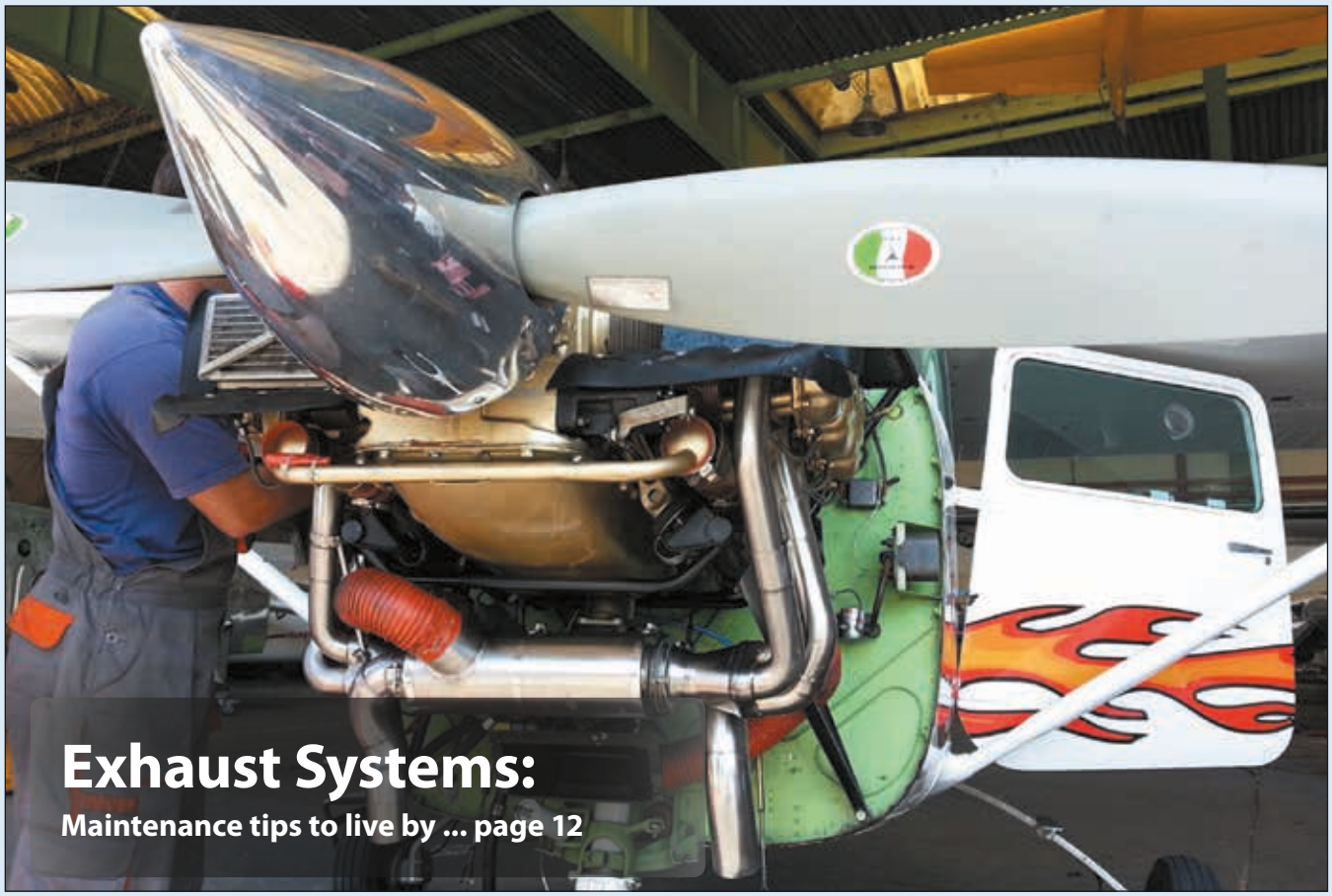
February 2019
Volume LI
Number 2

The consumer resource for pilots and aircraft owners

The Aviation Consumer®



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AVIATION CONSUMER (ISSN #0147-9911) is published monthly by Belvoir Aviation Group LLC, an affiliate of Belvoir Media Group, 535 Connecticut Avenue, Norwalk, CT 06854-1713. Robert Englander, Chairman and CEO; Timothy H. Cole, Executive Vice President, Editorial Director; Philip L. Penny, Chief Operating Officer; Greg King, Executive Vice President, Marketing Director; Ron Goldberg, Chief Financial Officer; Tom Canfield, Vice President, Circulation.

Periodicals postage paid at Norwalk, CT, and at additional mailing offices. Revenue Canada GST Account #128044658. Subscriptions: $84 annually. Bulk rate subscriptions for organizations are available.
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Postmaster: Send address corrections to AVIATION CONSUMER, P.O. Box 8535, Big Sandy, TX 75755-8535. In Canada, P.O. Box 39 Norwich, ON NOJ1PO, Canada. Publishing Agreement Number #40016479

WHY THE LATEST UAVIONIX PATENT IS SIGNIFICANT

If you've been holding out for a cheaper mandate-compliant ADS-B solution you've no doubt been eyeballing the sub-$2000 uAvionix skyBeacon wingtip position light with integral ADS-B. There's also the tailBeacon, a similar gadget that mounts on the vertical tail on airplanes with tail-mounted position lamps. As we've reported, uAvionix was slapped with a patent infringement lawsuit from Garmin on the basis that uAvionix copied some of its technology used in these devices. While the lawsuit will likely drag along in the system for some time—and it's been successful business as usual at uAvionix—we get calls and letters on a regular basis from concerned potential buyers. I get it.

It's bad enough to shell out two grand for a force-fed government mandate, and it would be worse if the product became orphaned should the courts rule in Garmin's favor. We've seen it before. Recall the contentious losing battle ADS-B maker NavWorx had with the FAA when the agency ultimately pulled the plug on its products after determining they didn't meet some of the stringent certification specs. That left a lot of early adopters scrambling for replacements and stung after shelling out a couple grand. It looks to be different at uAvionix, particularly now that it's earned patent 10,156,627 for its Aircraft Navigation Light ADS-B Radio, otherwise known as the skyBeacon and tailBeacon products. Just weeks ago the company announced that it earned an FAA STC for the skyBeacon and is finally shipping the product to an anxious group of paying early adopters. Using customer deposit money to feed the certification budget is often a necessary slippery slope to scale, and uAvionix didn't fall.

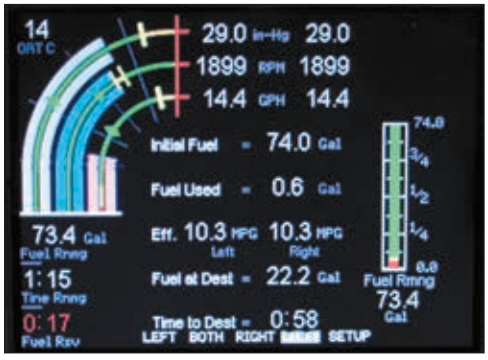
What's significant about the patent is that it covers the company's transponder synchronization circuitry, called the Power Transcoder. This is the tech that prompted Garmin to file the patent lawsuit to defend its own AutoSquawk interrogation circuitry it uses in a variety of Garmin ADS-B systems. Both technologies are cost-saving thanks to simplified installations. Without this internal circuitry, the ADS-B system would require an external control head for manual sync and fault monitoring. Plus you'd be messing around with changing beacon codes on multiple units during flight. Garmin bailed the market out of that silly chore with its control head-less AutoSquawk tech, which it currently uses in the GDL82 low-cost ADS-B Out system. This is a compact 978 MHz UAT module that connects inline with the existing transponder, including vintage non-Garmin models. It will also work with some existing antenna systems, and because of its sub-$2000 price, it will compete with skyBeacon installs. The skyBeacon is arguably the installation winner on many aircraft with externally mounted wing and tail position lights. Installs can be accomplished in a couple of hours or less, with some in under one hour. Garmin's GDL82 installation consists of mounting an external GPS antenna and the remote ADS-B transmitter. Realistically, that's a couple of days in the shop, but some shops might bang it out in a full day.

With the skyBeacon now approved and shipping, it will be interesting to see if it changes the current ADS-B Out buying trend, which points to Garmin's GTX-series ADS-B transponder. Nearly every shop I've spoken with over the past year says Garmin's transponder dominates. It makes sense for aircraft that need both a transponder and ADS-B compliance—especially ones that fly above 18,000 feet where 1090ES is required. As a bonus, you get wireless traffic and weather data—something you won't get with a standalone skyBeacon. In general, you'll pay $5000-plus for a full-up GTX345 install.

The uAvionix patent doesn't end the Garmin dispute, but uAvionix is fair in reiterating that the USPTO recognizes distinct differences between the two competing technologies. That's not a slam-dunk win, but it may be enough to boost buyer confidence. —*Larry Anglisano*

THE END OF AURACLE ENGINE MONITORS

I heard rumors that the AuRacle line of digital engine monitoring systems has been retired. This is of huge concern to me because I invested in this expensive system for my Baron, based on favorable recommendations from *Aviation Consumer* years ago.



If the company has indeed gone away, any idea where I might get support for this now orphaned system?

Rick Phillips
via email

It's not a rumor. In a letter sent to customers in late December 2018, Edwarda C. Lloyd, the Repair Service Coordinator for Ultra Electronics, said Ultra Electronics Flightline Systems (known as Flightline) decided to exit the digital engine display market with regard to the AuRacle product. Effective immediately, he said Flightline will no longer produce, repair, service or develop the AuRacle product and will be surrendering all of its regulatory certificates to the FAA.

If there's a bright side it might be that some AuRacle installations use engine probes and sensors sourced from JP Instruments, and a lot of the wiring is cross-compatible.

AVIDYNE AND FOREFLIGHT

There may not be a large number of people who are flying with an Avidyne IFD-series navigator whilst using the popular ForeFlight tablet app, but I bet the majority of those who do are irritated by the fact that ForeFlight still doesn't support ADS-B streaming with the IFD navigator family. ForeFlight can display ownship position and exchange flight plan data from the IFD, which was great news when the capability was first introduced.

A number of other EFB products are able to consume IFD-originated ADS-B data (FlyQ is one, which gets little recognition), and ForeFlight is able to display data from a variety of other hardware sources.

From what I read on the Avidyne support forum, it's promising to stay in touch with ForeFlight to ensure access to whatever equipment they need to get this working. Given that ForeFlight can already display the standardized GDL90 format data, and that the IFDs are outputting GDL90 data, this seems like a pretty simple problem to fix by rewriting some code.

Perhaps in future reviews you can make clear note of which EFB products work with in-panel navigators and which don't—and I'll buy you a bottle of Huntsville's finest bourbon, Irons One, if you're able to get ForeFlight off the hold-short line and actually fix this problem sometime before my medical expires.

Paul Robichaux
via email

Never, ever ones to pass on the chance for free premium southern bourbon, we got in touch with both ForeFlight and Avidyne. On the record, ForeFlight said, "We are actively supporting Avidyne as they implement our published GDL90 specification and perform testing. The display of ADS-B weather and traffic on ForeFlight will be supported in a future Avidyne update." According to Avidyne, "We have shared our ICD with ForeFlight and we currently can do two-way exchange of flightplan data. We expect that ForeFlight will implement the decoding and display of ADS-B weather and traffic from our IFD Wi-Fi data stream in a future release."

Keep that bourbon on ice.

UAVIONIX STROBE LIGHTS

You guys have been all over the uAvionix budget ADS-B skyBeacon and tailBeacon products and it's a huge resource for penny pinchers like me who have been waiting for a cheap ADS-B and lighting upgrade for my Grumman. But in one of your reports you said the uAvionix tailBeacon has a built-in LED strobe light. My shop told me I need a dedicated strobe system because the tail-mounted system from uAvionix only has ADS-B. Who is right?

Bill Arnold
Manchester, New Hampshire

Your shop is right. The uAvionix tailBeacon has a position light, but no strobes.

CESSNA 195 OWNERSHIP

The used Cessna 195 coverage in the December 2018 *Aviation Consumer* is likely the most resourceful article I've seen on this classic Cessna. Still, I think you underestimated the costs associated with keeping these airplanes in top condition. It's not a cheap airplane to own.

Phil Williams
via email

Maybe so, but we still think it's one of the most affordable classics.

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On The Cover: The Cessna in the lead image on the cover of this month's *Aviation Consumer* sporting a new exhaust is a teaser to this month's maintenance field report on aircraft exhaust upkeep. In the article we offer life-saving guidance for maintaining and replacing this often neglected system.

Aspen EFD1000 E5: Low Cost, But Stark

Aspen's new budget-based retrofit EFIS has a crisp display and IFR capability, but its feature set is limited to basic flight instruments.

by Larry Anglisano

As we've been reporting, prices for some retrofit primary EFIS systems have dropped to the sweet spot of around $5000 or less. This is thanks to a new regulatory certification process that sidesteps the pricey and time-consuming TSO process in favor of an STC. Aspen Avionics has populated the field with over 20,000 Evolution EFIS displays over a 10-year span and is the latest to offer a budget-based EFIS with the $4995 EFD1000 E5 Dual EFI.

But Aspen also offers other displays with more advanced features at higher price points, which muddies the buying decision. For this report we put the new E5 on our test bench to see how the feature set compares with other Evolution displays.

ENTER EVOLUTION E5 EFI

The non-TSO'd, STC-approved EFD1000 E5 EFI is Aspen's answer to Garmin's budget-based G5 EFIS displays. The E5 is approved under an AML-STC (approved model list supplemental type certificate), which blankets over 300 aircraft models. The E5 is still considered a major alteration and has the supporting paperwork for installation in type-certified aircraft despite not having a TSO.

Like every other Aspen Evolution PFD, the new E5 is several instruments in one. Unlike Garmin's G5 series, which are two separate instruments (attitude and directional), Aspen's E5 combines both an electronic DG and attitude display. Keeping with Aspen's original design, the 4-inch-deep solid-state gyro can on the rear chassis slides into the existing attitude gyro panel cutout, while the bottom portion of the instrument simply sits over the DG cutout.

