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The Aviation Consumer

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CYBERSECURITY AND GARMIN'S WIRELESS COCKPIT

The concept of a wireless cockpit—pushing flight plan data from a tablet app to certified avionics, to name one capability—is supposed to curtail the task of programming a panel GPS. I think Garmin's Flight Stream Connect wireless network, via its Pilot tablet app, succeeds in doing that, but doesn't eliminate all of the workload, which is a good thing. That was my impression after Garmin's Jessica Koss demonstrated the Flight Stream and ADS-B interface as we flew in the company Cirrus in the Northeast airspace, pictured to the right.

If you've ever flown with a pair of Garmin navigators (either the GNS430/530 or GTN750/650), you've likely used the crossfill function, where data that's programmed into one navigator automatically feeds into the other through an RS232 serial databus. This eliminates the tedious task of programming the same flight plan into both navigators. But programming the panel navigators remotely over a wireless hub can't work as seamlessly, and that has much to do with safeguarding critical flight data. Call it cockpit cybersecurity, if you will. That's what the FAA calls it.

In reality, the FAA certification folks got it right when they certified the first wireless cockpit interface—Aspen's Connected Panel—a few years ago. It required that the pilot has to first confirm the data that's flowing from the tablet before the navigator accepts it (and the autopilot flies it), even if it creates extra workload to verify and accept the data transfer on the receiving panel navigator. But aside from pilot intervention, combining uncertified tablet data with a certified panel navigator has more safeguards than you might think. It begins with a high standard of certification that addresses how the data is safeguarded.

Garmin commenced its STC-approved Flight Stream wireless project before the FAA issued its policy statement on cybersecurity as it relates to portable electronic devices and non-certified off-the-shelf commercial technologies. This meant without previously approved guidance in place, Garmin had to demonstrate (through a special compliance process) how the Flight Stream system addresses inherent security vulnerabilities—including data encryption issues—when interfaced with higher-level avionics systems. Alan Blood, Garmin's software engineering group leader, described some specific architectural traits inherent with the Flight Stream which made FAA certification easier.

"The Flight Stream box handles all of the wireless Bluetooth connections, including authentication and handshaking with the tablet computer. Once that data gets to the panel navigator, it goes into a holding area and can't be activated until the pilot reviews the flight plan and adds it to a flight plan catalog. It is an extra step or two," Blood said. Additionally, the tablet app sends over a list of waypoints (identifiers and GPS lat-long coordinates) for validation with the navigator's certified internal database. This prevents the pilot from sending over the right identifier, but perhaps the wrong geographical location. "We're trying to avoid a situation where someone could hack in, mess with the data and ultimately send the aircraft into a mountain," Blood said.

Although the Bluetooth Flight Stream can connect with multiple tablets, the device has to be manually paired from the dedicated Connect page in the GNS or GTN navigator. This makes it difficult for a back-seater to push data from his tablet into the panel, for example. Still, I wondered why Garmin didn't use Wi-Fi for connecting its Flight Stream wireless network, given the added benefits of password protection, but Garmin's Blood noted that connecting with Wi-Fi won't allow for simultaneous cellular and Wi-Fi connectivity.

I also wonder what capabilities will come next, as flight planning only scratches the surface of a full-up wireless cockpit. For certain, the FAA is onboard, overseeing that cybersecurity issues remain in check.—*Larry Anglisano*

FIRE EXTINGUISHERS: SIZE MATTERS

After reading the fire extinguisher article in the June 2015 issue of *Aviation Consumer*, I have some confusion about extinguisher size, partially because one photo example was apparently omitted from the article. I assume that a fire extinguisher with a "2BC" nomenclature in its model identification is two pounds of fire suppressant, and the "5" prefix indicates five pounds.

I have witnessed the aftermath of one crash—which was survived—and the fire extinguisher tore loose from its bracket and went through the windshield. That was a two-pound unit, so a five-pound unit would have about three times the energy (allowing for weight of the unit in addition to the suppressant.) The floor bracket won't hold up to that, due to the limitations of the aircraft floor itself. It would require underfloor reinforcement and a much sturdier bracket than the one supplied with the fire extinguisher.

Another option would be to mount the fire extinguisher in front of all passengers, but I can't do that on my Cessna 182. Mounting it on the floor between the seats is the only real option. The direction of travel of this eight-pound missile would depend on the angle of the crash, but having seen the one that went through the windshield, I am not comforted.

There are a lot more crashes than in-flight fires, so the larger extinguisher may or may not increase overall safety.

Second, while Halon is best, and what I have in my aircraft, worries about the corrosive effects are misplaced. Inflight fires are fortunately rare. If you survive one, having the aircraft totaled will seem like a pettifogging detail compared to being alive. I've actually used my extinguisher once, but it was in a post-crash fire of another aircraft; the two-pound Halon unit got the job done, but it was a small engine fire. I have a five-pound Halon unit from the 1950s in my office (it's far out of its expiration date) which I've used on one tiny fire. It's not considered legal by my local fire department, but it was much less messy and let me keep working after my dental assistant set the tray setup on fire (we use alcohol and a butane torch in root canals).

David Chuljian
Port Townshend, Washington

As was pointed out in the article, the numeric rating preceding the letter(s) on a fire extinguisher is the size of the fire, in square feet, the unit should be able to extinguish. The weight of the extinguisher for a particular numeric rating depends on the chemical used.

In general, for any given fire, the amount of Halon necessary to extinguish it is about half of that of other chemicals, although that is changing as new Halon alternatives are approaching the effectiveness of Halon. If the weight of the overall extinguisher is a concern, buy Halon to get the most effectiveness for the least weight.

As crash survivors, we are quite aware of the damage that can be done by any unrestrained object in the cabin during even a relatively low-impact accident and strongly recommend that anything in the cabin heavier than a throw pillow be secured.

ADS-B FOR EXPERIMENTALS

In a response to a letter from SkyVision's Harry Sanders in the July 2015 issue of *Aviation Consumer*, you state the following about ADS-B installation requirements to meet the 2020 ADS-B Out mandate:

"That means AC 20-165A applies, providing guidance for the installation of ADS-B Out equipment. It requires airworthiness approval through type certification or the supplemental type certification (STC) process for an ADS-B Out system meeting the equipment requirements of 14 CFR 91.227."

Since EAB (experimental amateur-built) aircraft do not have either type certificates or supplement type certificates, how do they go about meeting the ADS-B Out requirements?

Owen C. Baker
via email

Good catch, Owen. Sanders noted that FAR 91.336 replaced FAR 91.225 (not requiring TSO'd ADS-B hardware for EAB and LSA) for exactly that reason. But the rules could be changing again.

According to Ric Peri from the Aircraft Electronics Association, the FAA currently has a new advisory circular in draft which is specific to installing mandate-compliant ADS-B Out equipment in EAB and LSA models. It is expected to be released later this summer. We'll report on it after we read it.

MISSILES AND ROCKETS

On page 27 in the Mooney 231 Used Aircraft Guide (July 2015 *Aviation Consumer*) you published a file photo of a Mooney 300 Missile instead of a model 305 Rocket.

Unlike the Rocket mod for the turbo Mooney 231, the aftermarket Missile mod for the Mooney M20J (201) includes an IO-550-A5B engine, which is normally aspirated.

Rae Willis
via email

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Pipistrel's Alpha Electro: Electric Flight Realized

But with just an hour of endurance, the Electro is being pitched for one purpose: teaching landings. Broader application awaits more energetic batteries.

by Paul Bertorelli

NEW AIRCRAFT DEVELOPMENT

The age of the electric airplane has been much written about but far less demonstrated and delivered. So when Pipistrel Aircraft, the innovative Slovenian company, announced last April at Aero that it was ready to deliver a functional electric trainer, it drew crowds of the curious. But is the technology really ready for broad market distribution or does it remain a curiosity waiting for more mature technology?

Based on a recent trip to Pipistrel's factory, where we examined the new Alpha Electro and flew it twice, we would say it's somewhere between. Apart from its short flight legs—about an hour, give or take—the Electro is all but indistinguishable from its gasoline equivalent. It performs similarly, flies the same and even sounds somewhat similar from inside the cabin. It's more expensive than the gasoline version, but Pipistrel expects that price to come down as batteries gain more capacity at lower cost and motor prices decrease with more competition from additional vendors.

Pipistrel estimated that the Electro would have about a 60-minute endurance with an additional half hour of reserve, but we didn't see that in our trials. More like about an hour or so total with reserve enough to land safely for a recharge. Recognizing that it can't do what a gasoline aircraft can, Pipistrel is pitching the Alpha Electro for one narrow purpose: as a dedicated takeoff and landing trainer in a school otherwise equipped with gasoline trainers. That the Electro can do this is inarguable. The unanswered question is can (or will) flight schools invest in such a narrowly contrived tool and can they make money in do-

ing so? Early adopters are defined by a willingness to accept compromises that mainstream buyers will not and that seems to be where the Electro will find its initial market.

CONVERSION, COMPROMISE

At the Electric Aircraft Symposium in Santa Rosa, California, last April, Pipistrel's Tine Tomazic commented during a presentation on the Electro that he was glad it would be the last conversion the company would do. "Just because the airplane is electric," Tomazic said, "it doesn't mean it requires any less horsepower." That's another way of saying unless an airplane is feather light—and even then—current battery technology will sharply limit the flight duration of pure-electric aircraft.

That said, the Alpha airframe might be an ideal candidate for electric conversion. Its antecedents flow from the high-aspect ratio, low-drag sailplane airframes popular in this region of the world. Originally certified as a European microlight, the Alpha has, by U.S. standards, a low empty weight and a high enough useful load to nearly lift its own weight. (See our April 2015 review of the Alpha, which reports a useful load of 264 kg (581 pounds) on an empty weight of 287 kg or 631 pounds.) That means the Alpha airframe has sufficient, if not plenty of, capacity for batteries. And it needs a lot of them.

Conceptually, the Alpha Electro is simply an electric motor in place of an 80-HP Rotax 912 and batteries in place of fuel tanks. But the execution is far more complex than that and involves more electric and electronic engineering than the casual observer might expect.

First, the batteries. Pipistrel uses lithium-polymer chemistry which, allowing for the enclosures and management systems, yields about 155 wh/kg; typical energy density for lithium-ion systems these days. Total battery weight is 126 kg (277 pounds) divided evenly between a forward compartment behind the engine and a second identical compartment behind the cabin. The gasoline version has a small baggage compartment behind the two occupant seats, but the Electro loses that space to the batteries.

The batteries themselves are individual 3.7-volt (when charged) cells linked into what Pipistrel calls

The Siemens-provided engine, right, produces 60 kW, but is capable of higher power. Lower photo, Crt Gorup installs one of six 46-pound battery packs. Three are stored in the nose, three behind the cabin. Each box has an always-on capacity and health display and a cooling fan used during charging, bottom photo.

"logical cells" consisting of three individual cells. These logical cells are grouped together in a single, quick-change battery box containing 36 logical cells or 108 individual cells. There are six quick-change boxes, for a total of 648 cells. The airplane's nominal system voltage is 324 to 453 and to achieve this, the individual cells are wired in parallel to form the logical cells and the logical cells in series so that each of the battery compartments produces 399 volts. The compartments are in turn connected in parallel to drive the motor.

If all of this sounds straightforward, it's anything but simple. Each battery box has its own battery management system, which are in turn overseen by a central computer of Pipistrel's own design, according to Crt Gorup, who wrote the computer's code. To call this system sensor rich is an understatement. There are a dozen temperature sensors alone in each battery box, plus additional sensors for connectors to monitor heat buildup from high resistance and temperature sensors for the motor and inverter. There's even coolant to keep track of.

That's right, coolant. The brushless DC motor Siemens provided for the Electro is so power dense that its internal windings require cooling, which is done via a small pump circulating a glycol blend from a reservoir behind the motor. Does that mean that electric airplanes have radiators? The Alpha Electro does and it's about the size of a Rotax oil cooler. It channels air through an inlet on the belly and yes, Pipistrel had to contend with cooling drag, even though high cruise speed is not the Electro's forte.

