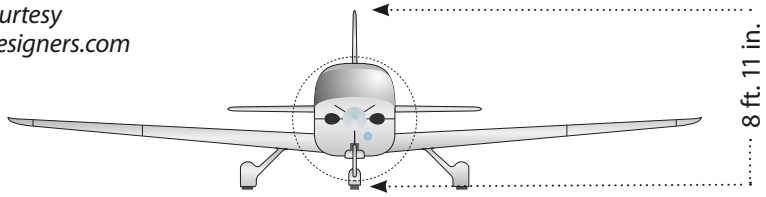
The company's first product was the SR20, which appeared in 1999, powered by a 200-HP Continental IO-360ES. At about $197,000 equipped, the airplane was a good

The 2006 SR22 in the lead photo was refurbished by Lone Mountain Aircraft. Sold at a premium, a Lone Mountain refurb includes a new interior, prop and factory rebuilt engine, plus a complete airframe strip-and-paint.

CIRRUS SR22



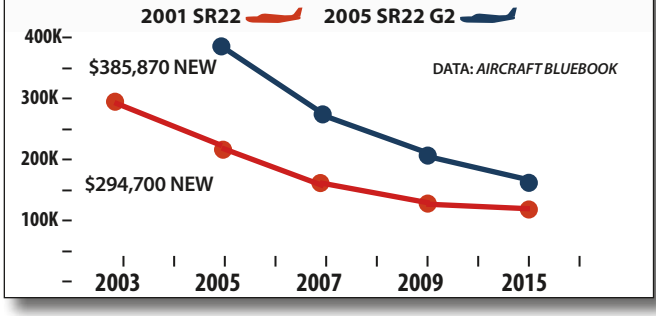
Drawings courtesy www.schemedesigners.com



SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
2001-2002 CIRRUS SR22	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$110,000
2003 CIRRUS SR22	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$130,000
2004-2005 CIRRUS SR22 G2	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$155,000
2006-2007 CIRRUS SR22 G2	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$200,000
2008 CIRRUS SR22 G2	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$220,000
2009-2010 CIRRUS SR22 G3	CONT. 310-HP IO-550-N	2000	$33,000	92	1150 LBS	180 KTS	±$315,000
2011-2012 CIRRUS SR22 G3	CONT. 310-HP IO-550-N	2000	$33,000	92	1150 LBS	180 KTS	±$375,000
2013-2014 CIRRUS SR22 G5	CONT. 310-HP IO-550-N	2000	$33,000	92	1340 LBS	180 KTS	±$470,000

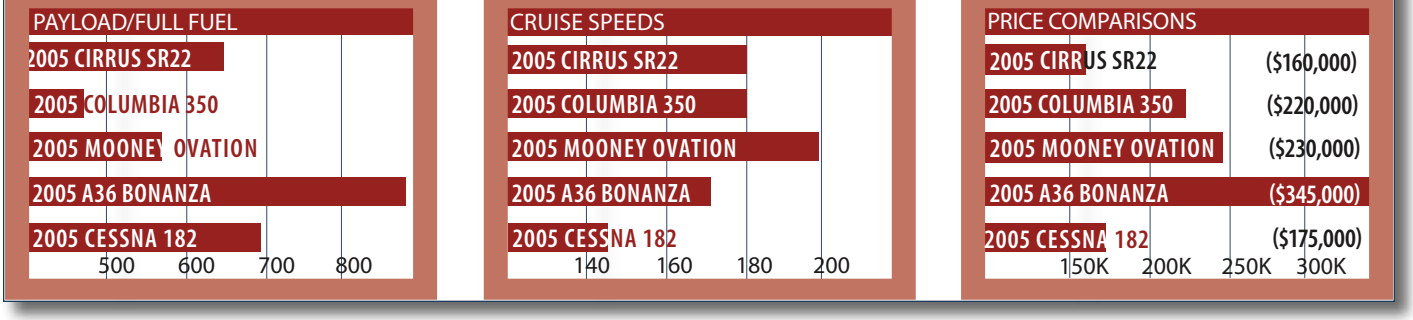
RESALE VALUES



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



The Garmin Perspective avionics suite, top, was first offered in G3 models, replacing the Avidyne Entegra, middle. Panels in first-gen SR22s sported a combination of glass and steam gauges, bottom.