CHECKLIST

- An affordable, IFR-capable PFD with an STC that allows you to ditch the vacuum system.
- The new display and processor are better than the first-gen Aspen PFD.
- The E5 is limited to displaying basic flight instrumentation and can't overlay synthetic vision, traffic or AoA data.

As we explain in the sidebar on page 6, the E5 has a full complement of flight instruments, but (aside from the attitude and heading) they aren't for primary instrument replacement. That means the rest of the existing traditional instruments have to stay in the panel. The E5 also has basic GPS and raw nav course guidance, but there is no electronic HSI, although the E5 is fully IFR capable. There is no map display that's standard on other Evolution PFD systems. Think basic utility.

As for sourcing the nav and GPS data for display, the E5 works with GPS navigators with Arinc 429 outputs, and with analog VHF nav radios (KX155, for one) when using Aspen's optional analog converter unit (ACU), which is a remote box that converts analog inputs to digital outputs. This accessory adds $1000 to the $4995 base price. The converter is included with higher-end Evolution systems.

Unlike higher-end Aspen displays, the E5 won't display synthetic vision or Aspen's software-based angle of attack data. It will work with a variety of third-party auto-

That's a typical Aspen E5 configuration shown in the lead photo. The PFD has full electronic flight instruments, but the STC doesn't approve it for replacing the airspeed, altimeter and turn coordinator instruments. When installed per the STC, the vacuum system can go away.

ASPEN EFD1000 E5 AT A GLANCE

pilot systems, including S-TEC and also the TruTrak Vizion. For autopilot interfaces other than the digital TruTrak (which wires directly to the E5), the optional ACU is required.

HARDWARE, FEATURE SET

At first blush the E5 may look like the first-gen Evolution that Aspen has been selling since the beginning, but it's quite different and uses Aspen's new display and processor technology. If you're used to those first-gen Evolution displays, even the entry-level E5's display will look and perform better. With 32,768 colors, a 400 by 760 display resolution and high-intensity white LED backlighting, the 6.0-inch diagonal TFT active matrix LCD screen is noticeably more crisp and brighter than the first-gen units. Aspen said it designed the new display for better automatic dimming and even at the lowest brightness, the screen doesn't lose its clarity. That's important given its small size.

Aspen calls the E5 a Dual EFI (electronic flight instrument) because it's really a dual instrument, replacing the traditional mechanical attitude indicator and directional gyro in one split display. The main electronics are contained in the unit, including a sensor board with solid-state AHRS (attitude and heading reference system), plus a digital ADC (air data computer) that's also built into the gyro can. There's also the MAP (main application processor) board, a CPU and IOP (input-output) board for communicating with remote systems, mainly GPS navigators and VHF nav radios.

The rear chassis has pneumatic connections for tying into the aircraft's pitot and static systems (used for airspeed, altimetry and for other instrument resolutions). The rear chassis also houses a rechargeable (and field-replaceable) backup battery, a 44-pin D-Sub connector and a cooling fan.

Like every other Aspen PFD, the E5 comes with an RSM, or remote sensor module, which works together with the sensors inside the E5 for 3D magnetic heading and GPS computations. The RSM installs much like an external GPS antenna and its placement in an interference-free area on the top of the fuselage is critical for accurate heading resolution. The setup and initial configuration is also critical, so our advice is to find a shop that has experience installing other Aspen systems. That shouldn't be difficult given Aspen's large dealer network.

The primary input controls for the E5 are limited to two control knobs and the center button at the bottom of the display bezel. The knobs are used for setting the course and heading, plus additional bugs and altitude settings. The lower center button is for selecting the navigation sources for the electronic CDI and for entering and exiting the menu and for reversion

BACKING UP AN ASPEN SUITE

No matter which Aspen you chose, you'll need to consider a backup strategy. In the case of the entry-level E5, you might end up retaining the existing attitude indicator even though the STC doesn't require one. That's a drastic shift from previous Aspen upgrades, particularly ones that include multiple TSO'd screens like the one pictured in the Cirrus panel here. Even though there is plenty of reversionary capacity (the right display can function as a PFD if the main PFD in the center goes down), plus a standby remote battery that powers the display if the electrical system tanks, the installation still requires a backup attitude indicator. That's not the case with the non-TSO'd EFD1000 E5.

Since the E5 was certified (via an AML-STC) using new ASTM standards, the typical installation doesn't require a backup attitude indicator as required by old regulations. As we explained, the E5 does require standalone airspeed, altimeter and turn coordinator instruments. But the STC does allow removing the vacuum system. If that's your goal, and you aren't comfortable with the E5's single

attitude source, you'll have to buy an electric (or electronic) backup AI. Yes, Garmin's G5 EFIS display is a logical choice for backing up the E5, but Garmin's STC only permits the G5 to be installed as the primary AI, or for backing up other Garmin displays, including the TXi PFD.

Since the E5 uses pitot and static pressure input as part of the AHRS attitude calculations, loss or corruption of the pitot or static pressure (perhaps an iced up pitot tube) can influence the accuracy of the displayed attitude data. That's a bugaboo with other legacy Aspen displays, and a compromised pitot reference can result in the loss of all primary flight data—even attitude. That's not the case with the E5 when it's connected to a compatible IFR GPS navigator, including a Garmin GNS or GTN. That's because the E5 can use GPS groundspeed instead of indicated airspeed as part of its overall AHRS solution.

In that case, the E5 will continue to display attitude and heading data and will display an "attitude degraded" message on the screen to prompt the pilot to turn on the pitot heat. When the system detects the pitot obstruction is clear, the degraded message goes away and the AHRS resets. Aspen users have waited years for this solution and it's built into the E5 and the new MAX.

or manual power control. The left and right buttons have no function on the E5. Five hot keys to the right of the instrument's navigation display toggle various features on and off, including the built-in GPS steering. The function of each key is indicated by a label on the display to the left of each key.

We think the E5 has an intuitive feature set that's rather shallow compared to higher-end Aspen displays, and Aspen took a logical approach to the user experience. For instance, the left and right bezel knobs are designed to provide immediate operation, yet are designed with fail-safe so you don't inadvertently cause an unwanted operation. For example, the first action of the knob wakes it up and changes the corresponding label from cyan to magenta. Additionally, the first click when the knob is turned (or the first press on the knob) wakes up the knob's function. After 10 seconds of inactivity, the knob returns to its default setting.

The left knob's primary function is for setting the E5's course value, and it's also used to bug an airspeed. The right knob is for the heading bug (HDG), editing the selected altitude field (ALT) and baro (BARO) setting. Successive presses of the right knob will cycle through HDG and ALT in a round-robin sequence. You also rotate the right knob to the left or right to decrease or increase the value of whatever is in the selected field. HDG is always the default setting for the right knob—the way it should be, given the frequency with which it's used.

The E5 screen is divided into three parts: an upper attitude display, a lower navigation display and a data bar between the upper and lower halves. Unlike other Aspen displays, the E5 only has one page, so you'll always view attitude and heading data.

The center button on the bottom of the display is for selecting/coupling the navigation source for the electronic CDI, which can be GPS1 or VLOC1, for example, depending on the external interface. Each press of this CDI nav source button selects the next available nav source, cycling through all available sources in a round-robin sequence. So there's never any mistake as to which nav source you're looking at, the currently coupled CDI nav source is displayed directly above the button. This is particularly critical when flying approaches and other precise procedures.

Three of the five keys along the lower right side of the EFI function as either single-action hot keys for frequently used commands or as menu keys when the E5's menu has been activated. These hot key functions are accessible at any time, except when the main menu is active, and each hot key provides instant access to the assigned command.

BASIC ATTITUDE AND NAVIGATION DISPLAY

Pilots new to primary EFIS displays should transition easily to the E5 because the primary attitude data is a familiar presentation. The attitude portion of the instru-

ment has a conventional blue over brown background with a white horizon line dividing the two areas. At extreme pitch attitudes (above 30 degrees nose up or below 25 degrees nose down), red unusual attitude recovery chevrons come into view, pointing toward the horizon or ground as applicable. At extreme pitch attitudes, some sky (blue) or ground (brown) will always be displayed to help maintain situational awareness, even though the horizon line may be off-scale. Slip/skid is indicated by the lateral position of the white rectangle under the roll pointer. One rectangle width is equivalent to one ball width of a conventional inclinometer.

The E5 has a data bar that visually separates the upper and lower halves of the display. GPS groundspeed (GS) and barometric pressure setting are shown in the data bar and when any of these values are either invalid or not available, the field is dashed. You'll need a compatible GPS navigator to display GPS groundspeed.

The lower half of the EFI is the navigation display, which has 360-degree and ARC compass rose displays. There's also the numeric display of the current magnetic heading, the selected heading and selected course. When connected to a GPS, there's an onscreen ground track marker. Unlike higher-end Aspen displays, the E5 doesn't have a traditional electronic HSI, but instead a basic CDI below the compass rose. The glideslope indicator (VDI) is placed up on the attitude display, as is the localizer (LDI) display.

PRICE IT OUT, FIRST

While we think the E5 is a good value at $4995, we also think there's a narrow market for it given Aspen's other displays that have a more substantial feature set. The E5 can't display Aspen's synthetic vision or the angle-of-attack data, and it requires the $1000 ACU for most autopilot interfaces. For the difference in price, Aspen will, however, have an upgrade path for the E5, which turns it into a TSO'd 1000-series display that can support higher-end features including synthetic vision, AoA and onscreen wind data to name a few.

Every Aspen PFD installation requires a remote sensor module (RSM) shown in the top photo. It houses a magnetometer for heading display, plus a GPS receiver. The optional analog converter unit (ACU) shown at the bottom converts analog to digital input signal.

As for installation effort, that's tough to nail because every aircraft is unique, but Aspen told us that 30 hours (minimum) of shop labor is a safe bet for the typical E5 installation. Remember, the interface requires a compatible IFR GPS navigator, and more than one navigator requires the installation of the optional ACU. In our estimation, even basic E5 installations might come in north of $7000.

As we go to press, Aspen is close to delivering the next-generation replacement for the Evolution Pro PFD with the Evolution MAX line. The MAX uses the new display and processor technology (the same that's used in the E5), plus it also includes the ACU for advanced autopilot interfaces as standard. Existing Aspen displays can be upgraded to the MAX, which could be worth it for owners of legacy Aspen displays. The MAX display upgrade comes with a fresh two-year warranty.

During our E5 bench evaluation, we also powered up a new MAX display for comparison with the legacy Evolution Pro. We'll do a separate article on these systems when they're available this spring, but we like what we saw. Like the E5, the new MAX is a huge improvement in display performance. Like the E5, the MAX PFD has a GPS-aided AHRS for pitot static system failures, an audio panel interface, a faster processor, onscreen font and window enlargement, plus the requirement for backup flight instruments is eliminated when a PFD is paired with a MAX MFD1000. Aspen already has upgrade pricing in place on its webpage.

As for the entry-level E5, we think it's a credible and affordable product to compete with Garmin's G5 if you can live with a no-frills feature set.

Contact www.aspenavionics.com and at 888-992-7736.

Insurance Update: A Hardening Market

The 10-year run that favored buyers of aviation insurance is coming to an end. Be an attractive risk by flying and training frequently.

by Jon Doolittle

The soft aviation insurance market has been going on for 10 years, such a long time that many underwriters, brokers and their clients have never experienced anything else. Among aviation insurance people, there was more and more talk about this so-called new normal as if the wildly cyclical nature of the business had disappeared and would never return.

And while this latest market swing has a somewhat tentative feel to it, there are reasons to think it is the beginning of the next hard market cycle. And reasons to think not.

As we do every couple of years, we recently took a close look at the state of aircraft insurance with the buyer in mind. Here's our synopsis.

FLASH BACK TO 2008

Most industry professionals place the beginning of the current soft market somewhere around 2008. At the time, insuring general aviation aircraft was fairly profitable for most insurers. As early as 2006, the relative profitability of this part of the business had led several companies to start new divisions to insure general aviation business. Both C.V. Starr and Allianz had started substantial GA operations.

> ***The real action is happening to the turbine owner-pilots who are faced with increases as high as 30 percent.***

Beginning in 2010, there was a further influx of companies starting their own aviation divisions. These included Travelers, SwissRe, QBE, Hallmark, XL Catlin, Great American and W.R. Berkley. General aviation did not grow much in that time, so by 2016 there were a lot more insurance dollars chasing each airplane and helicopter than there had been 10 years before. The market was awash in what insurers refer to as "capacity." Capacity is basically the capital required for insurers to set aside as reserves as they take on the risk that comes with new insurance policies. As the new companies entered the market, the legacy companies, including USAIG, Global Aerospace, AIG and Old Republic (Phoenix), were forced into a defensive position in order to maintain their market share against the new invaders, and we were off to the races.

Most aviation underwriters are smaller parts of big companies and so we often don't know the financial results of specific aircraft insurers with any great certainty. The large publicly held companies rarely make numbers for smaller subsidiaries available, so much of what we know about how companies are doing is informed gossip. The rest is trying to read the entrails of who is hiring, who is firing, who is increasing limits, who won't write helicopters anymore, who had the Gulfstream—you get the point. But

insurers do keep track of each other's losses, and there is much commonality in the reinsurers that they use.

WHAT ABOUT RATES AND REQUIREMENTS?

In speaking with brokers, underwriters and reinsurers, there is no doubt that over the past 10 years, rates for most general aviation aircraft have been coming down at each renewal. As one broker put it, speaking of the soft market, "Let's say that the current company offered to renew a policy at the same premiums as expiring, and it was a pretty good deal. But it seemed like there was always some company that would do it for less. If I didn't tell my client about the cheaper price, I wasn't doing my job, plus I was risking losing the business to another broker. So, faced with the loss of business, the current company would often agree to match the cheaper bid," he said.

But according to brokers we spoke with, more and more insurers are now insisting on increases, and walking away if their terms are not met. Just when this started is the subject of some debate. Several companies recently told us that they had started trying to increase their premiums.

In the past several years, price was not the only change brought by the soft market. Underwriting guidelines had also "softened." Some insurers had prior to the last soft market required pilots flying turbine airplanes to attend annual sim school. In the face of credible competition, some companies would allow the pilot to attend school every other year, or to train in the airplane instead of a simulator. In some cases, companies began to offer higher limits of liability, especially to turbine owners. Many companies started to offer value-added services, ranging from discounts on upset training to webinars on safety topics, onsite after-hours maintenance services to SMS audits or emergency response plans.