Similarly surprising is that the motor is geared, not direct drive as we might have expected. The reason for this appears to be an artifact from the motor being developed for other than aircraft use. Pipistrel founder Ivo Boscarol declined to say what the application was, but we suspect it's automotive. Boscarol said future iterations of the motor are likely to be direct drive, lighter and cheaper. "There will be more companies with motors." Boscarol said. "There will

To keep track of battery capacity, the Electro has a dedicated graphic monitor, left. Instruments and controls are identical to the gasoline Alpha. Smart charger, lower photo, tops batteries in about two hours.

have to be. Electric airplanes won't be competitive with gasoline if the electric engines cost as much as the rest of the airplane."

In the Electro, Pipistrel limits the electric engine to 60 kW or about 80 HP, the same as the gasoline Alpha. Even though the engine is capable of more output, Pipistrel wanted the airplane to perform exactly like the gasoline version and more power would guzzle the Electro's limited battery capacity, stunting its endurance further.

Pipistrel has priced the Electro at about €100,000 or $113,000 at recent exchange rates. Battery replacement cycles are expected to be about 2000 hours at a price comparable to a Rotax overhaul. It's unknown if the batteries will deliver this kind of service life, but Pipistrel's testing suggests they will.

CHARGING, ENDURANCE

At the EAS, Pipistrel's Tomazic quipped that the Electro's batteries were "600 little nightmares," an inside joke that a battery-savvy audience that was about to sit through an NTSB review of Boeing 787 lithium-ion fires resonated with. But lithium-ion safety is no joke and everyone in the industry knows it. Although fires due to cell shorts and unbalanced charging are a worry, the exact numerical nature of the risk for aircraft remains undefined. Given what is known, Pipistrel says it has taken appropriate precautions. The cells are contained in carbon fiber thermally isolating housings that form the removable, quick-change boxes and because the airplane should never be more than a minute or two from a runway, these are intended to provide sufficient protection.

But Pipistrel's philosophy appears to be to engineer a charging, monitoring and battery management system that will forestall thermal events in the first place. The system's lavish voltage and temperature sensing should quickly detect impending electrical anomalies.

Lithium-ion battery fires occur for two principle reasons: Cell shorts and unbalanced charging between cells, with the latter the more common. To keep cells balanced and produce the highest capacity battery packs, Pipistrel sorts the individual cells according to measured capacity and rejects as many as 5 to 7 percent as outliers because each cell array is balanced to the lowest output cell. This yields more efficient battery arrays that the battery management system can easily balance.

Pipistrel developed its own smart charger for the aircraft which plugs into a socket on the bottom of the fuselage. The charger senses the required charging voltage and will automatically halt charging if it detects significant imbalance between the logical cells. It's not capable of isolating individual imbalanced cells. In the aircraft, voltage is delivered from the two battery packs through two separate contactors. When the cockpit battery switch is activated to close the contactors, there's a noticeable delay as current is routed through a resistor to allow the system to correct minor imbalances. If the imbalance is too great—theoretically unlikely because the packs are charged together—the airplane's computer won't allow a power up. In other words, although the airplane's system monitor is capable of displaying all this, it's transparent to the pilot.

Charging should take two hours, but more or less depending on available electrical service. Three-phase power, which commercial hangars often have, results in faster charging. Pipistrel's marketing idea is to sell a school two Electros with one spare battery set between them, allowing charging while the aircraft are flying.

TV ELECTRO VIDEO

AVweb
www.avweb.com

FLYING IT

We took two brief flights in the Electro, both with fully charged batteries. Pipistrel's Nejc Faganelj did the demo flying. Preflight consists of familiar airframe checks, plus checking the charge and health level of the batteries. Each individual battery box contains its own

monitor similar to the Paperwhite display Amazon uses for Kindles. Battery charge state and health state are annunciated, along with internal temperature. In lithium-ion batteries, health state refers to loss of cell capacity with aging—a measure of actual battery energy capacity compared to what they could hold when new.

By intention, the Electro panel looks the same as the gasoline Alpha does—same instruments and arrangements. But in place of an engine monitor, the Electro has a battery system monitor that minds total battery capacity, motor, inverter and battery temperatures, RPM and a separate battery powering the avionics. The avionics battery charges from the main system batteries, as necessary.

Four switches at the bottom of the pedestal activate the aircraft systems with the right most switch a power enabler to conncect the batteries to the motor. The switch circuit has an electronic throttle-position sensor that won't allow the motor to become active unless the throttle starts at zero. There's really no run-up; just a final check of trim and battery capacity. Interestingly, when the airplane is lit up, there's a noticeable buzz that sounds just like a priming pump. It's the coolant pump for the electric motor.

Once the throttle is advanced, the airplane flies likes its gasoline counterpart with similar acceleration and climb. No surprise there, since it has the same power. What is surprising is the noise. There's no silent whoosh of clean electric power, but a noise level similar to the gasoline version, with slight prop-tip noise and pulsing against the windshield from the prop slipstream. From outside the airplane, however, the Electro is downright stealthy. After our pattern flights, Faganelj flew a series of low-altitude, high-power flybys. The airplane isn't quite silent, but its noise is barely discernible until it's quite close or has flown past.

Although the Electro is supposed to be flown no differently than the gasoline version, there may be slight variation in technique. Because it has plenty of power and low drag, Faganelj reduced power after takeoff from a high of 77 kWh indicated to about 60 kWh. (The same technique is recom-

continued on page 32

On The Horizon

A TILT TOWARD HYBRIDS

Pipistrel's early-to-the-finish line Alpha Electro may be the first commercially viable e-airplane, but there are other projects on the developmental horizon. Judging their technical merit is an academic exercise, but the companies pursuing them obviously believe there's a future in electrics, so these are worth a mention here.

If there's any emerging trend in electric airplanes, last April's Electric Aircraft Symposium in Santa Rosa, California, revealed it to be a tilt toward serious investment in hybrid-drive aircraft. Airbus has announced an ambitious project, Diamond has done the same and is partnering with Siemens AG, whose breakthrough super-efficient motors for electric aircraft were detailed at the symposium.

Another U.S. manufacturer, Aero Electric Aircraft Corp., is leveraging technology developed by PC Aero in Germany to produce what it hopes will be a certified solar electric trainer for delivery in 2017. AEAC has an order from Spartan Aeronautics reserving the first 20 of its Sun Flyers for the school's long-established aviation program. We're not sure how firm that commitment is.

Electric airplane development has been propelled mostly by small companies or startups. But the Airbus entry into the market with its proposed E-Fan project showed that larger players are at least interested in e-flight as showcase efforts. Although the $53 million Airbus has committed to its electric flight project is but a rounding error in the consortium's $60-billion-plus business, it appears to be the largest above-ground electric development program to date and is certainly the most ambitious.

In a partnership with a handful of other companies, including Safran and Daher, Airbus formed a new subsidiary, Voltair SAS, to develop two aircraft. The E-Fan 2.0 is promised for 2017 and will be an all-electric, battery operated two-seat trainer powered by a pair of ducted fans.

The E-Fan proof of concept made its first flight in March of 2014 and was displayed at the recent Paris Airshow, where it completed its 100th flight. Performance details remain sketchy but from what Airbus has released, it's similar to the Alpha Electro, with the longest flight lasting about 50 minutes. A flight across the English Channel is planned.

At EAS, Airbus' Ken McKenzie revealed something interesting about the E-Fan 2.0: It taxis to the runway with chain-driven wheels rather than thrust from the propeller. He said Airbus found this to be more efficient. Despite relatively few test flights, Airbus has taken on 10 industrial partners and aims to go after the same market

Siemens brushless motor

Airbus E-FAN


Diamond Aircraft hybrid

Pipistrel is: flight training in Europe. The company announced the E-Fan 2.0 will be manufactured in Bordeaux, in the south of France, with deliveries in 2017 planned.

"The battery technology continues to evolve and change. The important part for us is to lock down what technology to use; if you decide on one today and another one comes along tomorrow, you suddenly say, why did we do that?" McKenzie said. One of the technologies Airbus will have is what it calls an EFAC, a motor controller and electrical management system that can isolate individual battery cells, if necessary.

Even more ambitious is the E-Fan 4.0, a four-place hybrid that Airbus plans to aim at the U.S. GA market with aircraft certified and available before 2020 for both the training and the personal aircraft market. The 4.0 will be built and serviced in the U.S. "To give us the range that we want, the energy density for the batteries just isn't there yet. So we're going toward some kind of hybrid drive," McKenzie told us. He didn't offer details on this, but the other hybrids we know of—Diamond and Pipistrel—are serial hybrids that use a combination of a small engine driving a generator and a battery pack, with the batteries providing takeoff and climb burst power and the engine the cruise and battery recharge capability.

And that's what Diamond Aircraft has in mind with its next electric hybrid project, its third such effort. Working with Siemens, the new aircraft will be based on the company's DA40 airframe and will have two small electric motors in pods mounted on a canard.

Primary power will come from an Austro AE300 diesel driving a generator to both power the motors and charge the batteries, which will consume the airplane's entire back seat, says Diamond CEO Christian Dries, rendering the hybrid a two seater.

But load carrying isn't the point of the new project, Dries said, proof of concept and certification are. "This airplane is based on serial-production technology. Most likely this airplane will not come on the market," Dries told us, "but this is a so-called certifiable program. That means in this airplane, we help the authorities set the standards for electric airplanes."

The two motors weigh less than 30 pounds, but each deliver 85 kW or 114 HP. Battery weight totals 200 kg or 440 pounds, the heaviest battery payload of any small electric aircraft we know of. At typical cruise speeds of 110 to 120 knots, the airplane is expected to have a 10-hour endurance, burning about 1.8 GPH. Diamond has no specific timeframe on when the first flight will occur. "That depends on the authorities," Dries said.


AEAC Sun Flyer

While Pipistrel is out front with its pure electric Alpha Electro, it's also making a major investment in electric hybrid technology with its Panthera retrac. While the gasoline model suffers delays as the company reconceives it with a new engine, the hybrid version continues to advance. During our visit to Pipistrel's Ajdovščina, Slovenia, factory, Vid Plevnik told us the Panthera hybrid may appear as early as next year's Aero show in Friedrichshafen, although not in flyable form.

Like the Diamond and Airbus concepts, the Panthera is a serial hybrid using a small gasoline engine to drive a generator. Lithium-ion batteries in the wings provide burst power for takeoff and climb. Plevnik said for the first-generation hybrid, the Panthera will have a turbocharged Rotax 914 and batteries of lower energy density than those used in the Electro, but capable of much higher short-term discharge rate. Economy of flight isn't the primary driver here, but the ability to operate unhindered by density altitude with the safety of a secondary power source.

At AirVenture last year, Aero Electric Aircraft Corp. showed a single-place electric trainer called the Sun Flyer, which leverages technology developed in Germany by PC Aero. It uses conventional lithium-ion batteries whose endurance is extended by solar cells on the wings. AEAC is developing a two-place version of the airplane which it plans to certify under the primary category for a price under $200,000.

From China, comes the Yuneec e340 pure-electric trainer which flew at AirVenture in 2010. Although the company's website says the airplane continues in development, calls and e-mails to GreenWing International, its U.S. distributor, weren't returned. The company says it's also taking deposits on the eSpyder, a single-seat experimental electric.

Also from China is the RX1E developed by Shenyang Aerospace University. The company claims to have delivered its first customer aircraft in June and says it will have one at EAA AirVenture in July. Cost is $163,000 for a two-seat, sport/trainer type aircraft.

Parts Support For LSA: Fleet Size Matters

Parts support for popular LSA models is improving, thanks to maturing infrastructures and better parts inventories. An increased American presence is helping.

by Larry Anglisano

CHECKLIST

- ⊕ Improved parts network means less downtime for popular foreign LSAs.
- ⊕ Brands that sell both LSA and Part 23 models could have a parts inventory advantage.
- ⊖ Major structural damage could mean long downtime while manufacturers engineer a fix.

Let's face it, compared to a Piper Cherokee or Cessna 152, many LSAs have complex systems and specialized parts. Imported models are often tainted by concerns of less-than-acceptable field support when they break.

AIRCRAFT OWNERSHIP

Whether it's dealing with composite structure damage, a failed Rotax engine or an emergency service bulletin, the efficiency of scheduled and unscheduled maintenance should be a sizable consideration in the buying decision. This includes parts support.

Several years ago while comparing the operating costs of a Cessna 152 and a Remos LSA for training, we concluded that the Cessna can be more profitable because, in part, replacement parts are generally more available.