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

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 short-lived.

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 as the SR20.

The IO-550-N brought some improvement to the front end. It's 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. We've learned to love its simplicity.

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, 81 gallons in the SR22 (92 in later ones) 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—increased further with the current G5 model. 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 avgas prices. 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

The SR22's castering nosewheel can make hangar pulls/pushes problematic without a tug. Many owners wish the TKS de-icing system had an external gauge.

range of 700 miles, with reserves. At the max range setting, 1000 miles is doable, as we've proven.

CONSTRUCTION, SYSTEMS

Along with Diamond, Cirrus pioneered high-volume composite construction for light aircraft. When this technology was on the horizon, the aviation press was allowed to believe it would be stronger, lighter and cheaper than metal, even if Cirrus didn't exactly say that. 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-world 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.

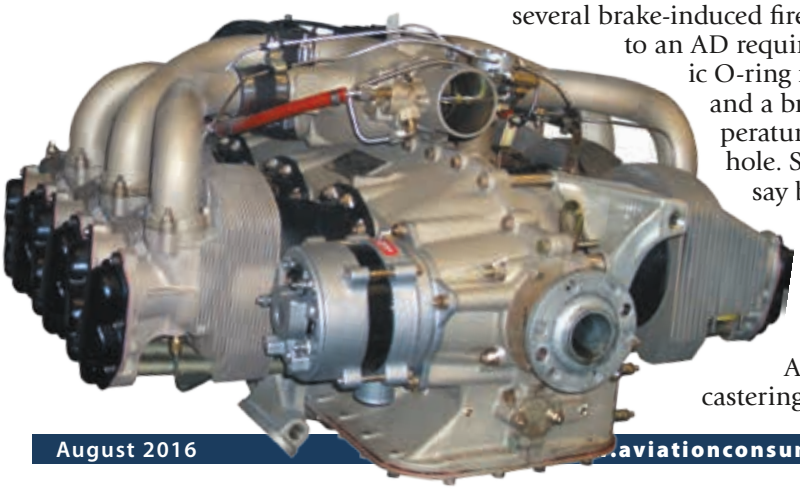
As with the SR20, trim is entirely electric via a single coolie hat on the side controller—fore and aft for pitch, side-to-side for aileron. Some early SR22s also had electric rudder trim, but that was later deemed unnecessary. Because the pitch trim motor is aggressive, mastering smooth pitch trim changes 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. As for the castering nosewheel, it makes the airplane a dream to taxi into a parking spot, but a nightmare to hand-push into a hangar.

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. Owners of G1 and G2 models complain of inaccurate fuel gauges, and while there was an aftermarket digital fuel sender and control head upgrade offered by

The Continental IO-550-N has a 2000-hour TBO and an average overhaul cost of $33,000.



Large cabin doors, a generous baggage compartment and sports sedan-like ergos makes the SR22 an easy traveler. G3 and G5 models have a 60/40 fold-down rear seat for loading more stuff.

CIES, it had problems, too.

While 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 Diamonds.

In keeping with its new-age approach to safety, Cirrus ridded its models of vacuum instrument systems as soon as it could. Although the very 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/alternator failure, will power sufficient avionics to continue the flight. Either 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, but that's changing.

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.

MODELS, MAINTENANCE

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. Some of the early steam gauge airplanes are getting Aspen Evolutions, Garmin G500s 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, an 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 color HSI. Both options had the ARNAV ICDS-2000 color MFD. The only other option in the early airplanes was a 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 Avidyne's Entegra PFD/MFD glass cockpits found their way into customer hands. The Avidyne airplanes had GNS430s, a System 55 autopilot 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. It's a huge improvement.

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—even in a softening economy.

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 once 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 turbonormalized 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 ergos.

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. It has 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.

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 315-HP TSIO-550-K-powered SR22T, to sell alongside the turbonormalized model, which remains in the lineup today.