More insurers would write policies with zero deductibles on fixed-wing airplanes. Especially on professionally flown corporate airplanes, some pilot requirements were relaxed, often to "any pilot approved by the chief pilot." Some underwriters relaxed guidelines on what limits of liability they would offer, especially for owner-flown turbines. Consider

If you're in the market for or already operate a turbine, your insurer might require more frequent trips to a training provider. That's a Flight Safety International avionics systems classroom in the top photo and a Cirrus SF50 jet at the bottom.

that $25,000,000 for a single owner pilot became more and more common, and at times $50,000,000 was available.

The primary beneficiaries of the soft market have been pilots and owners of turbine airplanes, both professionally and owner flown. Piston owners have seen less change in the premiums that they pay, the limits available to them or the training that they are required to do. For most turbine operators, their premiums have decreased substantially over the past 10 years, and for many others they could train at schools that were nearer to where they live, or even to train less frequently. Many finished up the last soft market insured in a more expensive airplane than they were 10 years before, with more liability coverage, and paying less money for all of it.

THAT'S ALL CHANGING

We spoke to brokers, underwriters and reinsurers to understand what was happening inside their business. There was some disagreement about details, but widespread accord about the bigger picture. Almost everyone felt that general aviation underwriting had become unprofitable as a whole, perhaps as far back as five years ago. The main reason, it was universally felt, was that premiums had been steadily dropping for more than 10 years, and were no longer sufficient to pay even for routine attritional losses.

Attritional losses are the smaller but more frequent claims, and usually do not involve bodily injury. These include things like hangar rash, bird strikes, foreign object damage, hail damage, taxi accidents and damage caused by motor vehicles. In some cases, especially those involving turbine aircraft, these claims can be quite expensive, often wiping out many years of premium income.

One underwriter cited what he

Years of low insurance premiums and pricey non-injury-related repair claims are finally catching up with insurer profits. One example is the wind damage to a parked motorglider, top.

called the "miss factor." He likened the current market with 14 underwriters to the big sky theory of midair collisions. He explained that back when there were only five or six companies, most of them had one or more bell-ringer claims each year. The companies knew they were coming and charged their clients enough so that they could put money away for them. "With all the companies that we have now, some will skate for a year or two, especially the fairly new ones. So, a couple of years, there were no huge losses, so they think that the rates they are charging are adequate. Then in year three, along comes the big bang," he said.

In his view, many of the companies were on such slim margins that one or two of these large losses might mean the difference between a year that was an anemic gain and a year of serious financial loss. He also added that enough of the companies had experienced one or two large claims that he felt that after 10 years there were few mavericks left ready to undercut the current market rates.

Other factors pushing the market toward charging higher rates include a lack of investment opportunities and the increased cost of repairing airplanes and settling lawsuits. One of the anomalies of this soft market cycle was the lack of opportunity for insurers to park their money in income-producing investments. In past soft cycles, these have allowed insurers to have an underwriting loss, but to make up the difference with investment income. For most of its 10 years, interest rates have been at historic lows and there has been very little opportunity for insurers to make up for poor underwriting results with investment income.

The other thing about this hard market cycle that is different from others is that there is a continued abundance of capacity, at least so far. In the past two years, there has only been one major underwriter who has left the market, as well as one specialty insurer. Most of the capital available to underwriters last year is still there. This is what makes some question the depth and longevity of this incipient hard market.

EXPENSIVE REPAIRS

Other factors cited by companies were the increased cost of repairing/replacing aircraft. Some of the larger claims in the past few years have been the total losses of late-model turboprops and jets. Partly this is due to the increased values and population of a number of new airplanes. Cessna CJ4s and Phenom 300s were rare 10 years ago, but their numbers are increasing. New ones tip the scales at almost $9,000,000. We see growing numbers of these very expensive airplanes, many flown by their owners. On the corporate side, a G650 or the latest Global or Falcon can easily top $70,000,000. At the same time, insurers told us that the cost of repairing damaged airplanes is also going up.

One reinsurer told us that over the past 10 years, the insurance rates for owner-flown turbine airplanes had gradually diminished, to the point where there was not much rate difference between professionally flown jets and turboprops and their owner-flown counterparts. He also pointed out that those owner-flown turbine aircraft also tended to carry higher liability limits than their piston-powered brethren. Moreover, the passengers in the back of these aircraft were often quite affluent and when liability actions were brought, these cases often went to the policy limit. In addition to the aviation disasters that spring to all of our minds, other factors are at work.

The same reinsurer cited catastrophic losses outside aviation as a cause for the market change. Insurers and reinsurers participate in a tremendously wide area of operations, in part because they need to diversify to protect themselves from a specific disaster.

The hurricanes of 2017 caused property and casualty insurers and reinsurers to face the fact that they could no longer subsidize the underperforming aviation segment of their business in the face of these losses. The California wildfires of this year will probably aggravate the situation. The parent companies of many aviation underwriters and their reinsurers will all be affected.

All of these factors have led aviation insurance underwriters to get serious about bringing their rates and loss ratios back to what are described as profitable levels. Most of these changes will show up in the arena for turbine-powered airplanes.

Owners of piston aircraft may see smaller increases at their renewals, at least so far. Corporate operators, the sacred cows of the business owing to their excellent equipment, training and safety records, are seeing what are described as moderate increases.

Underwriters of corporate airplanes are looking for varying percentages, depending among other things upon whether or not they have had recent claims. Just when the hard market began is the subject

of some debate. Several insurers told us that they had started trying to increase their premiums as much as two years ago, but most people felt that the full-fledged hard market started between three and six months ago.

TARGETING TURBINES

Piston owners may not be seeing significant increases immediately, but underwriters are looking carefully at what has cost them the most money in recent years. One underwriter told us that his company was considering no longer writing piston twins built before 1985 as new business. Another was looking at cutting back the liability limits he would offer on cabin-class twins.

Two told us that they had been raising their rates across the board for more than a year. We also heard from a couple that they were reviewing school requirements with an eye toward making recurrent training at a formal school mandatory for more types of airplanes. Older pilots and unusual aircraft types may come under scrutiny.

The real action is happening to the turbine owner-pilots who are faced with increases from 10 percent to as high as 30 percent. Those who have had recent claims may see a higher rate still, even if the claim was not an at-fault one. The increases that insurers are asking for from corporate operators tend to be lower, between 5 percent and 15 percent, but it is telling that they have gone from slight reductions a year ago to slight increases this year.

Another odd feature of this new cycle is the spectacle of insurers who would rather sell less of their product than more—or not even sell their product in some cases. Price hikes are not news. But not being able to find the aviation insurance product that you feel you need, and that you had last year—that is new. This is especially interesting, following hard on the heels of the excesses of the soft market with its seductive limits and low premiums. And it is happening in the midst of a market with plenty of capacity.

We spoke to several underwriters who were trying to cut down their exposure to owner-flown airplanes with values above $5,000,000 and limits of liability higher than $5,000,000. This does not seem to be a universal rule, but it does look like where many insurers are headed.

Owners of more expensive airplanes or owners who feel they need more liability protection may be forced to consider a quota share placement. A quota share or vertical placement involves several insurers who each take a percentage of any claim. One underwriter acts as the "lead" and issues the policy, handles claims and takes care of other day-to-day servicing. In this way, each insurer is only on the hook for its percentage of a claim.

This allows them to insure larger numbers of smaller units, and to make their results more predictable. This technique has been used for years to insure airline and aerospace manufacturers. A growing number of high-value owner-flown airplanes are becoming insured this way. In some cases, owners who feel that they need more liability coverage than their carrier is willing to provide them can purchase excess liability insurance. Excess liability is simply an additional layer of liability above what's provided on the aircraft policy. The liability coverage on the airplane typically responds first, and the excess liability is only tapped if the aircraft liability coverage is exhausted.

LOOKING AHEAD

When we asked aviation insurance industry people what they felt the future held, we got a wide variety of responses. Most people thought that rates would return to higher levels, perhaps 80 percent of what they had been at the beginning of the soft market. Some felt that the market would continue to harden for a year or two, but would level off as soon as underwriters were back out of the red. One person felt that because of the continued large amount of capacity still available in both the insurance and reinsurance markets, there was unlikely to be drastic change.

Our view is that rates will increase to the point where underwriters will no longer be reluctant to underwrite, and may stall there. The super-high limits and hull values that could easily be insured two years ago may continue to be elusive or to require special handling such as vertical placements. We also think that pricing on aircraft that are perceived by underwriters as low risk may start to go down again. Given the number of insurers in the market, the amount of capital available to them and the continued lack of other investment opportunities legally available to insurers and the carriers that own them, we have trouble visualizing a monolithic hard market.

In view of all this uncertainty, our advice to buyers of aviation insurance is unchanged. The old rules still apply. The object is to make yourself an attractive risk, more than ever. Fly regularly and stay current. Underwriters don't have much of a picture of you, but are likely to put their bet on the pilot who flies regularly.

Train every year. If you are in a turbine you probably are required to do this anyway. If you are in a piston-powered airplane, do a WINGS phase, or an owner's group refresher. It paints a picture of you as a safe, careful pilot. Unless there is a compelling reason to change insurers, stay with the insurance company you are with now. Underwriters do value relationships, and you will suffer less in a rising market with your current carrier than with anyone else.

We didn't say don't shop! We are huge believers in shopping and if the situation is right, changing companies makes sense. In a market like this, where the providers would rather sell less of their product instead of more, changing carriers may well be a self-inflicted wound. Give your insurance provider time to get you the best deal, especially if you are flying a high-valued turbine, making a transition or carrying high limits of liability.

Bear in mind that this year, that may take much longer than it did last year. When that annoying form comes in the mail, fill it out and send it back in. If your broker has more time, he or she can do a better job for you. Give them the tools to get you the best renewal available.

And if you are considering stepping up, make sure you have looked into the insurance implications before you commit yourself.

Contributor Jon Doolittle is Aviation Consumer's longtime aviation insurance expert and a broker at Sutton James, an Optisure Risk Partner, based at Hartford Brainard Airport in Connecticut.

Exhaust Systems: Keeping Them Healthy

Exhaust systems do their job in a world of heat, stress and vibration. Inspect them regularly and carefully—failure can be catastrophic.

by Rick Durden

As aircraft owners and pilots, we seem to pay far more attention to the middle portion of our powerplants—where reciprocation takes place—than to the area where the products of that reciprocation exit. It seems to be worthy of only a passing glance on preflight with, at best, a tug on the exhaust pipe to see if it's still more or less attached.

The discharge portion of a powerplant has a pretty nasty job and lives in an environment that may well be the definition of harsh. I think the FAA's description in its *Airframe and Powerplant Mechanics Powerplant Handbook* understates things: ". . . a scavenging system that collects and disposes of the high-temperature, noxious gasses as they are discharged by the engine." The reality is that those pipes bolted onto the engine eat flame, endure corrosive gasses that attack their very structure amidst intense vibration and are charged with safely channeling all of that heat and excitement to a point outside of the aircraft where they can do no harm to the trusting occupants of the cabin.

Because of the nature of the exhaust-world beast, the components of the system are going to wear out. As owners and operators, our concern is to detect the degree of wear before it becomes dangerous and take appropriate action.

Dangerous is any condition that allows products of combustion—the hot stuff containing gases that, when inhaled, will incapacitate or kill humans—to leave the exhaust system anywhere but at the end of the tailpipe.

These pipes are from the exhaust system of a Cessna 150—not exactly a high-powered airplane—yet they blew out because cracks were not detected during routine maintenance.

I'll outline ways that you and your maintenance technician can identify exhaust system wear before it becomes dangerous and what your options are when the system tells you that it's reached the end of its useful life.

HOW LONG?

Scott Utz, principal of Arapahoe Aero on Denver's Centennial Airport, said that he does not expect an exhaust system to last to engine TBO, especially on a turbocharged engine. In addition, how a pilot operates the engine affects the life of the exhaust system—the more heat, the faster the wear, another good argument for running the engine lean of peak if possible.

Exhaust systems are made of either stainless steel or the nickel-chromium alloy Inconel. The systems wear from the inside out. Unfortunately, there is not an easy or economical way to measure component thickness in your local shop. As a result, inspecting for condition means there is usually nothing to be found until wear has gotten severe enough that the component has failed, and must either be overhauled or replaced.

Mike Busch, proprietor of Savvy Aircraft Maintenance Management, which manages several hundred piston-engine airplanes, said that his company most often sees exhaust systems initially develop problems on the outside radius of bends in the system. That was echoed by Darryl Johnson, a maintenance tech at Northern Air in Bonners Ferry, Idaho, who also said that an owner who is looking over his or her airplane should look for cracks near bends as well as welds (a weld often weakens the metal adjacent to it), bulges in the exhaust pipes and for discoloration of the metal, particularly the colors green, blue or orange.

RACING TECHNOLOGY: MORE POWER VIA TUNED EXHAUST

We are aware of two well-established companies that claim that replacing your factory exhaust system with theirs will allow your engine to generate more power, increasing climb and cruise performance: Power Flow Systems and Leading Edge Exhaust Systems. As I was preparing this article I was saddened to learn that the founder of Leading Edge Exhaust, Dane Wagner, recently passed away and that the company's business activity is on hold. I was unable to get a prediction as to when or if it will resume business. Following the discussion of Power Flow, below, I'll give a brief rundown of the products Leading Edge offered in the past and may again produce.

• Power Flow Systems

Speed mod guru Robin Thomas started Power Flow Systems (www.powerflowsystems.com) with the intent of using racing technology to design "tuned" exhaust systems for aircraft. The concept involves reducing pressure at each cylinder's exhaust port just before it closes to maximize scavenging efficiency and allow the largest slug of a cool fuel/air mixture to then enter and be combusted.

More fuel and air per cycle means more power. To accomplish this, Power Flow customizes the exhaust tube for each cylinder so its length—from cylinder to the collector where the tubes join—causes the low pressure traveling down the tube behind an "exhaust puff" to reach the collector in time to suck out the exhaust from the next cylinder to fire. The installation on a Cessna 172 is shown in the top photo.