That means less downtime—critical in a training environment—and less hassle (read buyer's remorse) for recreational missions. As one LSA owner put it, "If I wanted a $180,000 hangar queen, I would have bought a vintage Ferrari."

A more mature parts and support chain, we thought, could be convincing enough to spend serious money on an imported LSA. To find out what and how manufacturers are doing to improve upon the support of popular models, we talked with fleet operators, individual owners and visited with a couple of LSA distributors and service centers in the U.S. The takeaway? We see an improving support trend, likely the result of a maturing market.

DOMESTIC ADVANTAGE?

When it comes to LSAs, buying American is the ticket to great support, right? Not so fast. Remember, Cessna's attempts at supporting its LSA—the Skycatcher—failed miserably, perhaps proving how difficult the task really is.

But indications show that sourcing parts domestically might get the aircraft off the maintenance floor more efficiently (and cheaply) than waiting for a parts container to arrive from Germany, as an example. Still, we found signs that skillful parts managers on the distributor level are better managing those logistics. More on that in a minute.

Helen Woods at Chesapeake Sport Pilot in Stevensville, Maryland, relies solely on an impressive variety of LSA models at her sport pilot school. With a flight line that includes a Van's RV-12, a Tecnam P92, a Searey amphib and a Sky Arrow, plus prior experience operating other LSAs, including models from Flight Design and Remos, she told us American-made models have a much improved return-to-service record than the foreign models she has operated.

"I'm transitioning my fleet of LSAs to an all-American line. We've seen a major change in the past three years

The advantage to Flight Design USA's assembly and maintenance floor, main photo, is a generous inventory of factory new and rebuilt replacement parts. It's skillfully managed based on the fleet's service demand history.

AVIONICS SUPPORT: GARMIN, DYNON RANK HIGH

That's not surprising since avionics repairs and exchanges for both brands are sourced domestically—Garmin is in Olathe, Kansas, and Dynon is in Woodinville, Washington. Only one LSA operator we talked with dinged Garmin for its support performance, which is unusual, based on our experience. It had to do with a failed portable navigator being used as the primary display in the panel of an older Flight Design CT. Since it was in reality a portable unit, the failed device wasn't given priority replacement status because Garmin doesn't consider portable units primary gear. But that was before Garmin assembled its Team X dedicated LSA avionics engineering and support division—a dominent commitment to the LSA market—that hasn't gone unnoticed by any LSA maker we talked with.

But overall, distributors report that Garmin and Dynon perform nearly equal when it comes to supporting their LSA/experimental (and some certified, in Garmin's case) avionics. Expect expedited component replacement for systems still covered under the factory warranty, which is generally two years for Garmin and one year for Dynon. For out-of-warranty repairs, most major components will need to be shipped back to the factory for repair. This entire process—from troubleshoot to reinstallation—could take a couple of weeks, billed at flat-rate factory pricing. Out-of-warranty repairs on Dynon EFIS displays, for example, run $250, plus freight. A failed Garmin G3X display is $650 and includes two-day shipping costs.

Keep in mind that for imported LSA models shipped from overseas, it's the distributors that will likely be installing the equipment during the assembly phase. While many of the systems come out of the shipping crate with prefabricated wiring harnesses, you can still be faced with avionics problems, which may be the result of faulty wiring connections or the rare infant mortality associated with new equipment.

The trend of more avionics is better continues. For full-panel equipage, we found that many LSA manufacturers are offering buyers the option of either Garmin's G3X Touch integrated avionics or Dynon's SkyView suite. But you'll also find options for TSO-certified equipment, including Garmin's flagship GTN750 IFR touch navigator. Since this is complex equipment, you'll want to ask a distributor how much experience it has installing advanced avionics and whether it teams with an avionics shop during the avionics portion of the assembly process.

with second generation light sport models. With more American manufacturers—particularly kit manufacturers—I see the parts problem going away," Woods told us. This also does good things for the bottom line.

"Not only can I readily get replacement parts, the parts are dirt cheap because some kit manufacturers have been building parts far longer than they have been building LSAs," she noted. Chesapeake Sport Pilot has operated over 20,000 hours in LSAs and was one of the first LSA-only flight schools to dive into the niche market. It's also one of the few survivors.

Woods has been so impressed with the service and parts support from Van's Aircraft, she's adding a second RV-12 SLSA to the fleet.

BIG ROCKS, TALL PROPS

The upper end of the LSA market is becoming crowded with respected American LSAs, including models from Legend Aircraft, Cubcrafters, Van's Aircraft and RANS Designs, to name a few.

John Whitish at Yakima, Washington-based Cubcrafters described the advantage of having a model line that includes both LSA (Carbon Cub SS and Sport Cub S2) and Part 23 certified (Top Cub) models.

"We were already well conditioned before we even entered the LSA space. Almost every major component is built at our Washington location," he told us.

Well, perhaps not every component, and that invites at least some parts logistic delays. Like many others, Cubcrafters sources systems like brakes, tires and wheels from outside vendors, including integrated avionics from Garmin and Dynon. On a side note, Cubcrafters isn't the only manufacturer that's seen impressive demand for Garmin's G3X Touch integrated avionics. Like most other manufacturers, it will also offer Dynon's capable Skyview suite, but notes that 85 percent of customers buy the Garmin G3X Touch over the Dynon SKyView panel.

Cubcrafters operates lean, but well-stocked, due to a diverse parts manufacturing line that feeds multiple products.

"Our parts department is responsible for supplying the line of production aircraft, our kit aircraft and also the source for all of the service parts," Whitish said.

The kit aircraft he's referring to is the $220,000 Carbon Cub FX Builder Assist model. As of June 2015, Cubcrafters has a fleet of 376 LSA models.

Not to say you can't break one, but Cubcrafters could have a service advantage because of its rugged, backcountry-designed product. Whitish acknowledged the $184,000 Carbon Cub SS comes with relatively lightweight conventional landing gear, but offers a heavy-duty gear option. Still, Whitish doesn't see landing gear prangs as being a real issue with its airplane's owners. But

The Cubcrafters Carbon Cub SS LSA, right, comes from a family of Part 23 models. This vertical integration keeps major parts manufacturing in-house, in America.

if you do ball one up, Cubcrafters is growing the network of existing 28 service centers.

IMPORT SUPPORT

Most operators we spoke with gave Germany's Flight Design acceptable marks for parts and maintenance/repair support. Much of that, in our estimation, has to do with a polished U.S. distributor infrastructure and a large fleet, compared to other foreign brands.

On the day we visited Flight Design USA's Woodstock, Connecticut, headquarters we found an operation that was purposely configured for efficient around-the-country parts and in-service support. This included nearly $500,000 of on-hand replacement parts. It also has the ability to offer spares and in-house composite and propeller repair. Flight Design USA's Tom Peghiny said support was a major focus from early on.

"Flight Design realized a long time ago that parts support is crucial to its fleet. If it was going to build a market in the U.S., it had to be able to support it. Part of that support effort allows us to build our inventory with factory consignment parts," Peghiny told us. Since the distributor only pays for the parts it sells, this arrangement allows for well-stocked shelves for supporting not only its own service operation, but the other several distributors scattered around the country. It also eliminates the stress of tying up serious money in a parts inventory.

There are currently over 400 Flight Design models flying in the U.S. and over 1800 worldwide. In LSA numbers, that's a sizable fleet and advantageous, in our view, for building a support network that stocks the most commonly used replacement parts. Unlike smaller brands that might only have a handful of aircraft in service, the existence of a larger fleet makes it easier for parts and service managers to know which parts are likely to fail—based on historical trends—and stock their inventory accordingly. But it's far from perfect.

The ugly side of LSA upkeep is dealing with damaged landing gear components the result from runway mishaps, a trait that's haunted the lightweight fleet almost since day one. In turn, savvy distributors keep a healthy supply of replacement landing gear struts and wheel fairings in inventory to help expedite the repair. It really comes down to customer service and preparedness.

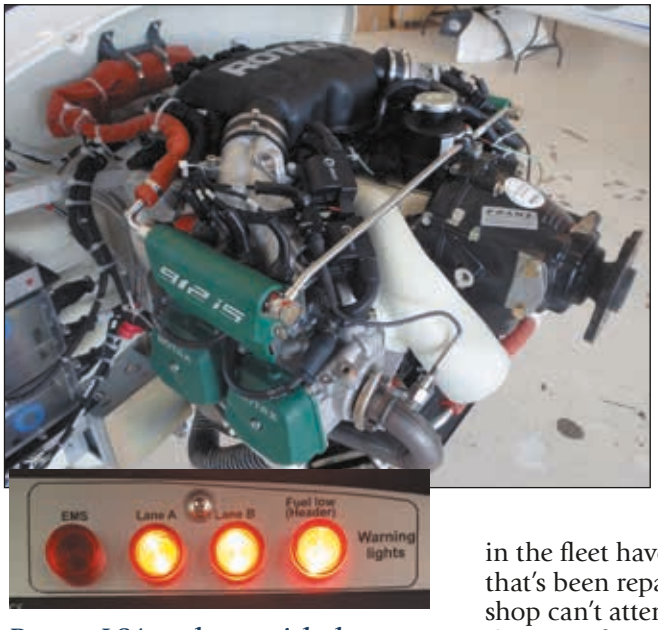
"I understand that when a customer spends $180,000 on a new airplane, there is an expectation to have it back from service in a reasonable amount of time," said Mat Fortin, Flight Design USA's parts manager. That's the support language we were looking for and saw evidence that Flight Design's U.S. support infrastructure is on the right track—and expanding.

Distributors like Flight Design USA can also handle the general support of parts for other brands, particularly when it comes to composite component repairs and in-house support of Neuform composite propellers.

Shannon Yeager from Tecnam US in Sebring, Florida, reiterated that the new Florida sales and assembly facility is a direct investment by Italy-based Tecnam to better support its U.S. and Canadian customers.

"We have onhand nearly 80 percent of the service parts for all of our current products, both LSA and Part 23 aircraft. But I have to say with honesty that there has been some design changes from earlier models, so I can't say that I have the entire legacy fleet covered all of the time," Yeager told us. But Yeager also said that parts requiring special manufacturing might be sourced (from Italy) in around four days. This handoff from overseas is more than acceptable, in our estimation.

In the LSA world, broken landing gear components have become a shrug-off. Larger distributors and service centers have learned to keep replacements on hand for the next prang.



Buy an LSA and you might buy an Austrian Rotax engine, including the 912iS, top. Operators and manufacturers we talked with generally had good things to say about support and dispatch rates, but a common nuisance relates to engine control computers and LANE annunciator management, bottom.

"Our location here in Sebring, Florida, puts us in better proximity to Miami, our inbound parts shipping location. The Sebring location is also where we distribute parts to service centers in Virginia, California and Minnesota," Yeager said.

Interestingly, Yeager described an international shipping zone that's in the works for the Sebring, Florida, facility that could prime the parts pump even more. Not having to pay customs fees until a part is sold can free up capital, while the operation stocks the shelves with more parts.

It's worth noting that Tecnam once built fuselage parts for Airbus and McDonnell Douglas. As for aftermarket LSA support locations, Tecnam is slowly growing its national network, while being cautious about bringing on new service centers without properly training them. There are roughly 400 Tecnam LSAs in service. It's currently waiting for Part 23 certification of its P2010 four-place single.

ENGINEERING HOLDS

It's not only parts sourcing that can ground an LSA, especially for composite designs. Major repairs (guidelined by AMST standards) requiring repair instruction—essentially specific direction from the manufacturer on how to go about a repair—can delays the aircraft back to service.

For instance, should you drive your LSA into the pavement hard enough to cause structural damage that other aircraft in the fleet haven't sustained (or that's been repaired), the servicing shop can't attempt the repair until the manufacturer engineers an official fix, or repair instruction. That's where a larger fleet has an advantage, since there will be a larger archive of previously approved instructions.

On the other hand, factory engineering delays recently kept a Cirrus we use for product evaluations grounded while the factory engineered a fix for a delaminated fuel tank structure. Sometimes delays are unavoidable, no matter the size of the fleet or whether it's an LSA or a traditional Part 23 aircraft.