The latest version is the SR22 G5, introduced in 2013. The G5 brought a variety of improvements, including optional tri-color paint work, a new 3600-pound gross weight, plus a welcomed 50-percent initial flap extension speed of 150 knots, up from 119 knots on older SR22s. With an additional 3.5 degrees of extension, this makes the aircraft much easier to slow on descent. To accommodate the new gross weight increase, Cirrus beefed up the main spar, strengthened the landing gear and added extra layers of composites to the airframe.

Speaking of composites, when composite airframes 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 big 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—if treated right.

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 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 well at the point of needing the 10-year repack/recertification. How much? Plan on about $13,000 all

SR22 CRASHES: LANDINGS, IFR OPS

Our survey of the most recent SR22 accidents led us to question a long-held opinion about handling on landing and wonder why Cirrus pilots seem to have so much trouble hand-flying their airplanes in IMC.

In the years we've flown the Cirrus SR22 line, we've felt that they were pretty much middle-of-the-road airplanes when it came to level of skill required to make a landing. We flew them on-speed on approach in varying levels of crosswind and found that control authority and responsiveness were predictable and comparable to other airplanes in their class.

After noting that 39 of the SR22 accidents involved landings, we're beginning to wonder if the airplanes are less than forgiving of pilots who won't fly at the recommended approach speed. Only 16 pilots lost control on the runway, about average for a nosewheel airplane, but 10 didn't have things collected well enough to land, went around and crashed during the go-around; three landed so hard they damaged the airplane; three hit something on final approach; and a surprising eight undershot their landings, hitting short of the runway. We have heard reports of high sink rates if a pilot lets the airplane get slow, and find the NTSB reports give supporting evidence.

Our recommendation after looking at the landing-related accidents for the SR22 is to fly at the speed recommended in the POH, not any more, not any less.

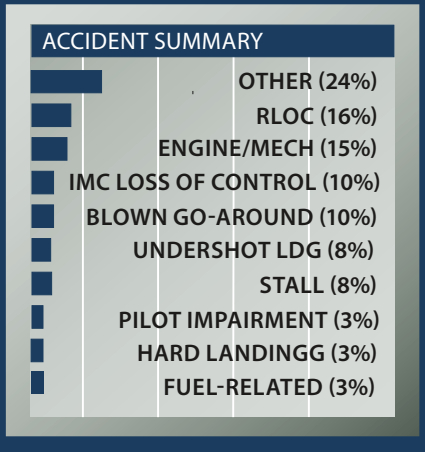
We did note that almost all of the RLOC accidents involved gusting crosswinds. Given what we also saw regarding issues with Cirrus pilots hand-flying their airplanes in IMC, we are concerned that the level of automation has caused correspondingly unsafe levels of complacency in Cirrus pilots and a loss of stick-and-rudder flying skills.

Fully 10 percent of Cirrus accidents involved loss of control in IMC—another two were the result of continued VFR into IMC. For an airplane that can compensate for pilot foolishness or impairment, we were surprised at these numbers. One Cirrus pilot took sleeping pills in a suicide attempt. After he passed out and a tank ran dry, the autopilot set up a controlled descent and the airplane landed.

Because many SR22s carry some form of flight data recorder, we are getting more insight into the dynamics of IMC loss of control accidents and learning that the automation is thus far not a silver bullet for increasing the level of safety. It may be working in opposition as pilots over-rely on it or get confused by its complexity and misprogram it.

A notable accident involved a pilot who engaged the autopilot *five seconds* after liftoff in anticipation of climbing into IMC. He misprogrammed the autopilot. Over the next four minutes, he fiddled with it rather than fly the airplane as he made several turns and stalled the airplane twice before crashing.

On the good side of the equation, we note that there were at least 15 successful CAPS deployments, saving a number of lives. A few of those were after loss of control in IMC.



in, if you go with an overhauled unit, but close to $15,000 for a new one. G1 aircraft require costly composite repair and paint work following a repack, but the CAPS is accessed through the baggage area in G2 models and beyond, eliminating the need to break the structure to gain access.

Speaking of paint work, if the paint is showing its age and you're tempted to upgrade to a more modern scheme that mimics a new Cirrus, you could get into a copyright infringement issue, since Cirrus has copyrighted its modern schemes. Scheme Designer's Craig Barnett—who has dealt with the issue first-hand—told us it's best to check with Cirrus before spraying.