Depending on the type of airplane, Power Flow claims measurable power increases with its exhaust system—23.8 HP on a 160-HP Lycoming O-320-A1A engine in a Cessna 172. The power increase translates into an increased rate of climb and cruise speed. It also means greater fuel consumption—as is expected with more power. However, as Power Flow points out, if the pilot reduces power to cruise at the same speed as before the mod, fuel consumption decreases. Depending on the installation, the fuel saving is from one to three GPH. However, none of the owners I spoke with pulled the power back; they took advantage of the speed increase.

Power Flow offers a 60-day trial period for its system—if you don't like it in that time, return for a full refund. David Parker, proprietor of Northern Air in Bonners Ferry, Idaho, told me that he has never had a customer decide to remove a Power Flow exhaust his company installed and said that he observed the systems to last at least to engine TBO, much longer than factory systems. Beyond 60 days, the warranty is one year or 500 hours of operation.

Full disclosure—I instruct at Northern Air. It has two 160-HP Cessna 172s. One has a Power Flow exhaust system. It has a noticeably better rate of climb than the stock 172 and is the one the FBO usually uses for its mountain flying checkouts due to its increased performance.

Power Flow exhausts are available for a wide variety of four-cylinder engine singles as well as the IO-530 powered Bonanzas.

Prices for the systems vary by airplane and options—and there are discounts if you are willing to wait a few weeks or months for your system—but figure on $4000 to $5500 and five to 10 hours for the installation.

• Leading Edge Exhaust Systems

In 1995, after 10 years of running a company that did exhaust system repairs, the late Dane Wagner opened Leading Edge Exhaust Systems (LEES), in Anchorage, Alaska, to build aircraft exhaust systems that were of higher quality and more robust than OEM equipment and that would allow the engine to develop more power. Having experience with the needs of the Alaska bush operators, he targeted their airplanes of choice, the Cessna 180, 182, 185 and 200 series and the Piper PA-12, 18 and 20/22. The system installed on a Cessna 182 is shown in the bottom photo.

Leading Edge stated that customers can expect to see a horsepower gain of approximately 10 percent using its pipes with a reduced brake specific fuel consumption (BSFC) and increased torque. It offered the best warranty I have ever seen for exhaust systems. My condolences to the Wagner family. For aircraft owners looking for increased performance and a more robust exhaust system, it is my hope that LEES products will again be available.

Not surprisingly, normal wear causes the components to become thinner so normal vibration will eventually cause the metal to crack, bulge or blow out. If an internal component breaks off, there is a chance it can lodge where it restricts exhaust gas flow. That increases back pressure on the engine, so the cylinders are less able to scavenge exhaust gases, which reduces power output. The power loss can be so great that the aircraft can't hold altitude or the engine simply quits.

David Parker, proprietor of

AN EXHAUST SYSTEM'S STEALTH KILLER: CARBON MONOXIDE

Here's the deal: carbon monoxide gas is odorless and colorless—and the manner in which it attacks a human means it is one of the most calculating serial killers in aviation. Once in your lungs it combines with the hemoglobin in your red blood cells to form carboxyhemoglobin (COHb) with a bond that is 200 times stronger than oxygen's bond on hemoglobin. CO enters your system and takes over. It puts your hemoglobin out of commission and then suffocates you—it deprives your body of oxygen. The hyperstrong COHb bond means that even tiny concentrations of CO can kill you through slow poisoning during a flight of just a few hours.

The oxygen-deprivation function of CO poisoning makes it deadly because it attacks the most important parts of your body first—brain, nervous system, heart and lungs.

That's why a number of CO-caused aircraft crashes are preceded by witness statements or radar tracks that describe an airplane wandering aimlessly through the sky or a pilot who does not respond to ATC calls to point him at an airport or instrument approach.

To make matters worse, the deadly effects of CO exposure in an airplane are exacerbated by altitude.

I've done the research to prepare the accident section of the Used Aircraft Guide in every issue of *Aviation Consumer* for the last 10 years. The accident reports I've read have caused me to form the opinion that the risk of an accident due to CO poisoning is higher than that of a midair collision. In addition to the fatal accidents where the postmortem exam of the pilot turns up CO poisoning, there are enough oddball loss of control accidents—especially on landing—where the pilot survives and is never tested for CO exposure to have caused me to form the opinion that those pilots were partially incapacitated by CO.

In 2017 the NTSB published a Safety Alert expressing its concern about pilot incapacitation due to CO and a recommendation that pilots should have a CO detector in their airplanes.

We pay good money for devices that will warn of a risk of a midair. Good-quality CO detectors cost less. Low levels are dangerous because the body doesn't shed the toxin rapidly, so the effects multiply. The device has to have an effective warning system—a warning that doesn't get your attention is worthless. You've got to know of a risk to act on it.

Aviation Consumer reviewed CO detectors in the October 2016 issue. One thing that was noted is that household detectors do not alert at low levels of CO and most have a time delay before the alert triggers. That disqualifies them for aviation use.

I've flown with three of the detectors reviewed in the article and recommend all of them because they work well, have a loud alarm and detect very low levels of CO. Here's a quick rundown:

The Tocsin OI-315 CO Monitor by Otis Instruments (top) is available for $169.95 at www.sportys.com. It alarms at 35 PPM, with a flashing LED light, 90 dB Piezo horn and the thing vibrates.

The CO Experts ULTRA (middle) is the most sophisticated of the portable units I've found. It's available for $199 fromw ww.aeromedix.com. The first alert is at 7 PPM. The type of alert changes as the concentration level rises. It has a memory feature that can be helpful to medical personnel to show the history of exposure.

The Pocket CO 300 (bottom) is priced at $131.95 from www.aircraftspruce.com. It is a keychain CO detector. It doesn't alarm until 50 PPM—a little high, in my opinion—setting off an 82-dB warning, LED light and vibration with increasing frequency at thresholds of 125 and 400 PPM. It has a replaceable coin cell battery.

I suggest that you stay away from the chemical spot detectors. To start with, you have to have keep it in your panel scan to see if it is giving you a warning. Worse, each type has a life limit—but pilots seem to stick them on the panel and leave them forever. Beyond that, for the ones that turn "dark," what is "dark"? How do you tell "dark" when you're flying at night?

The risk is real. The prices are right.

Northern Air told me that a part of every annual and 100-hour inspection his company does includes pressurizing the exhaust system of the airplane with a vacuum cleaner and swabbing the components with soapy water to look for evidence of leaks. It takes maybe 15 minutes and is likely to expose cracks that get overlooked during visual inspection and tapping components with a punch. I came away from the research I did for this article strongly of the opinion that a vacuum cleaner and soapy water exam of the exhaust system should be a part of every annual and 100-hour inspection.

If you see signs of discoloration, cracking or bulging of the exhaust system during your preflight or if

Discoloration on this exhaust pipe led to further examination that disclosed cracking, above right. The cone in this muffler, below right, is an example of one in good shape—clean, with no wrinkles or bulges.

your maintenance technician calls you up and tells you there's an issue with your exhaust system, every source I've found says that you've got a safety of flight issue that needs to be repaired before the next flight.

NOW WHAT?

It's happened. You've got a crack, bulge or blowout somewhere in your exhaust system. What is your next step?

A field repair by welding is possible. In my conversations with A&Ps in preparing this article, I found that few were willing to weld exhaust systems. The reasons included varying degrees of difficulty; that welding may only briefly delay the inevitable; that welding usually reduces the strength of the adjacent metal and may cause it to crack; and that there are very good specialized shops that have the equipment to evaluate exhaust system components and make a more informed decision regarding repair, overhaul or replace. None of the mechanics I spoke with was willing to make weld repairs on a turbocharged engine's exhaust system. They also pointed out that such repairs are prohibited on a number of turbocharged engine exhaust systems—notably 300- and 400-series Cessnas, with a history of catastrophic accidents traced to weld repairs on exhaust systems.

Most of the technicians I spoke with were willing to replace individual exhaust system components with new or overhauled parts but said that there are times that there can be challenges with alignment, which can cause other parts to crack.

A high percentage of the shops I spoke with said that when they get into an exhaust system that shows signs of distress their practice is to pull it and send it to a specialized shop asking that it "evaluate and advise." The big dogs in the field are Knisley Welding Inc., Aerospace Welding Minneapolis (AWI), Heliarc Welding Service Inc. (turbocharged Cessnas) and Acorn Welding (Canada). Not a single tech we spoke with had a negative comment about any of the specialized shops and a few expressed a high level of satisfaction with the speed of service they'd experienced. However, all said to call the shop before shipping to make sure the shop has needed parts on hand if repairs prove to be impossible.

The specialty shops can do repairs and generally also offer new and overhauled components and systems. "Overhauled" means that some portion of the original component was reused. In some cases the specialty shops have received FAA approval for modifications to original equipment systems that increase expected life or reduce heat on engine accessories by rerouting the system.

System costs vary based on number of cylinders, complexity of the system and whether you buy new or overhauled. In discussions with various shops, I heard prices starting as low as $2000 and ranging up to $6000.

CONCLUSION

Internal combustion engines have meant great things for aviation. However, the stuff that comes out of the exhaust can bring a flight to grief in a staggeringly short time if it is not managed appropriately.

Eyeballing the system during each preflight and careful examination—including pressurizing it and swabbing it with soapy water to check for leaks—during scheduled maintenance, and repairing or replacing worn components, are keys to keeping it healthy.

Globalstar Sat-Fi2: Good Ergos, Pricey Data

With a form factor that's cabin-friendly and a performance boost from the first-gen device, the $499 Sat-Fi2 portable satcom brings good utility.

by Phil Lightstone

When we evaluated Globalstar's first-gen Sat-Fi cabin satcom device in the December 2014 *Aviation Consumer* we were underwhelmed with its performance and form factor. But the latest-gen Sat-Fi2 is worlds ahead.

It needs to be because there is solid competition from Garmin's inReach line of portable satcoms. There's also the BendixKing AeroWave portable. With voice communications, Wi-Fi, an SOS function and hardware that's cockpit-friendly, we think the Sat-Fi2 is a credible contender in the price-sensitive portable satcom market. Here's a look.

THE NETWORK

Globalstar's LEO (low earth orbit) constellation forms a network with 24 ground stations that serve as a bridge to traditional terrestrial telecommunications networks on six continents, providing communications to over 120 countries. The current-generation LEO satellite constellation delivers low-speed bandwidth (72 Kbps), not dissimilar to fast dialup modems—good for voice calls, text messages, short emails and textual websites. Don't plan on downloading videos and other big files. That level of performance is best left to the more expensive geostationary satellite-based terrestrial broadband networks.

Still, the next generation of LEO com satellites promise to deliver connectivity upward of 1 Mbps, performance we're still waiting on. Worth mentioning is Globalstar was an early market player with reasonably affordable bandwidth. The SPOT Connect and SPOTx communicator use LEO satellites to deliver short messages through texting, email, Twitter and Facebook.

The Globalstar Sat-Fi2, shown center of page, has minimal user controls, a built-in antenna and a chassis that's built to withstand harsh cabin abuse. Since it doesn't have a display or keyboard, think of it as a portable modem.

Globalstar SPOT products transmit more than 1.3 billion messages a year, while connecting devices in locations beyond cellular coverage. According to the company there have been more than 6100 rescues initiated worldwide using SPOT satcom products.

Globalstar's end-to-end service comprises the Sat-Fi2 hotspot hardware, the Sat-Fi application installed on tablets, smartphones or laptops, a firmware download application, the My Account website and a satellite airtime subscription. The Sat-Fi2 device is assigned a 10-digit telephone number and through the Sat-Fi application is able to deliver satellite telephone services (including voicemail) to a smartphone, tablet or laptop.

BETTER HARDWARE

The Sat-Fi2 is a small device that can stash easily in a flight bag or a big map pocket or be temporarily placed up on the glareshield. The device weighs 12.6 ounces and measures 2.9 by 1.5 by 5.8 inches and has an integral flip-up satellite/Wi-Fi antenna. The device has a built-in lithium polymer battery, which delivers up to two hours of talk time and 28 hours when in standby. A Micro-USB port is used to both charge the battery and update the device's firmware.

The Sat-Fi2 is dust- and water-resistant and can withstand a high force of shock with an operating temperature as low as 4 degrees and as high as 95 degrees F. It operates as high as 21,320 feet MSL. Two additional hardware ports provide connectivity to an external satellite antenna (non-aviation) and DC power.

Ship's power can be delivered through a USB cigarette lighter adapter or a panel-mounted (and TSO'd) USB charging port, which connects to the device's Micro-USB port. While powered on, the Sat-Fi2 will draw power from the battery while it's being charged. The external power port will accommodate a 10- to 48-volt power source—either

an auxiliary power adapter or hard-wired into aircraft's electrical using fuse protection. When powered by the external power port, the internal battery is not charged. With an onboard battery, power is natively backed up (think uninterrupted power supply) when powered from the external power port.

To charge the device, connect the supplied Micro-USB data/power cable to the Sat-Fi2 USB port and plug it into a computer or the supplied AC power adapter. The Sat-Fi2 will perform a self test by flashing the status LEDs in a right-to-left then left-to-right sequence. If the power LED is blinking red, the battery requires further charging. Let the device charge until the power LED turns green. After charging, the USB data/power port cover needs to be properly installed (turn the D-ring screws clockwise) to ensure the device's water resistance. The internal battery is not field replaceable.

Similar to a GPS receiver, the Sat-Fi2 requires an unobstructed view of the sky. For our trial we flew with the Sat-Fi2 in both a Commander 114 and Cessna 172, placing it on the glareshield of the aircraft, and the device was able to connect to the LEO satellites. The antenna needs to be fully extended and pointed straight for best reception.

In 2016, Globalstar released a TSO-certified satellite antenna for Part 23 non-pressurized aircraft. While this antenna supports the Globalstar first-generation Sat-Fi product, it doesn't work with the Sat-Fi2. Globalstar is working on a docking station for the latest Sat-Fi2, which should be available in the second part of 2019. The Sat-Fi2 antenna/power module is removable, allowing the electronics pod to be attached to the docking station, which will provide hard-wired connections to both ship's power and an external satellite antenna, and will be equipped with a storage area for the antenna/power module.