When sourcing special order repair parts for imports (those not in stock in the U.S.), the common delivery timeframe we kept hearing during our research was "roughly three weeks." But it could be much longer. Consider that Flight Design, as one example, first sources most major parts from Ukraine before the parts are sent to Germany for distribution to the U.S. and elsewhere.

Flight Design USA's Peghiny noted that some parts could take several months before arriving at a distributor, although the customer might have the option of paying for expedited air freight. For large components, freight costs are huge.

ROTAX GUSHES AND FROWNS

Owners and manufacturers generally have favorable things to say about Rotax, which has nearly 40,000 engines flying. You won't hear about stuck valves, connecting rod failures, improperly seated rings and other issues that could plague what some naysayers might call "real" aircraft engines.

During our research, we did hear about issues involving Rotax charging systems, particularly in aircraft loaded with lots of current-drawing electronics. While there have been some efficiency gains through the use of LED lighting, for example, there is a worthy option for upgrading to an alternator to better handle larger loads.

If you've never operated a Rotax, expect some learning curve, and perhaps different maintenance issues than you might experience with a Lycoming or Continental. More than one distributor dinged the 912iS engine for nuisance LANE engine control unit (ECU) annunciations and other sensor-related quirks, but also admitted to at least some operator error when it comes to dealing with the Rotax ECU and ignition system.

"While it's a strong and efficient performer, the realities of our customer experiences have been the disappointment with the still-evolving Rotax 912iS," said one LSA distributor that wished not to be named. Instead, he favored the turbocharged 914 or 912ULS models.

Tecnam's Yeager also favors the 115-HP, 2000-hour TBO Rotax 914 as the forward-looking powerplant of choice for his company's LSA models.

"Having the 914 on the airframe gives a buyer the advantage should the LSA speed rules relax. If those rules change, the 912 could lose some value," he said. We'll look at Rotax field support and reliability statistics in an upcoming report.

HOW YOU MIGHT CHOOSE

The takeaway of our investigating comes close to contradicting the assumption that an American-made LSA will offer the easiest serviceability from a parts availability standpoint. Our own experience working on the shop level proved that quickly sourcing parts for American brands—including Part 23 models from Beechcraft, Cessna and Cirrus—isn't always a sure thing.

More of a gauge at how parts support might go for any LSA—foreign or domestic—is the size of the fleet, the size of the parts and support infrastructure and whether or not the company has a diverse product line, to include Part 23 models. Still, you should expect longer periods of downtime while shops source special-order parts outside of the U.S.

Thankfully, more established brands seem to be figuring out how to get better at keeping more parts on hand and LSAs in the air.

Fuel Pumps: Overhaul On Condition

The fuel pumps in your airplane should last to engine TBO if the fuel system is kept clean. If one does fail, overhaul is usually less expensive than buying new.

by Rick Durden

Some years ago I was taking an IPC and FR in a Piper Aztec. A few minutes into the climb, I shut off the aux pumps, one at a time. A few seconds later, one engine quit. I turned the pumps back on and the engine restarted. After leveling off and setting low cruise power, I tried turning off the pumps again, and found that the left engine was the problem. It would run fine with the aux pump on; not at all with it off.

I assumed that the engine-driven fuel pump had failed. I called ATC and said I was returning. On landing rollout, the left engine quit and wouldn't restart. I foolishly taxied to the FBO on the right engine, a fire truck following uselessly. As I shut down the right engine, the chief mechanic appeared and told me in a loud voice that there was fuel dripping from the left nacelle.

The problem wasn't the engine-driven fuel pump; it was a cracked fuel line. It was then that I started learning that aircraft fuel pumps, whether engine driven or electrically powered, rarely fail.

As I researched this article, the reliability of aircraft fuel pumps, as compared to other components on our airplanes, was pointed out to me by every mechanic and overhaul technician I spoke with. I guess it shouldn't be a surprise—pumps for moving liquids have been around for centuries, so one would expect the design and manufacture of such relatively simple devices to have been sorted out.

While most engine-driven fuel pumps are rotary pumps, just like vacuum pumps, the vanes are metal, rather than graphite, so there's no expectation that they will come to pieces every 800 hours or so. Diaphragm fuel pumps are equally reliable.

While doing my homework, I also found that it's much more common for a pilot to have an engine stoppage because he or she does not know the aircraft's fuel system or misuses the boost/aux pump than because a pump fails. Where turning on the electrically-driven fuel pump as a backup for the engine-driven pump is part of the pre-landing checklist on a Piper Arrow, doing so on a Bonanza will probably flood the engine.

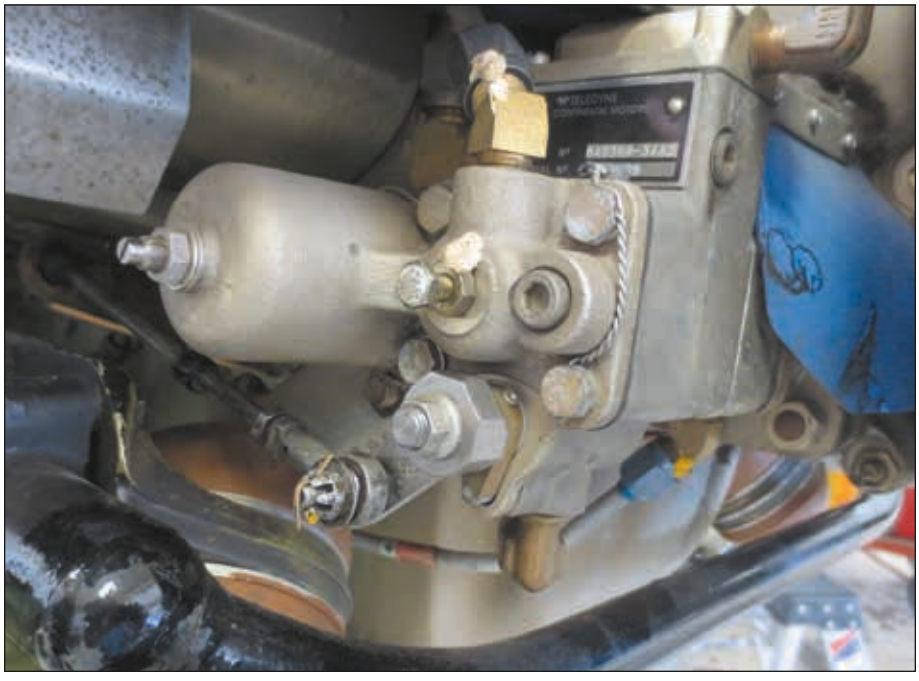
WHAT PUMP?

Whether you have to even be concerned about fuel pumps depends on the type of airplane you fly. The whole idea behind a fuel pump is to either get fuel to the engine or transfer fuel among tanks in the airplane. If you can't transfer fuel in your airplane and it has a high wing and a carbureted engine, there's no fuel pump—gravity gets the fuel to the engine. The fixed-gear Cessna Cardinal is an exception due to its wing/engine geometry and FAA certification requirements.

If you are flying a low-wing airplane or one with a fuel-injected engine, it will have an engine-driven fuel pump and a boost or aux pump. (I'll use aux and boost interchange

CHECKLIST

- Your fuel pumps should last through your engine's TBO.
- Debris in the fuel system is the prime killer of fuel pumps.
- Fuel leaking from a pump is a no-go item. Overhaul or replace before flight.



That is a Continental engine-driven fuel pump on a Piper Seneca's TSIO-360 engine.

KNOW YOUR FUEL SYSTEM

When I review accident reports for the Used Aircraft Guide, I'm struck by how often pilots mismanage the fuel system. Usually it's running one tank dry and not figuring out how to get fuel flowing to the engine from a tank that has fuel. From time to time a pilot pumps fuel overboard because he doesn't understand that on a fuel-injected engine, fuel and fuel vapor is returned from the engine-driven fuel pump to one of the fuel tanks.

On some airplanes, the return fuel and vapor goes to a designated tank rather than the tank the pilot has selected to get fuel to the engine—notably on tip-tank Cessna twins and early model Bonanzas. If the tank that is receiving return fuel and vapor is full, the excess will be pumped overboard, reducing the range of the airplane.

Know where the boost pump is located so you can check the area during preflight for signs of fuel leaking.

Make sure you understand how your boost pump is intended to work in conjunction with the engine-driven pump.

If the boost pump runs on standby, so to speak, on takeoff and landing, to supply fuel if the engine-driven pump fails, the checklist will call for it to be on for takeoff and landing, but off during the remainder of the flight.

If the checklist calls for the boost pump to be off during takeoff and landing, it is to be activated by the pilot only if the engine-driven pump quits. Turning it on—to either low or high position—with the engine-driven pump running, will result in excess fuel being supplied to the engine, potentially flooding it.

Should you experience fuel flow fluctuations—usually at altitude or climbing on a hot day—it's probably due to the fuel vaporizing in the lines. The solution is to turn on the boost pump—to the low position if there is a choice. That should clear up the problem, but it also requires adjusting the mixture as the increased fuel flow will have the engine running too rich.

ably.) If the engine is carbureted, the aux pump is a backup should the engine-driven pump fail. If the engine is fuel injected, the aux pump is a backup and is also used to prime the engine for starting.

Per its name, an engine-driven fuel pump is attached to the engine and driven off the accessory case. A boost pump is electrically driven.

Depending on the airplane, it may not be possible to start the engine if the aux pump has failed. Some may start without priming, and most twin Cessnas can use the aux pump for the other engine with the fuel selector in crossfeed to prime the engine with the dead aux pump. Nevertheless, I strongly recommend against flying an airplane with an inoperative aux pump—plus, it's in violation of the FARs.

LONGEVITY

We were told by users, maintenance shops and overhaul facilities that engine-driven and aux pumps routinely last to engine TBO. The manufacturers call for overhaul at engine TBO or at a calendar-year interval, most commonly 10 to 12 years.

The enemy of all fuel pumps is debris. According to Mark Mercer, chief inspector at Quality Aircraft Accessories, a major overhauler of fuel pumps, the failures he most often sees are due to debris that got into the fuel system when it was opened up to inspect or replace a component. He advised that any time the fuel system is opened up that it be flushed out before the aircraft is returned to service. That recommendation was echoed by Scott Utz, president of Arapahoe Aero at Denver's Centennial Airport. He also said that the fuel screen should be inspected and cleaned at every annual. Debris that has been caught by the screen can eventually fragment and work its way through and into a pump.

In addition to the good news that fuel pumps have a good record for longevity, they also don't require preventive maintenance. What they do require is looking at them on a regular basis to check for leaks.

If a seal or gasket wears out, it will probably lead to a leak—something not to be trifled with. Pull the pump and overhaul or replace it.

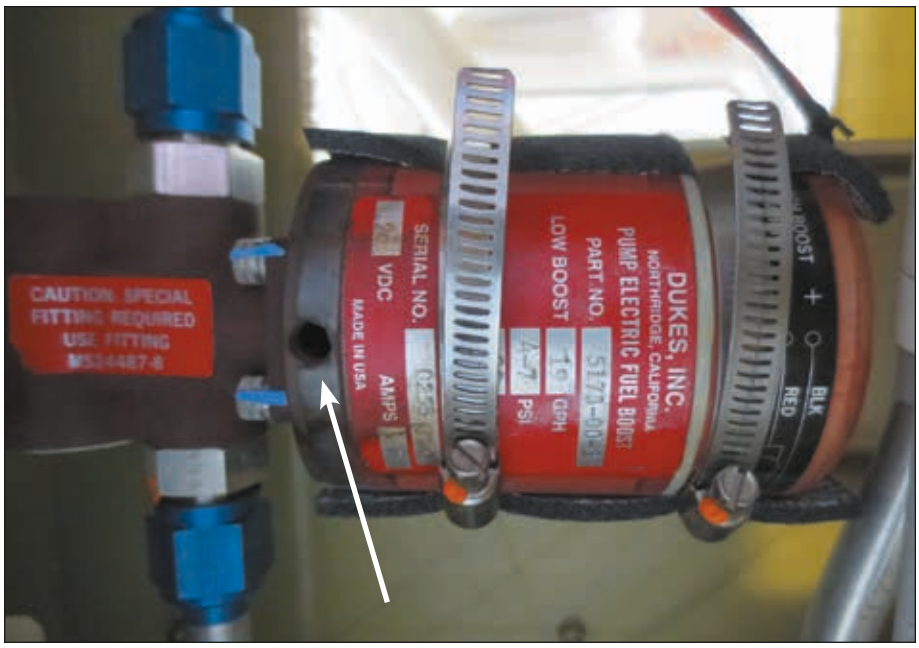
Many electric boost pumps are mounted somewhere between the fuel tanks and firewall. For instance, on a Beech Baron the boost pumps are in the wings; in a Cessna 210, the boost pump is just aft of the firewall, under the floorboards.