MARKET SCAN

Because of the habit of buyers upgrading 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 we reported in the December 2015 issue of *Aviation Consumer*, Cirrus eventually divested itself of owning any used inventory, partnering with Ohio-based Lone Mountain Aircraft Sales and TAS Aircraft Sales in Portland, Oregon, to carry, manage and resell the used inventory. A used Cirrus with a factory-certified pre-owned status carries a six-month, 100-flight-hour limited factory-backed warranty. But you don't always have to pay the certified preowned premium (roughly 10 percent, on average) to get a decent used Cirrus.

We think the best buys are the 2002 to 2004 aircraft with Avidyne avionics—particularly an early G2 model. The Bluebook lists these for well under $200,000 retail and we don't doubt bargains are out there. The 2001 to 2003 SR22s are even cheaper, with retail prices as low as $100,000. These likely won't be all-glass models—many have steam gauges with an Avidyne MFD. The interiors on these first-generation

SR22s were never a high point and many of these older models 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 Pilots Association at www.cirruspilots.org. For a detailed look at real-world performance numbers on Cirrus aircraft, see www.cirrusreports.com.

OWNER FEEDBACK

My military, airline and accident investigation background affected my purchase of a 2013 SR22 G5. When I started researching my first aircraft purchase, I spent nine months focusing on the Beech Bonanza. A FedEx pilot advised me that living in the wintry Northeast made a Cirrus with TKS and the G1000 Perspective worth considering. I fly an MD11 with a glass cockpit and HUD, so when I saw the avionics and autopilot package in the SR22, I was sold.

When I next watched athlete Ken Griffey Jr.'s video about him enjoying his Cirrus, I knew that if he could fit in it, so could I. My first demo ride with Eric Sanderman, the Cirrus New York territory sales rep, confirmed the spacious and comfortable cabin I hoped for. After Eric corrected my habit of flaring high from my job flying the MD11, it was a done deal.

With my Navy and FedEx flying experience, I entered general aviation flying expecting a high level of standardization with recurrent training and found that Cirrus pilots are getting more of it.

Cirrus Standardized Instructor Pilots (CSIPs) are another step in the right direction for Cirrus pilots. Cirrus itself controls the initial training and annual renewal of CSIPs, ensuring the program's quality. Insurance companies recognize the CSIP value and usually require owners to undergo factory/CSIP initial and may reward for CSIP recurrent training.

I call the Cirrus a "mini MD11 on steroids." My Cirrus affords me a similar high level of situational awareness that I'm used to in the MD11, plus the advantages of satellite weather and synthetic vision. After I soon retire from FedEx, I won't have a great copilot to keep me honest. However, the Perspective avionics with electronic data subscription allows me to not deal with paper, since my backup ForeFlight charts are on my iPad. This is great for single pilot ops.

Ken Newman spiffed up his G2 with custom vinyl graphics work, right.

I have the composite prop upgrade, which enhances both takeoff and landing performance on my 2900-foot home runway. I also had Lancaster Avionics in Pennsylvania install the upgraded Garmin Perspective software with ESP (enhanced stability protection), plus user defined holding patterns.

I've accumulated 450 flight hours and the airplane is more than midway through a five year spinner-to-tail Cirrus warranty. Other than new main tires and adding an Air Wolf oil separator, my periodic oil changes and annual costs are reasonable, with all work done by Jim Markey at Private Flight at Sullivan County airport in New York. My first two annuals were pretty clean and came in just over the expected labor costs.

My annual insurance rate for a $700,000 hull value with $2 million smooth coverage is just over $6000, with a 10-percent premium return for each claim-free year. A rough calculation of all costs since new (excluding training) has been about $165 per flight hour.

John Gabriel
via email

We purchased our normally aspirated 2006 GTX G2 in 2009 to use in support of our Connecticut-based aircraft insurance business, coming out of a Mooney 252. We were looking to get into an airplane that was simpler and less expensive to maintain than our turbocharged Mooney. Most of our trips are 100-300 miles, with several Florida trips each year. Our typical annuals run between $4500 and $6000. We had sizable annuals the last two years, including an engine overhaul, airbag seat belts and repacking the CAPS (nearly $16,000). I recommend finding a shop with lots of Cirrus experience.