The Sat-Fi2 has smart styling, including a chassis that's easy to move around the cabin. The image at the bottom is the unit contouring the glareshield of our Rockwell Commander test bed.

CHECKLIST

- ➕ Sized right for portability, inside and outside of the cockpit.
- ➕ It keeps crew and passengers connected with the ground when cellular coverage doesn't.
- ~ But you'll pay a premium for data charges, while performance doesn't touch terrestrial Wi-Fi.

WI-FI AND FIREWALL

The Sat-Fi2's built-in Wi-Fi access point will allow up to eight personal smart devices to connect and share access to the satellite network, creating a private network in the aircraft. The Wi-Fi radio operates on 2.4 GHz (2400 to 2500 MHz). During the initial setup, the Wi-Fi SSID (network name) and WPA2 password get configured.

Here's a tip: Document the SSID and password in order to easily connect guest users to the device without fuss. This will allow an appropriate security posture to ensure that user devices attached to the private network or access to the LEO satellite network are not compromised. In ideal conditions, the Wi-Fi range is roughly 100 feet—obviously sufficient in most all cabins.

With security front and center in the world of cabin Wi-Fi, the Sat-Fi2 has a built-in firewall to control both traffic and allow (or block) access to all or specific web servers. Consider that the majority of corporate IT departments will provide guidance in order to provide alignment to your company's acceptable internet use guidelines. The firewall allows domain names, IP addresses or port numbers to be controlled. This provides a reason-

The Sat-Fi2 performed well in both a low-wing and a high-wing aircraft using the standard flip-style antenna, but a docking station with connection to an external antenna is in the works.

able security posture when properly configured. Configuration changes to the firewall can be made through the Globalstar Sat-Fi app when attached with the owner account and through the My Account utility on the website.

The Sat-Fi2's main application, called Sat-Fi, creates a walled garden that allows access to the internet, email and SMS texting only through the Sat-Fi app. To control bandwidth costs, applications native to your tablet, smartphone and laptop computer will not have access to the internet. Smartphones and tablets—Apple iOS devices in particular—are inherently network chatty. As an example, background applications such as Apple Photos will upload photos and videos to iCloud in order to facilitate photostream sharing to other Apple iOS devices, while applications such as Facebook, Twitter and LinkedIn are graphically heavy.

With access to the open internet, bandwidth utilization and cost could be quite heavy if these applications were provided with native access. Globalstar eliminates the added overhead of these application background updates and synchronization (to the cloud) by using this walled garden approach. This approach to containing application access to the internet (and network traffic) allows the use of a smart device without making any configuration changes. This is ideal when transitioning from the aircraft to an FBO, to an office and home, allowing the device to switch between LTE and terrestrial Wi-Fi networks.

There are two types of user accounts: owner account—the actual owner of the device, which has administrator access—and a guest user account. Both account types are able to make voice calls, send and receive text messages, access email, make social media posts to Twitter and view local weather. The owner account has administrative privileges, which includes the ability to change the Wi-Fi password, delete messages in the queue and have access to the My Account utility. The Sat-Fi application allows the user to select the type of login, either administrator or guest.

VOICE CALLING

The Sat-Fi2 device is assigned a 10-digit telephone number aligning to the country in which it was registered. As an example, with a U.S. telephone number a user is able to call another U.S. telephone number without incurring long-distance charges. The duration of the telephone call will be deducted from the pool of minutes included in the service plan. The physical location of the Sat-Fi2 device does not matter during the telephone call. However, with a U.S. telephone number calling an international telephone number, long-distance rates will apply.

To use the satellite telephone services, simply launch the Sat-Fi app on your smart device or computer, log in to the app, select Telephone and enter the telephone number you wish to call. Include the country code and area code (1-416-555-1212, for example).

The call experience will be similar to a cellular telephone call. With the LEO satellites in orbit at 485 miles, the IP latency will be high. Globalstar uses G.711 voice compression to minimize the amount of bandwidth required to support the telephone call and deal with high IP latency. Inbound callers are able to call you by simply dialing your telephone number from a mobile telephone or landline. If the Sat-Fi app is not running or you choose to ignore the call, the phone call will be directed to voicemail. You are able retrieve voicemails through either utilizing the Sat-Fi app or using a landline or mobile telephone. We found the Sat-Fi2's voice quality to be similar to a decent cellular phone.

SOS AND SAT BROWSER

Like Globalstar's SPOTx and SPOT Gen 3 satellite communicators, the Sat-Fi2 provides SOS notification to a 24/7 emergency notification center. An SOS message may be initiated either directly on the Sat-Fi2 device or from the SOS option on the Sat-Fi application.

Once an SOS is initiated, the Sat-Fi2 will continuously send your GPS position every five minutes until the SOS is canceled or the device is powered off. While SOS is active, the Sat-Fi2 should remain outside where it has a 360-degree clear view of the sky with no obstructions in order to maintain network connectivity. Of course, the SOS mode should only be used during life-threatening emergencies. Sending bogus SOS messages may subject you to additional charges.

The rescue begins by pressing the SOS button, which is behind a protective cover that's prominently marked (the button must be pressed for three seconds), or through the SOS icon on the app's main screen.

GLOBALSTAR SAT-FI2 AT A GLANCE

* Dimensions: 2.9 by 1.5 by 5.8 inches

Once activated, the SOS icon will be displayed on the status bar and the SOS notification message will be sent every 2.5 minutes until it is acknowledged. SOS may be canceled one of two ways: Press the SOS hard button for three seconds or select Cancel SOS from the SOS screen within 10 seconds of activating the SOS. The SOS notification to the authorities will not be canceled if the device is powered off or if the Sat-Fi app is turned off.

The Sat-Fi2 sends a notification with the device's GPS coordinates to the GEOS worldwide monitoring center (www.geosworldwide.com). GEOS provides SOS monitoring and emergency dispatch through its dedicated International Emergency Response Coordination Center (IERCC) based in Houston, Texas. The IERCC is staffed 24/7 with trained personnel who have access to first responders. The average response time from the receipt of your SOS message until referring an emergency responder is 11 minutes. In countries where search and rescue (SAR) services are provided on a fee-for-service basis, you can upgrade to the GEOS member benefit for reimbursement of up to $100,000 in SAR expenses at an annual cost of $24.99.

Once an SOS message has been received, the IERCC calls your emergency contact(s) to determine if it is a false alarm. It locates and notifies an emergency responder and then maintains an open line of communication, including providing updates of your location. The IERCC will also keep your emergency contact(s) informed. SAR leaders believe that when stranded in the remote regions, two-way communications contribute to a positive state of mind, which improves survival outcomes. We agree.

The Sat-Fi2, through the application, will put your smart device into SOS mode. At the bottom of the SOS screen, a message box is displayed allowing you to type real-time messages to IERCC emergency responders.

CONTACT

Globalstar
877-452-5782
www.globalstar.com

SERVICE PLAN RATES

As with other Globalstar products, service plans can be paid annually or monthly. Globalstar does not offer a discount for prepaying the annual plans. The plans are differentiated based upon the number of voice minutes, text messages and data (MB) that's used in a month. Unused airtime cannot be rolled over to the next month. Monthly service plans range from $39.99 to $199.99 per month, including between 40 to 500 voice minutes, 5 to 75 MB of data and between 25 to 500 SMS text messages. Additional voice time is $0.99 per minute. If there is more than one Sat-Fi2 on the same account, the minutes are pooled.

OUR WISH LIST

Overall, the new Sat-Fi2 is a big improvement over the first-gen device.

After using Sat-Fi2 and collaborating with Globalstar product management folks, we recommended a few product enhancements that hopefully can be added to the product roadmap.

This includes hidden SSIDs, the ability to drop virtual breadcrumbs (like you can with the SPOT product), compatibility with an external TSO'd satellite antenna (something the company already has in hand), extending a Yippy web browser to aviation applications for weather data, plus including EFBs into the walled garden ecosystem, allowing those EFB applications to benefit from satellite connectivity.

Saying all that, we think the Sat-Fi2 can offer sizable utility for flying outside of cellular coverage, and when flying in remote locations. The obvious benefit with any satcom device is you can use it both in and out of the aircraft.

On flying trips to the Bahamas, for example, we have found cellular services to be nonexistent outside of Nassau and Freeport. Products like the Sat-Fi2 fill that gap. For the busy executive, IP connectivity allows the office umbilical cord to stay connected.

Like SPOT3 and SPOTx, the website updater application, the account activation process and the Sat-Fi application are easy and intuitive to use.

Despite high-priced data charges and aging satellite infrastructure, the portable satcom transceiver market has become competitive and crowded. If you want a portable unit with a keyboard for texting, the Globalstar Sat-Fi2 won't do it—you'll need to execute this from a smartphone or tablet.

But for on-the-fly ubiquitous access to instant messaging, emails, voice calling and websites that can be delivered whether on the ground, at an airport or at 18,000 feet, it's one reliable way of maintaining the cyber umbilical cord, with some limitations. At $499, we think the Globalstar Sat-Fi2 hardware is reasonably priced and performs well enough to do just that.

Contributor Phil Lightstone is a longtime IT and telecommunications professional, aviation writer and an active pilot.

AEROMEDICAL REVIEW

Mayo Clinic Medicals: Preventive Focus

Medical certification at the Mayo Clinic's Division of Aerospace Medicine is more about maintaining a pilot's health for the long term.

by Larry Anglisano

The well-respected Mayo Clinic has a rich heritage in aviation that dates back to the 1930s. Today, the Mayo Clinic's Aerospace Medicine program puts a sharp focus on routine FAA medical certification, but perhaps to a much higher level than you'd find in the office of your local AME.

The Mayo Clinic's comprehensive set of medical services for both professional and recreational pilots focuses more on preventive medicine—or keeping pilots healthy for continued long-term certification—while also working closely with the FAA so pilots with medical certification issues don't get snagged in FAA special issuance bureaucracy. Here's an overview of two programs focused on doing just that.

MANY FIRSTS

The Mayo Clinic has roots deeply planted in aviation dating back to World War II, through its Department of Physiology. This includes extensive research in aerospace medicine, and it can be credited for inventions to include the aviator's oxygen mask, the G-suit, the oxygen bail-out bottle and the M1 maneuver. Fighter pilots used this maneuver to maintain consciousness when subjected to G-forces.

The original lab and its founders developed the pulse oximeter, plus the Mayo Clinic housed the first hyperbaric high-altitude chamber. More recently, the clinic was used by Boeing for testing the oxygen mask system in the 787 airliner.

The clinic has campuses in Minnesota, Florida and Arizona, but much of the Aerospace Medicine program is at the Minnesota campus.

As for its history with pilot medical certification, the Mayo Clinic has been home to the nation's first flight examiner, designated by the Civil Aeronautics Board in the 1930s. It says its staff of flight physicians are experts in working with the FAA on behalf of the patient.

Dr. Clayton Cowl, chair of the Preventive, Occupational and Aerospace Medicine division, told us the department sees roughly 1800 patients per year, some with the most complex medical certification cases that you can imagine. According to Cowl, in all but a dozen or so cases spread out over 20 years the clinic was able to return those pilots to the flight line. As for the patients that the clinic couldn't get certified, they simply shouldn't be flying anyway, Cowl told us.

Dr. Cowl also reiterated that the Mayo Clinic has been extremely focused on changing the old paradigm of "what the certifying agency doesn't know won't hurt them." Of course, this mentality can seriously jeopardize a pilot's flying career. "This situation has really come into focus now that we're in an environment that already has a significant pilot shortage," he said.

Cowl makes a good point that's worth remembering, whether you go to the Mayo Clinic or your own AME for certification. As pilots, we almost always focus on the "what ifs" of losing a medical certificate to health problems, but to the clinic, it's more about the pilot getting the proper, regular screening in the first place. Think in terms of these folks being your health provider, equipped to facilitate modern screening procedures.

Is screening beyond what the FAA

Some historical photos from the Mayo Clinic worth showing: That's Charles Lindbergh working with the clinic during World War II on high-altitude research and the development of the G-suit, top, and oxygen masks in use in a Northwest Airlines DC3A passenger cabin, bottom.

requires necessary? We think so, and so does the Mayo Clinic. It's a common-sense mentality that we all have the opportunity to diagnose colon cancer early, rather than later. The same can be said for prostate cancer and a potential heart attack before it happens and a long list of other stuff that's part of aging.

"Why are pilots willing to spend thousands of dollars on training and cockpit gadgets, but the most important part of the aircraft—the pilot—often gets short-changed from a medical upkeep standpoint?" Cowl said. His other point is that taking a preventive approach to certification can make the process so much easier, with better, correct documentation that could mean less risk of losing a medical in the first place. If you've dealt with it, you know where the problem solving begins—which is often navigating the system on your own.

PROPILOT

That's what the Mayo Clinic calls the preventive medicine path it has in place for maintaining a medical and it really caters to professional pilots, although any pilot might benefit, particularly one who doesn't need to renew the medical yet, but has been diagnosed with a potentially disqualifying condition. The clinic's ProPilot program was designed for two things. First, as a means for professional pilots to get regular medical certification with the least amount of trouble, although that's not without some effort and additional expense because you'll have to visit a Mayo Clinic campus to get it done. More on that in a minute.

The second thing, and perhaps most important, is if you do show up with a medical certification problem, the clinic says it has an inside working relationship and a direct, open line of communication with the FAA to solve the issue quickly. Worth mentioning is that there is obviously a trust factor that needs to be established between the pilot and Mayo Clinic. As a result, the division performs what it refers to as confidential evaluations, where medical conditions are addressed in a confidential and safe environment, whether a pilot has specific health concerns or even wants a potentially career-ending condition evaluated without getting the FAA involved yet.

Regardless the level of medical certification a pilot intends to achieve, the Mayo Clinic looks at the bigger picture for every applicant who walks in the door. "We want them to have a long and healthy retirement. If they're flying for pay, we want pilots to retire on their terms. We do everything we can to prevent problems before they occur," Cowl said. He attests that inflight medical emergencies (for flight crews) are extremely rare, no matter what kind of aircraft you fly. However, the consequences for a professional flight department or even a recreational owner-pilot who has a lot of money invested in an aircraft can be huge. Moreover, Cowl said the trend has been for blue-chip companies with large flight departments to

send pilots to the clinic simply for its preventive approach to certification.