Boost pumps are made up of an electric motor, a pump and a space in between. If a seal or gasket wears out, the fuel is likely to leak into the space built to separate the fuel containing part from the electric motor. That space has a drain—and it may have a tube that carries through the aircraft's skin so that it can drain the fuel safely overboard. Know where the boost pump(s) is on your airplane and where you would expect to see fuel if there is a leak.

Scott Utz told us that there are two symptoms of a boost pump starting to wear out that a pilot can detect. When priming the engine, a pilot usually looks at the fuel flow or pressure gauge and holds the prime switch until the pressure/fuel flow reaches a certain level. If the pump won't generate that pressure, or it starts taking a longer time to do so, it's a warning that the pump is getting tired. Similarly, if the sound of the pump changes, especially if there's an unusual screech, a bearing may be going.

More and more owners are replacing or overhauling components on condition rather than at some set time in service. Mike Busch, maintenance technician and proprietor of Savvy Aircraft Maintenance Management, is an outspoken proponent of on condition maintenance. In talking with him for this article, he was quick to caution that if an owner is going to go to on condition maintenance for fuel pumps, he or she has to pay close attention to their condition. "They cannot ignore an odor of fuel when priming the engine. That's a condition and it means taking action."

Scott Utz warned us that if you experience a problem with the fuel system beyond a leaking fuel pump, take some time to troubleshoot the



Looking up at a Dukes aux pump mounted in the belly of a Columbia 400; arrow points to the fuel drain, right. Aux pump fuel drain on the belly of a Cessna 210, lower right.

problem. He cautioned that it's especially important on the Lycoming fuel injection system, as the engine-driven fuel pump and fuel servo are dependent on one another and a problem with one can manifest itself in the other. The fuel servo is expensive to work on—don't assume it's the problem. The issue may be with the fuel pump.

Debris in the fuel system may cause a properly working fuel pump to become your enemy. I had an engine quit on a Cessna 310 going through 60 knots on takeoff. After I got the airplane stopped, taxied in and complained, it was found that debris in the vapor return line from the engine-driven fuel pump blocked the flow of excess fuel and vapor from the pump back to the fuel tank. The pump was doing its thing just fine, but the blockage caused too much fuel to go to the engine, flooding it.

WHEN IT'S TIME

So the improbable has happened—your engine-driven fuel pump has a slow leak. You've had your A & P look at it and she's told you in no uncertain terms not to fly the airplane. What are your options to get back into the air?

You can buy a new pump, buy an overhauled pump or send the broken one out for overhaul. For engine-driven fuel pumps, the price differential between new, overhaul-exchange and overhaul is often low, sometimes only a few hundred dollars. Your choices for a new pump will be limited to the manufacturer of the pump installed by the manufacturer of the airplane and approved as original equipment or another pump manufacturer that has received a PMA or STC for its pump on your type airplane. That means a little homework on your part and price shopping.

There are several specialized shops approved to overhaul fuel pumps and suppliers such as Aircraft Spruce that sell new and overhaul exchange pumps. Most manufacturers, suppliers and overhaulers will get a new or overhaul exchange pump to you overnight—plan on returning your pump for core credit.

For boost pumps, the choice between overhaul and new is easy—there's a big price delta, so plan on buying an overhaul exchange unit if you're in a hurry or having your pump overhauled if you're not. Again, do a little price and manufacturer shopping as there may be more than one pump approved for your airplane and the price for overhauled units may vary significantly between types of pumps.

Trying to keep track of how many companies manufacture fuel pumps isn't easy. The rule of thumb is that the company that made the fuel pumps in your airplane will either still be in existence in some form (it may have a new name through merger or acquisition) or there is an overhaul shop that has approval to overhaul it.

If you want the lowest price and it's okay for your airplane to be parked for about a week or so, you can send your pump out for overhaul by one of the specialized shops. Mark Mercer said that his company, Quality Aircraft Accessories, turns pumps in three to five business days. A & Ps we spoke with said that turnaround time was consistent with their experience.

According to overhaulers and

mechanics, an overhauled pump is essentially as good as new because all parts subject to wear are replaced. Following overhaul, each pump is flow tested and set to meet the manufacturer's flow specs. Nevertheless, the flow will have to be fine tuned to match the particular fuel system quirks and condition once the pump is on the airplane.

CONCLUSION

Both engine-driven and electric fuel pumps have a good record for reliability and need no preventive maintenance other than to keep debris out of the fuel system. If you are going to ignore the manufacturer's recommendation on replacement/overhaul interval, then pay attention to warning signs that a pump is wearing out. If it's leaking, don't fly the airplane.

Garmin Improves The D2; Ups Its Camera Game

Garmin's next-gen D2 Bravo pilot watch steps up the styling and function, while the new VIRB X-series action cam has a simple menu structure.

by Larry Anglisano

With stiff competition in the sports wearable and action cam market, Garmin is wasting no time rolling out second-generation products aimed at the market it owns: aviation.

This month, the company unveiled its improved D2 aviator watch and a redesigned HD action camera—the VIRB X-series. Here is a field report of both.

EGO-STROKER

We thought Garmin's first-gen D2 watch was a yawner in the cockpit, although it worked well as a sports watch since it was born from the company's Forerunner cachet. But the first-gen D2 lacked the poshness of a Breitling or TAG Heuer, dressed down in utilitarian form. Of course, it costs far less and there's nothing wrong with utility over style. But, the new D2 Bravo steps it up a few levels in both styling and function.

A redesigned stainless steel bezel, domed sapphire lens and a hefty leather band give the $699 D2 Bravo a look and feel that means business.

The previous D2 had decent battery life and the D2 Bravo is better, ticking (electronically) for six weeks in normal watch mode and 20 hours in GPS mode. Its redesigned EXO GPS WAAS antenna makes for a smaller footprint and quicker position lock-on than the older watch.

Garmin's D2 Bravo, main photo, finally looks and feels like a real pilot's watch. The VIRB XE's build quality is rugged enough for exterior mounting.

CHECKLIST

- The D2 Bravo aviator watch has higher-end styling that was missing in the old model.
- We think the VIRB X cam is easier to manage than the GoPro.
- We're still not entirely sold on wearable technology for the cockpit.

The Bravo's function display is total electronic, with a high-resolution color screen and LED backlighting. We flew with it in a sun-splashed cockpit and found it easy to read at a glance, plus it's an easier read than a Pebble, in our view. Its feature set and menu structure is relatively shallow and main controls are limited to five function keys—three on the left and two on the right—side of the bezel. We like the Bravo's display of Zulu/UTC time because it is, after all, a wrist watch.

The Bravo has a worldwide aviation database for straightforward direct-to and nearest airport navigation. Hold the upper left function button and a list of nearest airports appears. Once you select the airport as the destination, the display shows an electronic HSI in relation to GPS track data, plus distance to the destination, in addition to a bearing marker on an electronic track display. You can also select a basic moving map display. A bit much for the pilot who also has a ton of navigation data on a tablet computer, and perhaps on the instrument panel? Maybe, but not a bad tool for backup, in our view.

The Bravo has an altitude alerting function, which is accessed on the devices altimeter page. It allows

D2 BRAVO WATCH AT A GLANCE

From left to right, above: The D2 Bravo watch has an electronic HSI display, which is based on GPS track data. It's an awkward way to navigate, in our estimation, but whatever works for backup, right? Perhaps more useful is the display of textual METAR data, which is sent to the watch from Garmin's Pilot tablet app. The waypoint page is useful for quickly identifying navigation data to nearest waypoints. Finally, the Bravo offers some of the same athletic functions as the Forerunner sports watch, but the Forerunner is better packaged for extreme sports.

you to select a target altitude vibration alert when reaching it, based on pressure altitude. Barometric pressure can be manually set to better the accuracy of the sensor. Additionally, the Bravo watch provides vibrating alerts in 30-minute intervals to notify you when cabin pressure is at or above 12,500 feet.

WIRELESS CONNECTIVITY

Inside the Bravo lives a capable sports watch (it comes with an interchangeable sports band), and like other devices in Garmin's wearable line has full wireless connectivity with ANT+ sensors. This includes a heart rate monitor and bicycle cadence sensors. It also has a dedicated swimming, skiing and snowboarding mode, plus it's compatible with the HRM-Run accessory for full running dynamics.

It also has wireless Bluetooth connectivity—integral to receiving textual weather from Garmin's Pilot app running on an iPad or Android tablet. METARs are color-coded and displayed in plain language format, but don't expect radar graphics—the display is too small, anyway.

Connectivity with the smartphone also enables email and text notifications, a function we have learned to appreciate with Garmin's new Forerunner sports watch.

Let's take a look at Garmin's redesigned VIRB X-series HD action camera, which has connectivity with the D2 Bravo watch. The Bravo enables video camera start and stop, plus still-photo capturing.

GOPRO WANNABE?

That was our first impression while pawing the new VIRB XE camera. One of the traits we liked most about the first-gen VIRB (Garmin still sells the original VIRB Elite, for now) is the large record start/stop slide switch. The new X has a thumb switch, which works well when not controlling the action from a smartphone.

The new VIRB X-series has a footprint which is more GoPro Hero-like. It measures 3.0 by 1.6 by 1.4 inches and weighs 5.36 ounces. No protective case is required. Its naked chassis is waterproof to 50 meters. Like the older Elite, the new X uses a microSD card. It (and the lithium-ion battery) is accessed by unlatching a door on the front of the device. Battery endurance is good, at around two hours. We're not thrilled with how the device connects to the charging cable. A small cradle snaps to the side of the camera's chassis. If the pins on the cradle don't line up perfectly with the pins on the camera, the battery won't charge

The VIRB X-series is compatible with GoPro mounting hardware and has minimal controls, top. The front of its waterproof case, middle, swings open for quick access to the microSD card and battery. Custom G-Metrix data can be overlaid on top of the captured video, bottom, using Garmin's Edit software

properly. A mini-USB plug-in would be easier, in our view.

The VIRB is available in three models (in addition to the early-gen Elite): the $299 X and $399 XE, differing partly by variable video resolution capability.

For example, the wide-angle-shooting XE can shoot 1440p at 30 frames per second and has a 12 megapixel still camera. The VIRB X is limited to 1080p at 30 frames per second. Additionally, the VIRB XE has a Pro Mode with more advanced manual camera adjustments, including white balance control, sharpness control, color profile control, ISO limit and exposure bias. There is also a "tall mode," which captures a large vertical viewing area using a 4:3 aspect ratio. The video capture at the lower left is an example. The VIRB X-series records video in mp4 format and photos in jpeg.

For capturing audio, the VIRB X-series has an internal microphone, but Garmin's $40 optional three-to-one combo cable includes a 3.5mm stereo input for an external microphone input, RCA composite video output and a mini-USB port, which we didn't try. The audio we captured in a variety of settings—including mounting it under the wing of a Piper and on the fuel tank of a motorcycle—was quite good. It cancelled wind noise far better than our Hero4. Garmin is working on a future expansion which will wirelessly connect it to Bluetooth headphones and to Garmin's new GMA350C audio panel.

The VIRB X has only four bezel controls, including a menu and power key which also function as arrow keys for scrolling through menus. And that menu structure is refreshingly shallow, with easy-to-read status bar icons and straightforward settings for video resolution, field of view, memory card space, battery level and the status of any external sensors. The cam has a top-mounted trigger switch to start video recording and the switch houses a shutter button for still shots. You can set the camera to begin recording video automatically when it's moving, which saves space on the memory card.

To our disappointment, the VIRB's LCD display doesn't have a video/photo view finder. Instead, you'll need to use Garmin's Pilot app. The dedicated VIRB mobile smartphone app has a monitor (and also controls the cam), which worked flawlessly on our iPhone, although it lacks live streaming.