We did the factory IFR transition with a local CSIP and were skeptical that it would take 15 hours to complete the transition, but it did. Our lowest-time (and youngest) pilot got through the course the quickest. It took me about 18 hours, and I found the training materials thorough.

Our airplane has the Avidyne MFD/PFD driven by dual Garmin GNS430s. If you have not flown with a large PFD/MFD combo, you are in for a treat. The setup works really well and takes a lot of the work out of cross-country trips. Having the big weather picture and being able to instantly look at METARs along your entire route is a great improvement over calling Flight Service and straining to hear them on a VOR frequency. Get used to using speed and altitude tape bugs—it makes flying the airplane much easier, especially the altitude bug. I wish you could view the entire CMax approach plate, rather than having to scroll from view to view, but I think it is way better than paper charts. The geo-referenced airport chart with the airplane's position superimposed takes the sweat out of getting around large airports, even at night.

We typically run between 65 and 70 percent power, and see between 165 and 170 knots true at 7000 feet, which is where the airplane seems happiest here on the East Coast. Fuel burns (lean of peak) are around 13.5 GPH with stock fuel injector nozzles. We are considering adding GAMIjectors next year to get the temperatures a little closer together, but the engine runs quite happily well lean of peak.

After flying in the Mooney, the Cirrus cabin is ludicrously spa-

The Aviation Consumer

USED SR22

(continued from page 31)

cious and comfortable. Even a tall person in the back seat will not feel cramped. The positioning of the sidesticks frees up the space where the yoke usually is and gives you a great view of the panel. We didn't really notice any difference between using them and a conventional yoke after the first five minutes of transition.

Our airplane has the S-Tec 55X autopilot and we really like it. It is fully coupled, will fly rate-climbs and descents and has GPS steering for full route intercept and tracking. Like other owners, we notice the autopilot's tendency to Dutch roll when flying an ILS approach, but overall it works well and is easy to use.

My least favorite thing about the SR-22 is the trim. There is no fine-tuning and no manual wheel, so getting trim exactly right, well, you just don't always. We've heard all kinds of solutions. Most commonly, pilots turn on the autopilot and let it trim the airplane. Hand-flying straight and level requires the use of the altitude bug and an active instrument scan, even on a perfect VFR day. Stick forces are heavy, but there is plenty of control effectiveness. There is also plenty of rudder/aileron interconnect. During takeoff you need full right rudder and a fair amount of right aileron, which can startle you the first time you rotate.

Most pilots won't have much fun or get much utility from the airplane unless they have an instrument rating and remain fairly current. Flying in the system took me a little while to figure out. Since flap speed for the first notch is a slow 119 knots, you really need to get the airplane slowed up early. The gear is already down and there are no speedbrakes. The only thing you have to slow you down is pointing it uphill and the propeller. If you let this airplane get too far in front of you, it will take a while to catch up to it.

Our G2 has two alternators, but only the primary will run everything. If you lose it, you need to land soon. The second alternator is quite small and stretches your battery's glide a little bit. We have the older non-known-ice TKS system, and it will give you protection for about 25 minutes, but there is no fluid gauge. It really is meant to get you out of ice—not a system to take it on.

MD11 captain John Gabriel, left, was sold on the advanced avionics and roomy cabin of his 2013 G5.

If you are considering an SR22, make sure that you measure your hangar first. Wingspan is almost 40 feet. Ours has about 6 inches of clearance on either side. Pushing it in with the castering nosewheel is not for the faint of heart. Get a tug.

Cirrus got the SR22 mostly right. I wish there was an elevator trim wheel, more deice fluid, two full-size alternators, speedbrakes and higher flap speed. But it flies at a reasonably fast speed, has good range and payload and is extremely comfortable. It is nice to know the CAPS is there. There are enough used ones out there that the older ones are pretty well-priced for what they offer. All in all, we are very happy with our G2.

Jonathan Doolittle
Sutton James Inc.

FEEDBACK WANTED

BEECH SIERRA

For the November 2016 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Beech Sierra. We want to know what it's like to own these aircraft, 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 **(full-size, high-resolution please)** you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments. Send correspondence on the Sierra by September 1, 2016, to:

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