MORE THAN A CERTIFICATE

It's clear that airman medical certification at the Mayo Clinic goes beyond the FAA's requirements and you might expect additional screening you'd likely never get during a routine visit to your local AME. For private pilots (or those not flying for a professional flight department) the process for certification is pretty much the same as it is for the pros, although there is no one size that fits all. Dr. Cowl reinforced, as you'd expect, that the majority of younger pilots under the age of 40 simply don't require the same clinical focus as those over 50 or 60. But it's never too early to begin the preventive approach.

When a pilot shows up for a baseline visit, the clinic documents an extensive family health history and the pilot's medical history, but not, according to Cowl, from a standpoint of finding something that might ground the pilot. Instead it's used as a basis for directing the preventive tests that are the most applicable to that individual.

As an example, if you are under age 40 and sign up for the ProPilot program there is going to be a set of baseline tests that the Mayo Clinic runs. This includes a chest X-ray, which generally won't be required every time you show up. The way the clinic looks at it, if say three years down the road you're on a flying trip and find yourself in an emergency room with a case of pneumonia, it can transmit the on-file report of the baseline chest X-ray for comparing it to the current one.

As another example, if a pilot has a strong family history of coronary disease, the clinic will tailor an appropriate surveillance approach, which might include cardiovascular studies including a stress test on a treadmill, before it becomes a disqualifying issue. It might also include preventive things like taking an aspirin each day, doing a cholesterol profile and treating it if the results raise any flags.

Even if you don't have a family history of colorectal disease, it's widely prescribed to get a baseline colonoscopy at 50 years of age. Dr. Cowl reports that the clinic sees a large number of pilots slightly over age 50 with colorectal polyps. They often aren't cancerous—yet, but they certainly could be full-blown cancerous lesions ten years down the road, for example. Of course, more than one AME told us what we already know and that is you should be getting this routine screening anyway, especially if you are under the care of a competent primary care doc.

On the other hand, we asked Dr. Cowl if, in general, he believes pilots are avoiding routine medical screening in fear of jeopardizing their medical certificate. The answer was yes. "I think there are a lot of pilots who put their head in the sand for fear of the great unknown, as opposed to developing a trusted relationship with an AME willing to take the extra time that's required to expedite the certification process should it become a deferral or special issuance," he told us.

AN INSIDE TRACK

We've dealt with deferred certification and while the outcome ended well, can attest that the process can drag along while the pilot does the majority of the work. And that is where the Mayo Clinic says it has the advantage, taking the role of a pilot advocate who has the inside track to the right people at the FAA, while understanding the correct language that's required when corresponding with the FAA. Dr. Cowl said many (not all) AMEs simply don't want to spend the extra time that they may or may not be reimbursed for to simply pick up the phone and help expedite a pilot's certificate for even the most minor deferrable condition.

The ProPilot program is currently administered at the Mayo Clinic's Rochester, Minnesota, campus, which has six full-time AMEs and a variety of other sub-specialists who are also pilots. We think this under-one-umbrella team approach has advantages because as one unit, all of the testing data and other specifics can be sent to the FAA as one package, rather than the chore of doing it with multiple correspondents.

There are also examiners at the Mayo Clinic's Jacksonville, Florida, and Scottsdale, Arizona, campuses, but they aren't part of ProPilot. Of course traveling to Minnesota for the ProPilot program won't be without sizable effort and expense. For the busy flight department that's counting on keeping its pilots on the flight line, it's an expense that may be worth it. For the typical recreational pilot who doesn't have a medical condition (that they are aware of), perhaps not so much. The costs for ProPilot vary widely depending on testing and how many company pilots are enrolled in the program. Some of the care might be billable through some insurance programs.

CLEAR APPROACH

As we go to press, the Mayo Clinic is rolling out the Clear Approach program. The idea behind Clear Approach is to make some of the things the clinic does with ProPilot accessible to recreational pilots faced with potentially disqualifying conditions. For starters, it's a means of telling your medical story online (electronically) in a confidential manner, and the clinic won't share this so-called confessional-booth discussion with the FAA. In either real time or within a 24-hour period of describing the problem, you'll get a response from the Mayo Clinic with an overview of how the FAA is going to deal with the condition, the testing you'll likely need and should you decide to work with the Mayo Clinic in proceeding with certification, help with setting up an appointment to begin.

"Should the pilot elect to press the big green button, all they need to do is get themselves to the Mayo Clinic and we'll take care of the flight physical, the testing, the subspecialty referrals and other things on the back end," Dr. Cowl said. That initial electronic consultation carries a nominal fee of around $50. Until the volume of pilots in the Clear Approach program becomes adequate enough for the clinic to justify expanding visits to its Florida and Arizona locations, pilots will need to visit the Minnesota campus.

Understanding that Clear Approach is a way for the clinic to channel pilots toward its practice, at the least the clinical portal is a good first step in figuring out a reliable path to certification. We'll follow up on Clear Approach as it matures, but in the interim you can link to the Mayo Clinic's programs at www.mayoclinic.org.

121.5 MHz ELTs: Prohibited By FCC

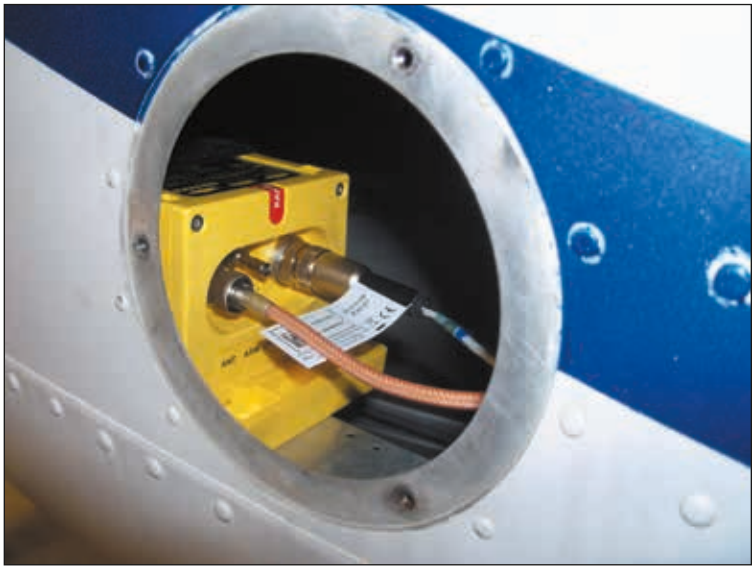
Old 121.5 MHz ELT technology has been dying a slow death and a new ruling by the FCC finally puts the nails in the coffin for sales and certification.

by Larry Anglisano

It was nearly 10 years ago that we advised not to rush to the shop to yank out 121.5 MHz ELT systems in favor of the superior but pricey 406 MHz tech. Still, the handwriting was on the wall: Some day, 121.5 MHz beacons will be extinct and that day is now. As we go to press, the FCC (not the FAA) issued a rule that prohibits the manufacturing, importation, sale and even the certification of 121.5 MHz beacons.

Recall that similar rulemaking was stirring in 2010, but the FCC—at the request of the FAA and AOPA—stayed the amendment. The new FCC ruling lifts the stay prohibiting these old beacons effective Jan. 11, 2019. What does that mean to plenty of aircraft owners who haven't made the switch to 406 MHz models? It's simple: The old 121.5 MHz model can't be certified any more, pretty much rendering it a boat anchor—or better, a wheel chock (after all, they're painted the right colors).

You can still use the beacons, of course, but don't expect much if any support for these old units and that includes replacement batteries and service parts. The FCC's ruling should come as no surprise because the international Cospas-Sarsat search-and-rescue program stopped monitoring the 121.5 MHz frequency in 2009 due to reliability and false alert concerns. Along with other Cospas-Sarsat participants, the National Oceanic and Atmospheric Administration, U.S. Coast Guard, U.S. Air Force and NASA have been advising users to switch to 406 MHz ELT units for nearly a decade.



"The record demonstrates that 121.5 MHz ELTs were clearly inferior to 406 MHz ELTs due to interference and other concerns even prior to the termination of satellite monitoring of 121.5 MHz, and that the advantages of 406 MHz ELTs have increased since then," the FCC said in a statement.

It went on to say that removing 121.5 MHz beacons from the marketplace won't impose significant costs on users based on the price differential between 406 MHz ELTs and 121.5 MHz systems. It also said, in part, that there's no evidence manufacturers and distributors would be burdened with stranded inventory of 121.5 MHz beacons. Worth mentioning is that most 406 models also have integral 121.5 MHz transmitters, which means you can still keep and maintain your newer 406 beacon, and manufacturers can still sell them even though they transmit on both frequencies.

In our view, the FCC has done its homework on this, noting that the price for 406 MHz systems has dropped substantially in recent years. In 2010, the FAA estimated the average cost of a 406 MHz ELT to be more than $2500, but according to the FCC's recent report, comments submitted in 2013 indicate that the price had already dropped to less than half of that. "Based on staff review of publicly available information, we believe that 406 MHz ELTs are now available for less than $600," it said.

On the other hand, we think the commission underestimates the amount of labor that's involved in retrofitting 406 models in place of existing 121.5 models. In many cases, the installation labor will be more than the cost of the new beacon because 406 MHz systems require a remote control/activation switch that has to be mounted on the instrument panel or within an area that the crew can easily access. Moreover, while some manufacturers have 406 models that can use some it not all of the installation hardware that exists in 121.5 MHz beacon installs, the disassembly of the interior to route a harness between the tail-mounted beacon and the panel-mounted control switch can be big work.

Our advice is the same as it always was: Upgrade to a 406 MHz system while the aircraft is open for other work—perhaps an annual inspection or major avionics projects where this grunt work is already in progress.

Last, it looks like it's time for a market scan of 406 MHz systems and we're working on it. In the interim, link to the FCC's bulletin at https://tinyurl.com/y9ha79dx.

Columbia 300/350:

Prices remain stable for these speedy and modern composite singles, but you'll pay a premium for newer models with fully integrated avionics.

The original Lancair Columbia was a lot of things, and in some ways helped set a new standard that lives on to this day. First, it was one of the new-generation singles spawned by NASA's AGATE (advanced general aviation transport experiments) program and promised growing small aircraft use in intercity transportation. That concept also brought forth the Cirrus SR20 and SR22, which proved far more popular and ultimately outlived the retired Columbia.

But equally important to the airplane's target buyers was its speed, modern composite design, state-of-the-art avionics and the fact that it was boldly different than any Cessna, Beech, Mooney or Piper. Further to its credit, a normally aspirated 300 and 350 will outrun a Cirrus SR22 by roughly 10 knots.

But the airplane did have some disadvantages that might be significant to buyers who are eyeballing remaining Columbias on the current used market. Although both the Columbia 300 and earlier SR22s have identical empty and maximum gross takeoff weights, according to the *Aircraft Bluebook* the 300 gives up 150 pounds in full-fuel payload to the SR22, because its tanks are larger. It's a little more sensitive in loading, too, and perhaps a deal-breaker for some—it lacks the Cirrus' airframe parachute system.

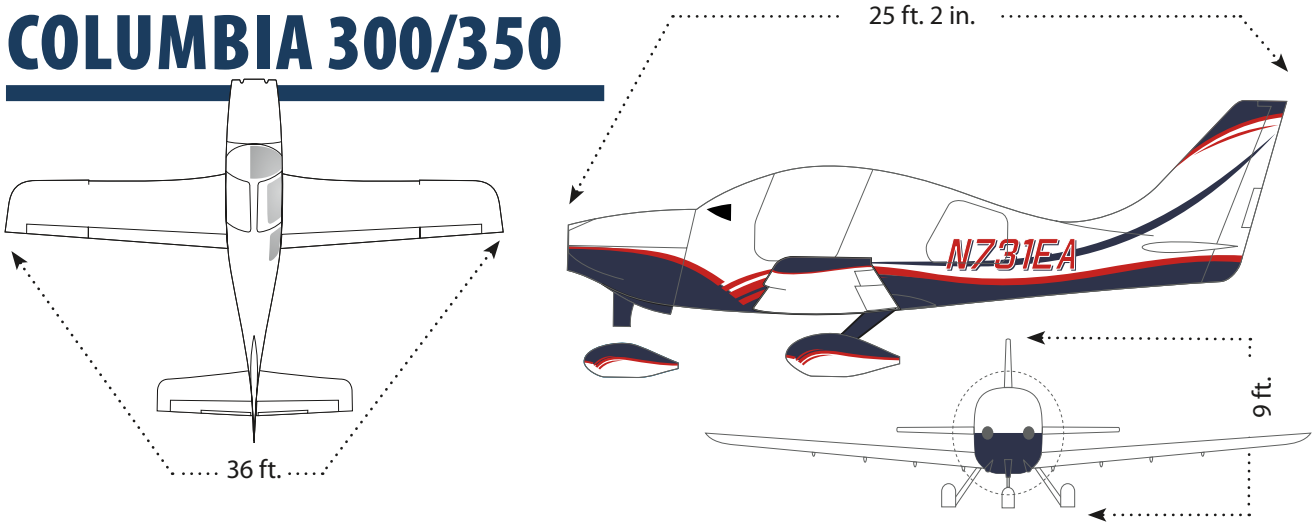
Columbia pilots will have to pay close attention to loading, perhaps more than many other aircraft models.

KITPLANE DNA

To fully understand the basic concept of the Colombia models, you need a history lesson that dates back to the experimental kitplane Lancair days. Founded by Lance Neibauer in 1981 as a producer of composite homebuilt aircraft kits, Lancair fielded its first offering in 1985. The kitbuilt Lancair 200, powered by a 100-HP Continental O-200, quickly grew popular and was followed by higher-horsepower versions of the same basic two-seat airframe. In 1990, Lancair began developing a four-seat model, coming up with what is perhaps the company's most popular kit, the Lancair IV, a retractable-gear screamer. A fixed-gear version soon followed, known as the Lancair ES. Those two kit-built four-seaters served as a foundation for the LC40 model, also known as the Columbia 300. But before the LC40 model

That's an original Lancair demo photo of a 2003 Columbia 300, officially a model LC42-550FG. The current Aircraft Bluebook suggests an average retail price of $190,000.