The smartphone connects to the camera via Wi-Fi and it never lost connection when the camera was mounted outside of the aircraft. Garmin sells a remote control for $50. It works from 10 meters away.

G-METRIX

The new VIRB X-series has built-in GPS, G-force and orientation sensors and can also connect with a variety of Garmin's ANT+ external sensors. When editing the playback video with the VIRB Edit software, you have the option of adding G-Metrix gauges, graphs and other data that shows real-time speed, altitude, track, heart rate, bicycle cadence and a variety of other activity-specific information. For flying, G-Metrix can be useful in a training environment. We took the VIRB XE flying on a gusty day—mounted under the wing—and seized the opportunity to bang out a few crosswind landings. With G-Metrix data added to the playback, it was easy to see which approach and touchdown speeds worked the best—and worst.

The VIRB X-series records video in mp4 and photos in jpeg format. If given the choice, we would spend the extra $100 for the XE model, given the stunning video quality of the 1440-pixel resolution.

What impressed us the most is the new VIRB's ease of operation, build quality and battery endurance. As a bonus, it works with GoPro mounting hardware. Our only nit is its missing viewfinder and lack of live streaming on the app. We think many buyers will want it. Contact www.garmin.com, 800-800-1020.

Aviation Insurance: Soft Market, Low Prices

With more companies writing aviation insurance, it's a buyer's market. Premiums are at historic lows and a wide range of coverage is available.

by Rick Durden

There are only some 200,000 aircraft in the U.S.—there are more cars than that in a large town—so why any profit-oriented insurer would enter such a restricted market seems to defy logic. Yet, in the last decade, the number of aviation insurance underwriters has gone from the old, hard core of nine to 14, an increase of more than 50 percent. The result is predictable—with a relatively large number of companies competing in a limited market, insurance premiums are low and owners have little trouble getting coverage.

What does this mean for owners and pilots seeking insurance in the short run and the industry in the long run? We put those question to several insurance brokers and underwriters and got consistent answers: Because we're in the "softest" market in over 40 years, it's a great time to be buying insurance, but the fact that premium dollars are barely covering the cost of claims paid means the current situation should not be sustainable—yet there's no end in sight.

HOW IT WORKS

Insurance companies enter into contracts to pay money to an insured should specified events (usually accidents) occur in return for a fee (the premium) from the insured. The insurer takes the premium money and invests it. So long as the amount the insurer earns from the premiums and investments exceeds what it pays out in claims, the insurer makes a profit.

One way to improve the balance sheet is to not pay claims, however, that's not really an option for aviation insurers because the aviation community is so small. If an insurer gets a reputation for fighting claims, aviation insurance brokers learn about it quickly and steer their clients away from that insurer.

Currently, aviation insurers are being whipsawed by two realities: the stock market has been relatively flat, so return on investment of premium funds has been mediocre; and there is so much competition for customers that premiums are low. The result is that the insurers are reporting very little or no margin between income and outgo—which means that those who invest in insurance companies may move their investment dollars elsewhere.

Jon Doolittle, owner of Sutton James insurance brokerage, told us that the market is as soft as any he has ever seen, "Prices are down significantly and underwriter guidelines are eroding." Doolittle said that where owners of turbine and cabin-class airplanes used to have to go for simulator-based recurrent training annually, now it's likely they can get the insurer to agree to recurrent training every two years and it can be in the airplane. In addition, more and more insurers are agreeing to allow owners to take recurrent training through aircraft owner groups such as the American Bonanza Society and Cessna Pilots Association.

While the brokers we spoke with agreed to be quoted, those involved in underwriting (setting premiums and deciding who their employer insurance company would insure) would not agree to be identified. The underwriters we spoke with said that they were offering higher limit cover

Why we buy insurance. Hull insurance pays for the repairs; liability insurance protects the owner should he or she be sued. In the current soft insurance market, prices are cheaper and more coverage is available than has been the case for decades.

CHECKLIST

- Insurers are competing aggressively for your business.
- Higher coverage limits than ever are available for owner-flown aircraft.
- Read the insurance policy carefully—aviation policies are not identical.

POLICY SUBLIMITS: WEALTH HAZARD?

For more than 30 years, the most popular liability policy in aviation has provided coverage of $1 million with sublimits of $100,000. Owners sleep soundly at night, confident that they have an insurance pool of a million bucks should they roll Ol' Bessy into a ball. These same owners have the personal net worth necessary to own an airplane and often have auto and homeowners insurance that has at least $1 million in liability coverage.

There's only a minor problem—that sublimits policy only offers $100,000 of coverage per person injured or killed in an accident, not $1 million. For a full million dollar pool of money to draw from for personal injuries should you have an accident, you need what is called a smooth policy, one with no sublimits.

We recognize the popularity of sublimit policies with insurers—because they are among their most profitable products—and aircraft owners, because they are notably less expensive than smooth policies. However, in speaking with aircraft owners over the years, we have found that a substantial portion don't realize that they only have one-tenth of the overall value of the policy available for any on person who is injured or killed.

Insurers tell us—and our experience is in agreement—that the vast majority of lawsuits or claims made against a pilot by someone injured in an accident settle for the $100,000 limits. However, a majority isn't all of them. If the pilot messed up and caused an accident that seriously injured or killed the sole passenger, the value of the claim against the pilot could easily exceed $100,000. We have seen lawsuits brought against pilots and the estates of pilots in which the insurance company immediately paid the $100,000 policy limit, but the case continued against the pilot because he or she, or the estate, had assets. In addition, once the insurance company pays the limits of the policy, it no longer has to pay to defend the pilot, something that can be staggeringly expensive for the pilot.

In our opinion, an owner must be fully aware of the nature of the liability coverage he or she is buying. A $100,000 sublimit policy may be the right one—but it may not.

We do note that while it is not well known, there are policies available that offer $1 million coverage with sublimits of $200,000 or $250,000. They are priced less than smooth policies.

If a person has the money to buy an airplane, trying to save a few hundred dollars on insurance by buying a sublimit policy may be a serious mistake. We recommend that an owner speak candidly with an insurance broker and an attorney about coverage—and read the policy—before making a decision on liability insurance coverage. In the current soft insurance market, smooth policies are cheaper—and available for more pilots and airplanes—than they've been in years.

age to less-experienced pilots than they had in the past. One underwriter said that it was tough to hold the line when it came to pilot experience for coverage. He said that his company had been approached to cover a private pilot with less than 100 hours who wanted to step into a six-place single. That was outside the parameters for his company, so he declined. He later learned that another company agreed, and charged a premium that was half what it would have charged for such a high-risk pilot five years ago.

Underwriters were unanimous in telling us that companies were currently writing coverage for pilots stepping up into sophisticated airplanes that they would not have touched 10 years ago. One said that if a pilot has the money to buy a lot of airplane, his chances of being able to get insurance on favorable terms are the best he's seen in his decades in the business.

Mike Pratt, a broker with Epic Insurance Solutions, told us that he's been able to place coverage for clients at levels unheard of just five years ago. He recounted recently obtaining a $5 million smooth liability policy for an owner-flown twin-turboprop for a $9000 annual premium—if he had even been able to obtain such coverage five years ago it would have cost $20,000.

Jon Doolittle told us that insurance underwriters have different levels of comfort and expertise. They get to know some types of aircraft very well and prefer to write policies for those aircraft. Historically, he said he knew which insurers to contact to get the best rate and coverage for the particular type of airplane owned by a client. Now, he said, underwriters are constantly looking for a niche, and which ones are looking where changes regularly. So when he is trying to place insurance for a client he knows that he's going to be able to get a good deal, but he has to make many more calls until he finds the underwriter who is in that niche at that time.

Pratt echoed the sentiment, noting that one insurer that had historically only covered classics suddenly started writing insurance for all types.

BUYING INSURANCE

Okay, the market is soft, there are good deals on insurance to be had, how do I buy insurance for my airplane, or to cover me as a renter?

As an aircraft owner who wants to insure his or her aircraft and self, the procedure is to buy two types of coverage that is bundled together into one policy—insurance that fixes or replaces the aircraft in the event of an accident (hull insurance) and insurance that covers the owner for liability should the owner get sued as a result of an accident (liability insurance). To do this, we recommend that the owner contact an aviation insurance broker. In fact, contact a few and talk with them to see which one you connect with and choose him or her.

A broker owes a fiduciary obligation to the owner, not to any insurance company, so he or she seeks out the best coverage available for the owner. A broker is not an insurance company. The broker then shops coverage for the owner—going to the various insurance underwriters with

LIGHT SPORT LIABILITY INSURANCE: NOT SO SOFT

As the number of Light Sport airplanes increases and more pilots are opting to forego the third class medical and simply fly Light Sport, we were curious to see how the insurance market is for liability coverage for those airplanes.

We asked *Aviation Consumer* contributing editor and owner of the Sutton James aviation insurance brokerage, Jon Doolittle, to go into the insurance market and get quotes for various Light Sport airplanes, new and legacy. For the quotes, the owner was to be a 40-year-old male, private pilot with 500 hours total time, 20 hours of tailwheel time and who flies 100 hours a year. The result is shown in the chart below. The dollar figure on the left side of the "/" is the annual premium for a $1 million liability policy with a $100,000 per person sublimit. The number to the right is the price for $1 million smooth coverage—if there is no dollar figure and the word PASS is shown, that means the company would not quote smooth coverage for that pilot in that airplane.

Doolittle told us that two of the companies don't distinguish between light sport and private pilots, while others had requirements for an annual medical (they would accept a non-aviation medical) and an EKG. Others will write LSA airplanes, but require a third class medical for the owner/pilot. That got our attention—in what is arguably the softest insurance market in history, some insurers are requiring that light sport pilots have an FAA medical. We don't know if that's because insurers do not yet have much loss experience with LSAs and will become more liberal as they do so, or if they know something about medicals and their relation to the risk of pilot incapacitation that the rest of the industry doesn't. Should the market harden before insurers obtain more loss data, we're concerned that more may incorporate a third class medical condition on coverage. It certainly bears watching.

Two companies would not quote the Skycatcher and some others were "lukewarm" on it due to lack of factory support. The Ercoupe seemed to have fewer companies interested in it than other LSAs. Doolittle said that nobody seemed to know why. The companies that didn't write them didn't know much about them and the companies that did write them had nothing bad to say about them.

We found it interesting that the price differential for liability coverage between the most expensive and least expensive airplanes within a given insurer was small, however, the differential between insurers could be huge—with the most expensive nearly twice as pricey as the least expensive. The main reason for this is that premiums reflect each company's loss experience and, inexplicably, the insurance companies do not share loss information.

We think that is wrong, especially in an industry as small as aviation insurance, overall, and the fraction of it that is LSA.

LIGHT SPORT AIRCRAFT TYPE	INSURER A*	INSURER B	INSURER C	INSURER D	INSURER E**
2010 Flight Design CTLS	$333/PASS	$281/PASS	$656/PASS	$374/PASS	$401/$882
1946 ERCO Ercoupe 415-C	$303/PASS	PASS	PASS	$372/PASS	PASS
2010 Legend Cub AL-3	No response	$306/PASS	$629/PASS	No response	$407/$895
2011 Cessna Skycatcher	PASS	$281/PASS	$656/PASS	$372/PASS	PASS
1946 Piper J-3 Cub	$352/PASS	$248/PASS	$629/PASS	$429/PASS	No response
2010 Remos GX	$333/PASS	$281/PASS	$656/PASS	$372/PASS	$401/$882

*** For tailwheel airplanes, the company requires 25 hours of tailwheel time.**
**** The company will only quote LSAs if hull insurance is also purchased—liability portion of premium shown.**

the details of the owner's piloting experience and the aircraft to get quotes for coverage. The owner and broker then discuss the quotes and coverage and the owner makes a choice.

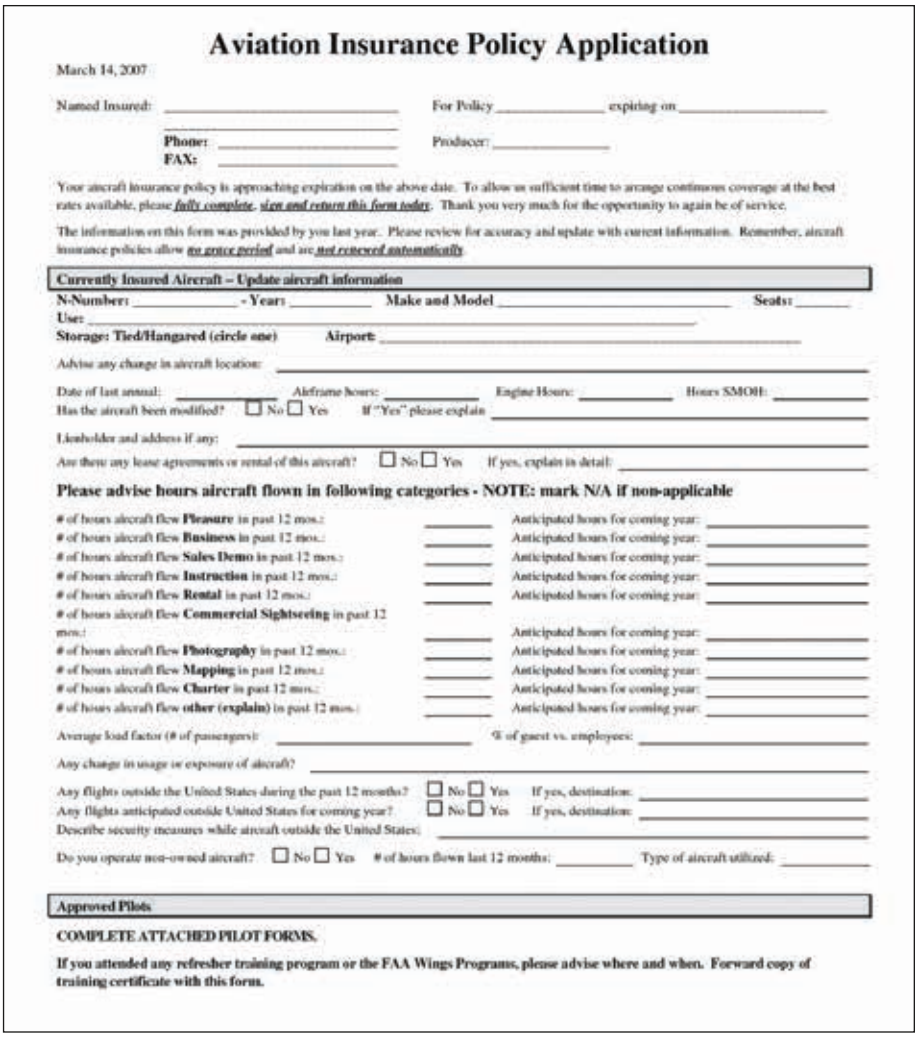
A warning: Do not try playing brokers against each other by having more than one broker get quotes for you. The brokers go to the same insurer underwriters for quotes and underwriters don't like quoting the same airplane twice. You can get into the position of being unable to get any insurer to cover you.

At the same time, the owner is working with a broker, we also recommend that the owner also contact the aviation insurance company Avemco. Avemco is the only direct writer of aviation insurance. That means it sells insurance directly to aircraft owners (brokers do not get quotes from Avemco). All other aviation insurers only sell insurance through brokers. When contacting Avemco for a quote, a owner needs to understand that the person with whom the owner deals with is an employee of Avemco and owes a fiduciary duty to Avemco, not the owner.

Once the owner has quotes and coverage information from the broker and Avemco, it's a matter of comparing them to see which best fits his or her needs.

POLICIES ARE NOT THE SAME

Unlike auto insurance where policies are nearly identical, each aviation insurer has slightly different types of coverage and policies—and those differences can be critical. We strongly recommend that you obtain a sample of the actual policy for each insurer that gives you an attractive quote.



Aviation Insurance Policy Application

March 14, 2007

Named Insured: _____ For Policy _____ expiring on _____

_____

Phone: _____ Producer: _____

FAX: _____

Your aircraft insurance policy is approaching expiration on the above date. To allow us sufficient time to arrange continuous coverage at the best rates available, please ***fully complete, sign and return this form today***. Thank you very much for the opportunity to again be of service.

The information on this form was provided by you last year. Please review for accuracy and update with current information. Remember, aircraft insurance policies allow ***no grace period*** and are ***not renewed automatically***

Currently Insured Aircraft – Update aircraft information

N-Number: _____ - Year: _____ Make and Model _____ Seats: _____

User: _____

Storage: Tied/Hangared (circle one) Airport: _____

Advise any change in aircraft location: _____

Date of last annual: _____ Airframe hours: _____ Engine Hours: _____ Hours SMOH: _____

Has the aircraft been modified? ☐ No ☐ Yes If "Yes" please explain _____

Lienholder and address if any: _____

Are there any lease agreements or rental of this aircraft? ☐ No ☐ Yes If yes, explain in detail: _____

Please advise hours aircraft flown in following categories - NOTE: mark N/A if non-applicable

# of hours aircraft flew **Pleasure** in past 12 mos.:	_____	Anticipated hours for coming year: _____
# of hours aircraft flew **Business** in past 12 mos.:	_____	Anticipated hours for coming year: _____
# of hours aircraft flew **Sales Demo** in past 12 mos.:	_____	Anticipated hours for coming year: _____
# of hours aircraft flew **Instruction** in past 12 mos.:	_____	Anticipated hours for coming year: _____
# of hours aircraft flew **Rental** in past 12 mos.:	_____	Anticipated hours for coming year: _____
# of hours aircraft flew **Commercial Sightseeing** in past 12 mos.:	_____	Anticipated hours for coming year: _____
# of hours aircraft flew **Photography** in past 12 mos.:	_____	Anticipated hours for coming year: _____
# of hours aircraft flew **Mapping** in past 12 mos.:	_____	Anticipated hours for coming year: _____
# of hours aircraft flew **Charter** in past 12 mos.:	_____	Anticipated hours for coming year: _____
# of hours aircraft flew **other (explain)** in past 12 mos.:	_____	Anticipated hours for coming year: _____

Average load factor (# of passengers): _____ % of guest vs. employees: _____

Any change in usage or exposure of aircraft? _____

Any flights outside the United States during the past 12 months? ☐ No ☐ Yes If yes, destination: _____

Any flights anticipated outside United States for coming year? ☐ No ☐ Yes If yes, destination: _____

Describe security measures while aircraft outside the United States: _____

Do you operate non-owned aircraft? ☐ No ☐ Yes # of hours flown last 12 months: _____ Type of aircraft utilized: _____

Approved Pilots

COMPLETE ATTACHED PILOT FORMS.

If you attended any refresher training program or the FAA Wings Programs, please advise where and when. Forward copy of training certificate with this form.

When purchasing aviation insurance, plan on filling out an application similar to this one.

Insurance policies are contracts and only cover exactly what is in the contract. Look at what is covered and what is excluded. A very low premium may sound great, but the policy may have so many exclusions that it is worthless for the type of flying you do.

However, if a policy looks attractive, but has an exclusion you don't like—such as no coverage for operations on grass runways—see if the insurer will remove the exclusion. Often that can be done at no charge or a small increase in the premium.

RENTER'S INSURANCE

Buying renter's insurance is essentially buying the liability portion of an aircraft insurance policy. You are buying insurance to cover yourself should you have an accident and have to pay for the airplane and/or someone sues you. The procedure is the same; contact a broker and Avemco, get quotes and compare policies.

When seeking insurance, we recommend that you spend some time talking with your broker about yourself, your flying and your airplane. While getting a quote on coverage may simply involve entering data on a computerized form, much of the work a broker does is to talk with underwriters personally—aviation insurance is still very much driven by people talking directly to people.

If your broker knows you, he or she can bring out those things that make you a good insurance risk when talking to underwriters—which can mean better coverage at a lower price than comes from a one-size-fits-all computer form.

Never, ever lie about your experience to make yourself look good. Padding your hours, ratings and experience is a way to get coverage denied should you have an accident.

SAFETY

All of the underwriters we spoke with expressed concern about the general aviation accident rate due to the soft market. Especially for higher performance airplanes, insurance requirements for time in type and recurrent training have helped keep accident rates down. As underwriting standards slip, higher risk pilots are flying higher performance aircraft—and for the folks who make their living looking at accident data versus pilot experience, it's a bad situation.

They know that the one variable that affects accident risk is recency of recurrent training and the underwriters we spoke with expressed concern that because recurrent training requirements are slipping, more people are going to get hurt.

THE FUTURE

With insurers apparently making little profit in the aviation field, we don't think the current low rates will continue. But, as Mike Pratt pointed out to us, people have been saying that for over three years, yet when one insurer leaves aviation, another comes in, keeping premiums down.

While we don't think the sky is going to fall, insurers have to see a profit to justify staying in a particular field, so more may step away from aviation. With fewer players, premiums will go up and experience and training requirements to get coverage will tighten up.

We've seen it happen in the past as soft markets drove insurers out of aviation—through conscious business decision or bankruptcy—and the market hardened. It usually happens gradually, however, a sudden series of general aviation accidents or a major airline accident that mean insurers have to pay large claims can, and has, caused the market to harden in short order.

Our take is that the current soft market is good news if you are buying or renewing your insurance. Having your broker shop your coverage could give you a lower premium than last year. If you've been considering moving up to a higher performance airplane but have been concerned about coverage, there's never been a better time to make the move.

DuraCharts: Better Paper For VFR

Thanks to better print quality and a lower price, we favor DuraChart VFR sectionals over the FAA's offering.

by Larry Anglisano

Remember the days of sprawling a VFR aeronautical sectional chart across the flight planning table—whiz wheel in hand—mapping your low-and-slow route around the TCA? I do.

That's why buying a venerable paper VFR sectional chart always seems worth the nine bucks, even if it gets tossed in the flight bag or map pocket in case the iPad quits. Haven't gone digital yet? You could print your own paper charts, but for lay-it-on-the-seat reference as you motor along in a rental Tomahawk or vintage Cub, the traditional sectional lives on, perhaps given a new lease on life by Washington, DC-based DuraCharts.

The company began producing its own VFR sectional and terminal area charts just as the market began shifting to digital chart use. The company's survival, said DuraCharts' Byron Hanna, might be attributed to users wanting both paper and electronic charts.

"Many of our customers initially made the switch to electronic charts, but then realized that paper VFR sectional charts can be easier for planning a route," he said.

The DuraChart is the result of the company founder's frustration with the lack of durability he experienced with the FAA's charts, which would tear after just a couple of flights.

The charts are printed on the water and tear-resistant synthetic Papertyger brand paper. Papertyger sandwiches a thin layer of plastic between two sheets of erasable paper, resulting in a chart which we found incredibly durable after several months of abuse.

Hanna said it took the US government less than two years to copy DuraCharts, which ultimately began printing its sectionals on the same Papertyger material as Duracharts.

DuraCharts offers sectional charts for the lower 48 U.S. States, in additional to over a dozen terminal area charts. While it sources the navigation data through the same channels the government uses for its charts, it doesn't copy the data that is on a government sectional or terminal chart. Instead, it compiles the cartography data itself (DuraCharts runs the now-privatized Defense Mapping Agency) and prints the data at its Washington, DC, headquarters.

A single DuraChart sectional is $8.00 ($7.00 each with a yearly subscription, and $5.00 each if you're an AOPA or EAA member.) If you're a CFI, you'll pay only $4.00 per chart. An FAA sectional is $9.00 each—if you can even buy one at your local FBO. I can't—the FAA pulled its dealership because it didn't sell enough.

Contact www.duracharts.com.

While some tablet apps have chart annotation capability, it's simply easier to highlight and write on the erasable DuraChart, main photo. Compared to an FAA sectional chart, top, the DuraChart, middle, has brighter font and some gotta-know data is conveniently larger.

Columbia 300/350:

A certified and speedy four-seat, fixed-gear composite born from the Lancair IV homebuilt. You can pick up an early steam gauge model for a modest $150,000.

What do you get when you mate a sleek and efficient composite airframe to a high-output Continental engine, advanced avionics and an ergonomic interior? Sales—and lots of them. This is evident by Cirrus Aircraft's success with its SR22. That was the premise behind the original Columbia 300/350, the normally aspirated versions of the company's flagship Columbia 400, and later Cessna Corvalis series.