COLUMBIA 300/350

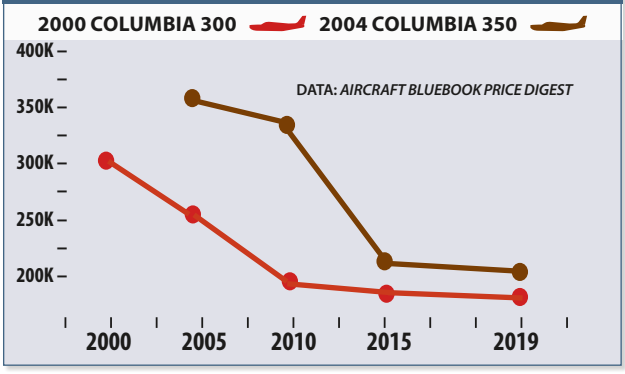


Drawings courtesy www.schemedesigners.com

COLUMBIA 300/350 MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	RETAIL
2000 COLUMBIA 300 (LC40-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1150 LBS	190 KTS	±$150,000
2001/2 COLUMBIA 300 (LC40-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1150 LBS	190 KTS	±$160,000
2003 COLUMBIA 300 (LC40-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1150 LBS	190 KTS	±$175,000
2003 COLUMBIA 350 (LC42-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$190,000
2004 COLUMBIA 350 (LC42-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$205,000
2005 COLUMBIA 350 (LC42-550LG)	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$215,000
2006/7 COLUMBIA 350 (LC42-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$235,000
2008/9 CESSNA 350 CORVALIS	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$312,000
2010/11 CESSNA 350 CORVALIS	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$398,000

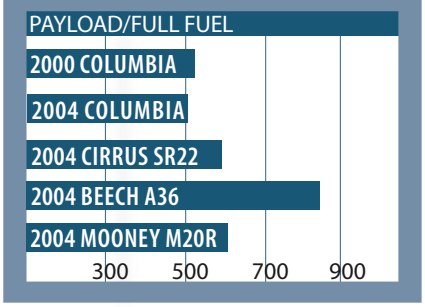
COLUMBIA 300/350 RESALE VALUE

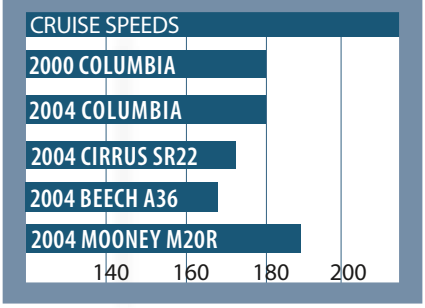


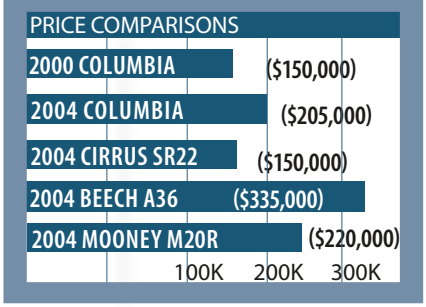
SELECT HISTORICAL ADs

AD 2008-06-28	LIMITATION ON AVIDYNE PFD UNDER CERTAIN CONDITIONS
AD 2007-07-06	REPETITIVELY INSPECT AILERON AND ELEVATOR LINEAR BEARINGS
AD 2006-25-08	DEACTIVATE KELLY AEROSPACE THERMAWING DEICING SYSTEM
AD 2005-02-01	REVISE THE AFM'S TAKEOFF CHART DISTANCE VALUES

SELECT LATE-MODEL COMPARISONS







Early Columbia 300 models have round-gauge flight instruments. The one at the top has been retrofitted with Garmin GTN navigators. The 2007 model 350L, bottom, has a Garmin G1000.

arrived, NASA launched AGATE in 1994, which was designed to breathe life into a deflated general aviation market. Huge liability claims had rendered the industry unprofitable a decade earlier, although the higher-end market for turbine-powered aircraft was doing OK, if not thriving. In fact, the only bright spot for piston-powered GA was in the homebuilt, experimental market, where liability issues were minimal.

Lancair had become a prominent player in that market, and NASA, among others, encouraged development of an FAA-certified aircraft. In 1993, Lancair spun off a new company, Pacific Aviation Composites USA (PAC), in nearby Bend, Oregon, to manufacture certificated aircraft. The first Lancair LC40 prototype flew in July 1996; a certification prototype followed in early 1997 but the 310-HP model wasn't certified until 1998. That same year saw Cirrus obtain FAA approval of its SR20, with "only" 200 HP but with an airframe parachute and much more of an organization behind it.

The Cirrus product took off, soon followed by the 300-HP SR22 in 2000, providing real competition for the LC40-550FG, as the 300 is formally known.

The turbocharged fire-breathing Columbia LC41-550FG/400 came out in 2000 also featuring a glass cockpit developed in part on NASA's own Columbia 300. That same panel was incorporated into the 300 airframe/engine combination, which became the LC42-550FG, or Columbia 350, type certificated in March 2003.

But financing issues plagued PAC. After Sept. 11, 2001, its certified-airplane production ceased while the company sought investors. In January 2003, manufacturing resumed after Composite Technology Research Malaysia (CTRM) bought a controlling interest in PAC for over $50 million. By 2006, CTRM became interested in selling its share of the company.

In July 2005, Neibauer had sold his interest in the kitbuilt models and PAC became Columbia Aircraft. Despite having what most owners felt was a good product, Columbia couldn't overcome what many perceived to be an unsteady history. That reputation, plus withering competition from Cirrus, forced Columbia into bankruptcy in 2007, culminating with its acquisition by Cessna in November 2007.

Cessna, after offering the 300 and 350, produced a single version of the once Columbia 400, the TTx. It was powered by a Continental TSIO-550-C six-cylinder, fuel-injected, twin-turbocharged engine with dual intercoolers—boasting a 235-knot maximum cruise speed. It also had Garmin's G2000 Intrinzic touch avionics suite and a price north of $800,000. Textron ultimately pulled the plug on the TTx in 2018, leaving the market speculating on the future of the company's piston single line.

CONSTRUCTION, STYLING

Because it was certified under the relatively new FAR Part 23 (at the time), some of the Columbia's features, systems and limitations may not be familiar to pilots steeping into it compared to all-metal airplanes of an earlier era. For the Columbia 300/350, the fuselage shell, wings and most control surfaces are a honeycomb sandwich of pre-impregnated—or "pre-preg"—fiberglass around a honeycomb interior. "Pre-preg" means the fiberglass cloth is impregnated with catalyzed epoxy resin. Air pressure fixtures clamp the layers

together during heat curing, while a thin wire mesh just beneath the skin provides lightning protection and enables IFR certification, heretofore a composite bugaboo.

Structural components such as ribs, bulkheads and spars are constructed in the same manner. Where additional strength is needed, such as in spars, carbon fiber is added to the honeycomb sandwich. The result is a strong, light airframe, certificated in the utility category instead of the less-demanding normal category. In fact, when the wing was loaded to demonstrate its strength, it exceeded FAA requirements. One of the changes from older certification rules contained in Part 23 is an airframe life limit. The Columbia models' limits are 25,200 hours, which should be enough. (If you plan to fly one more than that, call us.)

Because of its composite construction, the airframe comes with some limitations. For example, the type certificate limits exterior colors—the same basic limitation was imposed on Cirrus models—and major repairs "must be accomplished by an appropriate FAA certified person qualified to perform maintenance on composite aircraft structure." The wizened IA caring for your Skylane and whom you routinely include on your Christmas card list may not qualify.

Other limitations in the type certificate include a maximum operating altitude of 14,000 feet without an FAA-approved oxygen system installed, or 18,000 feet with one. Presumably, this applies even when a non-approved portable system is carried, though we'd be surprised if operators strictly adhered to it. If one wants to climb higher in a Columbia, the 400 is approved for up to FL250. Additionally, maximum zero fuel and minimum flying weights apply. The new TTx has the BiO2 four-place oxygen system.

A Columbia's cabin isn't exactly cavernous, top, but occupants are protected by energy-absorbing seats. Gullwing doors, bottom, give any Columbia plenty of sexy ramp appeal.

CONVENTIONAL CONTROLS

With the exception of side sticks and a rudder limiter, the Columbia's control system is a conventional design. Anyone familiar with a Cirrus will feel right at home. Ailerons and elevators are one-piece construction, incorporating rods and bellcranks, à la Mooney. The left aileron includes a servo tab, which decreases control force and likely contributes to the ease of control with the side sticks. When *Aviation Consumer* flew an early Columbia 300 as the type was being rolled out, we noticed a slight breakout force to actuate the ailerons. We felt it initially disconcerting in turbulence, resulting in overcontrolling in the roll axis. Our pilot got used to it after a while.

The Columbia's rudder also is of one-piece construction, actuated by cables running through plastic tubes. No pulleys are used, and there's little discernible control friction. But it does include an item not usually found on light singles: a rudder limiter.

Because of the increasingly strict FARs on spin resistance, the limiter snaps on when power is above 12 inches of manifold pressure and after the stall warning has sounded for two seconds. The limiter restricts rudder travel to six degrees either side of center, rather than the normal 12 degrees.

This is effective in preventing spins. In the wild old days, rather than go to the trouble of performing additional testing and design work to certify for spins, manufacturers merely slapped on a placard prohibiting spins. Not any more.

One thing our evaluation pilot thought was clever is the airplane's roll and pitch trim system: It's all-electric, with no manual reversion,

COLUMBIA 300/350 LOSSES: CONTROL

We had to do some looking to find accidents involving the Columbia 300/350 series. While there weren't a lot built, few of those that rolled out of the factory door have crashed—we found 11 reported accidents in the U.S. over the last 25 years. That's certainly not enough to even approach a statistical universe for analysis, but we were struck by one thing that we did not see: There were no fuel-related accidents—even where there are only a few accidents involving a type, we expect to see at least one fuel-related crunch. To us that means that the Columbia has a user-friendly fuel system that accurately indicates quantity aboard.

There was only one engine failure accident, although it was a bad one. The pilot reported a power loss and then smoke in the cockpit before communication was lost and the airplane crashed fatally. Post-accident analysis of the recorded engine data showed that the engine was steadily losing oil pressure by the top of climb. The pilot apparently disregarded low oil pressure warnings and did not follow the POH admonition to land as soon as practical.

There were four runway loss of control (RLOC) accidents, which struck us as high, although we felt for the pilot who hit two Canada geese on, or immediately after, touchdown and lost control of the airplane. Reading between the lines of the remaining RLOC and hard landing accidents we think that speed control on final is important in a Columbia—extra speed is not a Columbia pilot's friend. Two pilots lost control when landing in crosswinds—one after hitting a dust devil and one when he didn't react fast enough to a gust to avoid turning 90 degrees off of the runway and breaking the nosegear off in a ditch.

The other RLOC accident involved a 2800-foot-long mountaintop runway. Following a fast touchdown a third of the way down the strip, the airplane started bouncing, reaching an estimated 30 feet AGL during one. The airplane then left the runway and started down an embankment before turning back, crossing the runway and crashing into four parked airplanes. A post-crash fire resulted in the death of the occupants and destruction of three of the five airplanes involved.

One Columbia pilot was curious as to where he would touch down if he followed the GPS approach all the way to the runway surface. He hit hard, suffered a prop strike and broke the nosewheel off. He then rotated aggressively enough to hit the tail on the runway and started a go-around. The airplane did not climb significantly before hitting storage containers a half mile off the end of the runway.

Another pilot landed fast and hard, damaging the landing gear and causing fuselage components to deform downward.

There was, sadly, one VFR into IMC event in fog. The aircraft spiraled into a lake.

Two pilots had difficulties flying VFR at night. One crashed into the side of a mountain. The other lost control shortly after a "black hole" takeoff from a rural airport and spiraled into the ground. The pilot had 24 hours of night experience, mostly in urban areas, and had not flown at night for 11 months. Despite that, he was carrying passengers.

Finally, shortly after takeoff, a Columbia pilot noticed that a carpet strap was hanging out of the door on his side. Despite strong warnings about not opening a door in flight in the POH, he opened it. The door was violently pulled out of his hand, injuring him enough to require stitches. The door then departed the airframe. In doing so it damaged the wing and horizontal stabilizer. The pilot was able to successfully land the airplane.

and actuated by a coolie hat atop the side stick. Rudder trim is controlled by a switch on the lower center panel, with a graphic display of blue and green lights showing trim tab position. Prior to takeoff, the various switches are moved until the trim lights show only green. Once a trim tab has been moved from the takeoff position, the respective light turns blue so the pilot can see not only how far off center it is, but has a quick reference by color once the tab is back to the takeoff position.

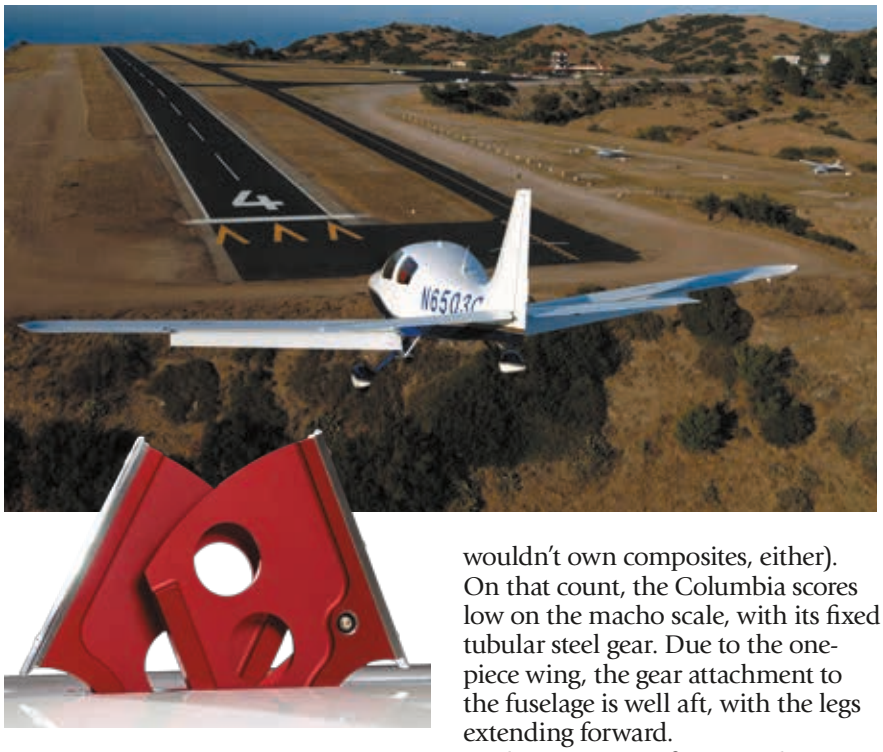
A major difference between the Columbia 300 and the 350 is avionics and gyro power. The earlier 300 models had dual vacuum pumps. Standard equipment included steam gauges in front of the pilot, with a rack of UPS-AT avionics (pre-Garmin units) for talking and squawking. A pair of Avidyne multi-function displays (MFDs) were available options; when installed, they were positioned right-center in the early panels.

All that changed when the 350 came out, using the 400's systems and panel. For one, it was an all-electric airplane, with a dual bus, dual alternator/battery electrical system eliminating the twin vacuum pumps in the Columbia 300. Continental's FADEC (full authority digital engine control) engine management system, employing a single lever to control power, mixture and the propeller, was available as an option.

All Columbia 300s are 14-volt airplanes. The 350 started out that way, but the company went to 28-volt systems in 2005, beginning with serial number 42501. In keeping with Lancair's original emphasis on speed, exterior airframe surfaces are smooth as silk. Among other things, this means flush fuel filler caps similar to those used on Lancair homebuilts, which have proved problematical on other types. Basically, flush caps don't do as good a job at keeping water out of the tanks, something to bear in mind if your airplane will be left out in the rain.

Fuel capacity is a generous 106 gallons total, with 102 usable, carried in a wet wing, between the spars, so it's reasonably well protected in a crash and quantity doesn't affect the center of gravity.

Fuel lines run to the selector valve under the center of the fuselage, in front of the forward wing spar. From



Speedbrakes help make the slippery Columbia manageable during descent and landing.

a crashworthiness standpoint, the lines are exposed for only a few feet in front of the spar. The fuel valve's selector handle forms the forward portion of the armrest between the front seats. It's shaped to make it clear to which tank the valve points, making it one of the better human-factor designs we've seen.

The wings include conventional Fowler flaps, with settings for takeoff and approach (12 degrees, with a 129 KIAS limit) and landing (40 degrees, limited to 119 KIAS). To meet certification requirements, the flap extension speeds are painfully slow for an airplane cruising at over 180 knots, which means either large power reductions are necessary to slow down after a descent, the pilot really needs to plan ahead, or both. Some individual aircraft may be equipped from the factory with optional speedbrakes, or they may be added in the field. While we generally can do without speedbrakes, they're not a bad idea on the Columbia models.

To many pilots, high performance means retractable gear and we suspect some wouldn't be caught dead owning an airplane unless the gear folds up (that crowd generally wouldn't own composites, either). On that count, the Columbia scores low on the macho scale, with its fixed tubular steel gear. Due to the one-piece wing, the gear attachment to the fuselage is well aft, with the legs extending forward.

The nosegear is free-swiveling through 120 degrees but self-centers in flight. Taxiing requires differential braking, of course, as it does with Cirrus models and many others. While overheated brakes on earlier Cirrus models have caused fires and at least one airworthiness directive, we're not aware of any similar problems among the Columbia fleet.

AVIONICS, CABIN

The Columbia's clean-sheet-of-paper approach to instrument panel design resulted in one stunningly free of clutter, at least when compared to earlier, more traditional designs. As with the Cirrus, there are no bulky yokes to block the panel's view. Our flight tester found switches were well-placed and labeled, with one exception.

That exception involves the circuit breakers, which are located low on the left cabin sidewall in front of the pilot's seat. The panel is difficult to see and the labels are almost impossible to read without a head-down motion bound to induce vertigo when you can least afford it.

Overall, though, the interior is of the sort you'd expect to see in this class of airplane. It has leather seating, teak control sticks and an attractive and functional three-point restraint system. The cabin is physically small and the headroom is a bit tight for a tall person. Fit and finish

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Philip Potts sent a photo of his Columbia 350 parked next to a Cirrus. He rented the SR22T for seven years before buying the Columbia, which eased the transition.

are good, but we're positive that years of use have taken their toll on older airplanes, even though the results can't be as bad as older offerings from the Big Three.

Early in the Columbia 300's production, three avionics options were available. The standard IFR package included an UPS-AT SL30 navcom, SL70 transponder, GX60 GPS, SL15 audio panel, Stormscope and an S-TEC System Thirty autopilot with altitude hold. The premium IFR package included dual SL30s, SL70 transponder, GX50 GPS, SL15 audio, Stormscope, AlliedSignal KCS 55A HSI System and a KI 256 Flight Director.

These avionics are considered dated by today's standards, we should note. Rip all of that out for a generous aftermarket glass retrofit, new navigators, a better autopilot, plus ADS-B and you could be looking at an investment that nears $100,000. Buyers of early models should keep this reality in check. Most of the early Columbias we spotted on the used market have mostly been upgraded. A common package includes Garmin GTN navigators (usually a big-screen GTN750 and smaller GTN650), upgraded audio system and in some cases a primary flight display.

The third original option was a basic avionics package appropriate only as an interim solution until an owner obtained a custom installation. As noted above, some buyers also opted for dual MFDs.

When the 350 and its all-electric panel rolled out, gone were the steam gauges. In their place was the Columbia 400's all-glass panel, based on the Avidyne FlightMax Entegra primary flight display (PFD) and using dual Garmin GNS430 navigators. Technically an option on the 350, it was one nearly every buyer selected. A major difference between the Columbia's FlightMax installation and the same PFD in contemporaneous Cirrus models was its orientation: Columbia aircraft have the display mounted with the long axis vertically, in portrait mode, rather than horizontally as in the offerings from Cirrus.

As for crashworthiness, the Columbia 300/350 scores well on safety and crashworthiness, in our view, with good seatbelts, a crushable structure and energy-absorbing foam seats. That said, we're not fond of gullwing doors, hinged at the top and opening upward, common to Columbia and Cirrus models. They expose the interior to rain during entry and exit and they've never struck us as being as structurally robust as conventional doors. Columbia doors have a redundant latching system designed to keep them closed in flight and there's a door ajar light.

Should the airplane come to rest inverted, there's an emergency lever at top center of the cabin interior to pull hinges out of both doors, allowing them to be pushed out. For the rescuer, there's also a lever on the underside of the aircraft, with a placard telling how to pull the lever and get the doors open.

It's likely that most inverted situations will mean the airplane is on its top and one wingtip, so one of the doors should open without extraordinary effort. The placard tells a rescuer what to do if the airplane is balanced on the top, precisely inverted, although uneven ground may defeat any attempt to open a door.

As a backup, a crash axe under the front of the pilot's seat gives the occupants a tool to chop their way out. In a test, a small person from the factory was locked in an inverted fuselage and given instructions to get out. She retrieved the axe and battered her way out within a minute.

Both Columbia models have a maximum gross takeoff weight of 3400 pounds, same as the Cirrus SR22. With a basic empty weight of 2250 for both the SR22 and the Columbia 300, the only real difference in loading the two is full-fuel payload and how it all gets balanced. Meanwhile, the 350 weighs a bit more—2300 pounds empty—so its useful and payload are down about 50 pounds compared to the other two airplanes.

Also, the Columbias come with a maximum landing weight of 3230 pounds. That means just over 28 gallons of fuel—or roughly an hour at takeoff settings—will have to be burned following a gross weight, full-fuel departure before a landing may legally be made. This, combined with a maximum zero fuel weight that varies with CG, means the pilot will have to pay attention to loading, perhaps more carefully than with other models. Few single-engine owners are familiar with the zero fuel weight concept, which means that any additional weight above a certain minimum must be fuel only.

In working several sample weight and balance problems with an early 300, we noticed it's quite easy to load the airplane out of its aft CG limit. For example, with four 200-pound occupants and 120 pounds of baggage, the same plane was over its max landing weight without any fuel. It was a more than two inches aft of the CG limit.

With just two 200 pounders, 50

pounds of baggage and full fuel, the airplane we flew was loaded at the center of the CG range. Admittedly, our sample airplane was heavy—it had a 2337-pound empty weight and only a 1063-pound useful load.

Before signing on the dotted line for a used Columbia—or any aircraft, for that matter—run a few weight and balance problems using the candidate airplane's POH to see how it stacks up on your typical missions.

There are a handful of Airworthiness Directives (ADs) pertinent to both the 300 and 350 models. The most recent is AD 2008-06-28, now in its first revision, applying to Avidyne primary flight displays (PFDs) by serial number and may require incorporating new limitations when certain conditions involving incorrect attitude, altitude and airspeed information for the PFD or backup instruments exist.

Meanwhile, AD 2007-07-06 applies to all Columbia models and requires repetitive inspections of aileron and elevator linear bearings, and control rods, for foreign object debris, scarring or damage to prevent a jammed control system. This is probably the most onerous AD affecting Columbias.

Another AD, 2006-25-08, requires deactivation of Kelly Aerospace Thermal Systems' ThermaWing Deice System (also known as E-Vade) if installed on Columbia 350s (and 400s). Some owners are opting to remove the ThermaWing system and have TKS installed. We looked at these deicing systems in the February 2017 issue of *Aviation Consumer*.

Also, there's AD 2005-02-01, which applies to 300 and 350 models and requires revising takeoff chart distance values in the Airplane Flight Manual (AFM). Post-certification flight testing revealed takeoff distance values could not be duplicated and were as much as 65 percent shorter than required. Finally, AD 2004-06-09 requires inspecting 300 and 350 models' fuel pressure transducer for evidence of chafing. A compliance kit may be installed to terminate the AD.

Once Cessna took ownership, a major unknown with the in-service Columbia fleet created by ongoing financial uncertainty was resolved.

In December 2010, a Cessna 400 being flown by an FAA test pilot at the factory developed a fuel leak that was later determined to be related to the wing skin disbonding from the main spar. The issue produced an AD that only applied to one 350 on the production line and seven 400 models, also on the line.

OWNER COMMENTS

Purchased in 2014, my 2003 Columbia 350 is my first aircraft after 50 years of rentals. My mission revolved around speed, economy, payload and fuel capacity. Having rented a 2007 Cirrus SR22T for seven years it became obvious that a more complex 40-year-old aircraft did not meet my traveling requirements. Both the Cirrus and Columbia exhibit similar operational qualities and I like them both, but being more familiar with the Avidyne integrated avionics and an aircraft without a turbo, my choice also became price dependent.

Since 2014, N6503C (once a factory demo) has flown 700 hours (virtually all IFR) and I usually operate at full gross weight on flights roughly four hours in length between 10,000 and 12,000 feet. I operate at roughly 61 percent power LOP and see 163 knots and 12.3 GPH. While operating in the Western mountains, the highest practical altitude is 14,000 feet due to power limitations in turbulence, mountain waves, subsidence and high density altitudes. When flying solo, an endurance of seven hours is possible for those hearty souls.

Unlike the Cirrus, the Columbia has speedbrakes—useful during those descents over mountains into valley airports. Occasionally ATC thinks jet-like performance, leading to steeper high-speed descents; thankfully speed can be managed by the brakes. (I found the Cirrus propeller has a more effective braking area with power retarded.) The side stick control has smooth, light/moderate forces and the aircraft's handling is excellent at low and high speeds, with chandelles and lazy eights fun to fly.

The original avionics included an Avidyne FlightMax Entegra PFD/MFD and dual independent Garmin GNS430 navigators. Both round gauge and electronic engine monitoring systems are redundant, yet

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Columbia 300/350

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useful for fuel and electrical system management.

My upgrades included two Garmin GTN650 navigators and a GDL88 ADS-B system. I appreciate the Garmin touchscreens, the ADS-B weather and traffic data and compatibility with the ForeFlight app. For me, this arrangement provides a comprehensive and redundant information capability that exceeds the legacy G1000 system's capability, which was introduced in 2004.

If I had to replace the Avidyne displays, I would consider installing the new Garmin G500 TXi displays as an improvement.

History has it that as a Columbia demonstrator aircraft, a prospective buyer experienced a hard landing in my airplane. The right landing gear, wing and stabilizer were damaged by the mishap. The Columbia production facility replaced the right gear, right wing and stabilizer. For me, through five annual inspections and 700 hours of flight, the aircraft flies true to the book, while maintenance has been for normal wear and time-dependent replacement items. This Columbia has been a very reliable aircraft.

My experience during annual maintenance was either reluctance by a Cirrus service center to get involved with this different airframe or "working on this is not a problem," treat the aircraft with all the standard maintenance procedures. I experienced both. I finally convinced the service center to perform the most recent annual by buying the maintenance manual.

The result: The shop found some new stuff to replace (first-time expenses) but they considered the airplane easy to maintain with no unusual systems. I am pleased, but Cessna Textron part costs are questionable. For example, a muffler cost $2600.

The Columbia's 310-HP Continental IO-550-N engine has a typical overhaul cost of $33,000.

As for approximate annual operating costs (not including engine reserves), I plan on $140 per flight hour for this airplane. That includes hangar costs, oil and general "fix it" stuff. Insurance is $2300 per year, the annual inspection base price is around $2500 and fuel (at around $5.50 per gallon at 12.5 GPH) is $9625.

For me, the Columbia 350 encompasses operational economics, advanced design and modern electronics that are often regarded as more advanced than many commercial airliners.

It is too bad that Columbia—and now Cessna—was injured by economic conditions that forced it into receivership. I think it was about marketing, not quality or performance.

Philip G. Potts
via email

FEEDBACK WANTED

CESSNA 182

It's time again to take a fresh look at the Cessna 182 Skylane market in an upcoming Used Aircraft Guide in *Aviation Consumer*. We want to know what it's like to own these singles, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your 182 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 that can be helpful for buyers considering one. Send correspondence by March 10, 2019, to:

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