Speed was important when the Columbia first hit the market, but the airplane's greatest initial appeal probably had more to do with not being made of metal or wearing a Beechcraft, Cessna, Mooney or Piper label. 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 inter-city transportation. Incidentally, the concept also brought forth the Cirrus SR20 and SR22, which proved far more popular. In fact, as of June 2015, Cirrus delivered 6000 aircraft in its 16-year production run. But despite the sales domination, a Columbia 300 or 350 will outrun a Cirrus SR22 by 10 knots or so, and it arguably has more ramp appeal because there just aren't that many, by comparison. Still, the Columbia does have some disadvantages. Although both the Columbia 300 and earlier SR22s have identical empty and maximum gross takeoff weights, according to the *Aircraft Bluebook Price Digest* 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 lacks the Cirrus' airframe parachute system. More on weight and balance issues in a moment. And, of course, Columbia is no more, having long been acquired by Cessna during Chapter 11 bankruptcy proceedings.

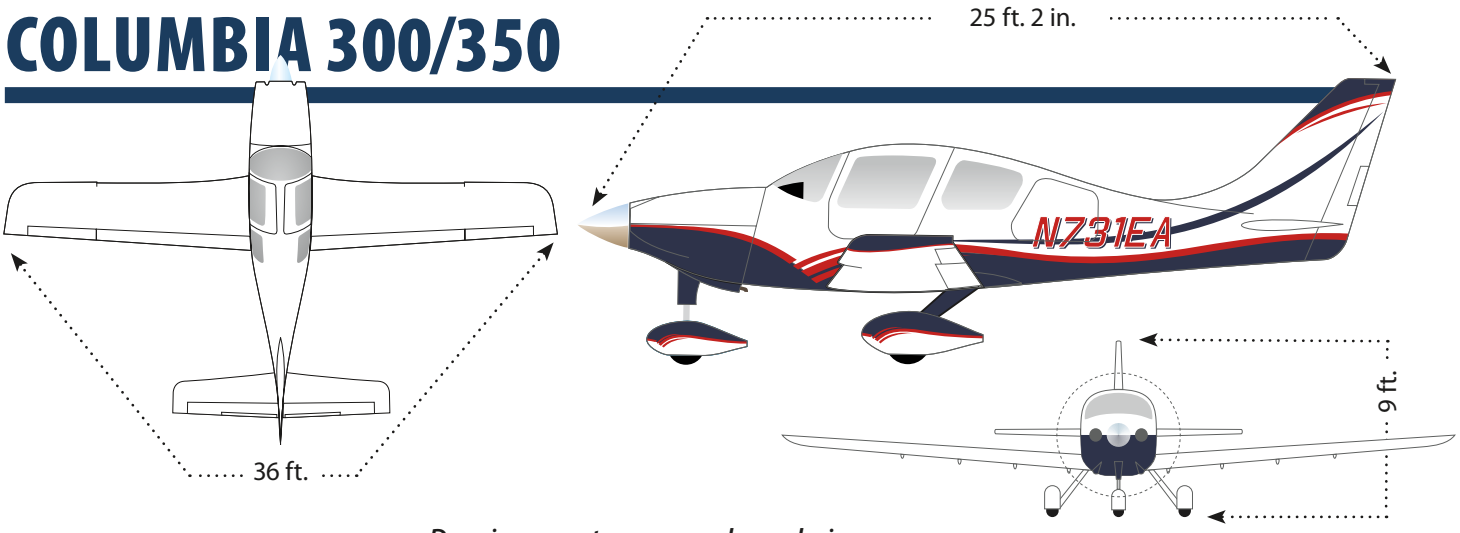
It eventually wore a Cessna badge, but the Columbia is very much its own airplane. Fast, sexy and complex.

HOMEBUILT GENES

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

With the right training, owner Luke Peterson transitioned to his 2004 glass-cockpit-equipped Columbia 350, main photo, in a few days, previously logging only 10 hours of complex time.

COLUMBIA 300/350

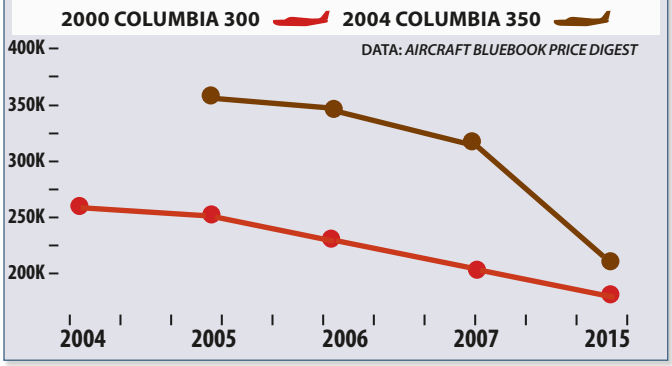


Drawings courtesy www.schemedesigners.com

COLUMBIA 300/350 MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
2000 COLUMBIA 300 (LC40-55FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1150 LBS	190 KTS	±$150,000
2001/2 COLUMBIA 300 (LC40-550 FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1150 LBS	190 KTS	±$165,000
2003 COLUMBIA 300 (LC40-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1150 LBS	190 KTS	±$180,000
2003 COLUMBIA 350 (LC42-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$200,000
2004 COLUMBIA 350 (LC42-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$210,000
2005 COLUMBIA 350 (LC42-550 LG)	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$220,000
2006/7 COLUMBIA 350 (LC42-550FG)	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$330,000
2008/9 CESSNA 350 CORVALIS	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$300,000
2010/11 CESSNA 350 CORVALIS	CONTINENTAL IO-550-N	2000	$33,000	106	1100 LBS	179 KTS	±$450,000

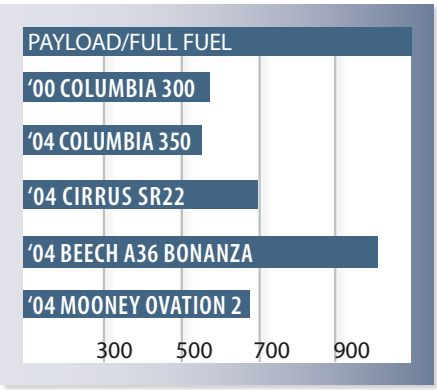
COLUMBIA 300/350 RESALE VALUE

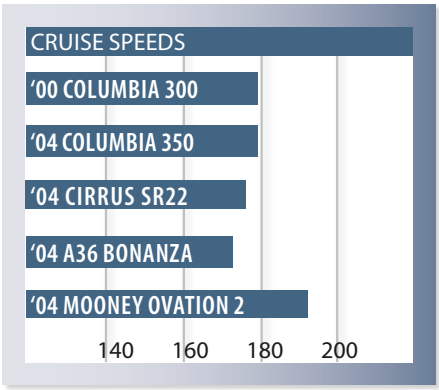


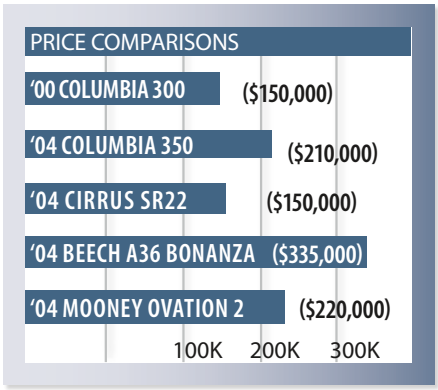
SELECT HISTORICAL ADs

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







We can think of worse places to be than the Columbia's front office, top. Those are Avidyne Entegra screens in the portrait configuration. Wooden control grips house a cooley hat trim switch and the command switch for optional speed brakes, bottom and inset.

LC40 model, also known as the Columbia 300. But before the LC40 model 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 okay, 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 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 September 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, now produces a single version of the once Columbia 400, the TTx. It's 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 has Garmin's G2000 Intrinzic touch avionics suite and a price of around $800,000.

DESIGN, CONSTRUCTION

Columbia aircraft put into service since the mid-1990s, few all-composite piston airplanes actually have received type certification. Because it was certified under the relatively new FAR Part 23, some features, systems and limitation may not be familiar to pilots steeped in, for example, 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.

SYSTEMS

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 break-out 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.

The Columbia stands tall on its gear, which has a castering nosewheel to help save weight. The gull-wing doors have a redundant latching system to help keep them closed in flight.

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, 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.

The Columbia's energy-absorbing foam seats lend to good crashworthiness.

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.

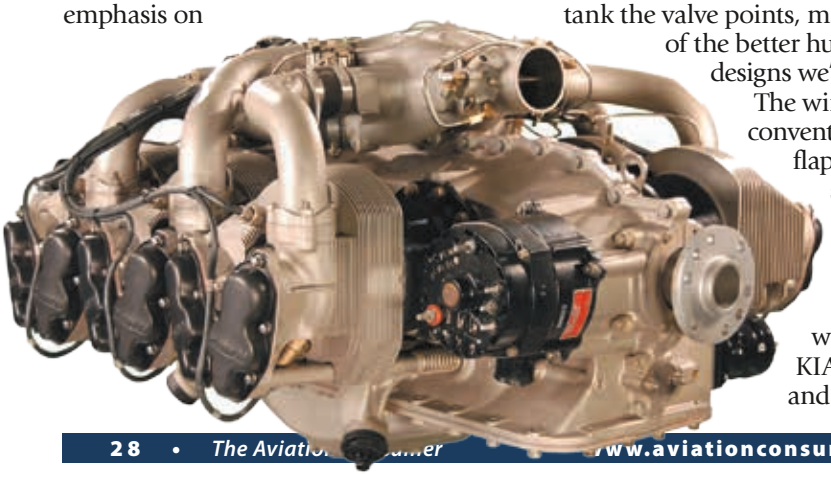
All Columbia 300s are 14-volt airplanes. The 350 started out that way, but the company went to 28-volt systems in 2005, beginning with serial number 42501.

DESIGN

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 homebuilt, which have proven 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 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 nose gear 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

The Columbia/Cessna 300 and 350 are powered by the normally aspirated Continental IO-550-N. The typical cost for a factory rebuilt "gold standard" replacement, left, is around $40,000.

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. Our tester reported a cabin feeling surprisingly roomy, even though it's physically small and the headroom is a bit tight for a tall person. Fit and finish were good, at least in a new, immature model. And, while we're positive a few years of use will take its toll on older airplanes, 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, Allied-Signal KCS 55A HSI System and a KI 256 Flight Director. These avionics are considered dated by today's standard, 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.

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.

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 is 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 which varies with CG, means the pilot will have to pay attention to loading, perhaps more carefully than with other

COLUMBIA CRASHES: LOST CONTROL

As we would expect from an airplane as slippery as a Columbia, runway mishaps and botched go-arounds are the most popular way for its pilots to make it into the NTSB wreck reports. The good news? The reports aren't littered with Columbia augers. On the other hand, the FAA registry lists less than 700 in service, and that includes the Columbia and Cessna 400 models.

Still, our sweep of Columbia and Cessna 300/350 wrecks dating back to 2003 uncovered only eight NTSB report-making events. Two of them involved fatalities.

While there simply aren't a lot of 300/350 accidents, the ones that did crash didn't do so from engine or airframe-related failures. One Columbia's airframe failed after its pilot landed so hard the fuselage main composite structure partially separated in a downward direction, while also damaging the landing gear attachment structure. This, of course, isn't the fault of the aircraft. The NTSB's final conclusion was that the pilot misjudged the airspeed during the approach and an improper flare, resulting in a fast and hard landing (hard being the operative word).

There were a couple of Columbia pilots that allowed the airplane to get a bit too squirrely on the landing rollout, did the right thing by initiating a go-around, but lost control in the process—hitting terrain and objects off the runway.

The ugliest landing-gone-bad occurred when a Columbia pilot was attempting to land on a 2800-foot long (and 50-foot wide) mountaintop runway. The NTSB said the airplane approached the runway high and fast, touched down within the first third of it and bounced 20 feet above the surface—and continued to bounce down the runway for another 300 feet—in a 30 degrees nose-up attitude while the speed brakes were deployed. As the airplane headed toward an embankment off the left side of the runway, it rolled right and the right wing tip scraped the runway. After traveling up the embankment, the airplane turned back toward the runway, crossed it and struck four parked airplanes. A post-impact fire consumed the accident airplane and two of the four parked airplanes. Three onboard the aircraft were killed.

Another fatal crash was the result of a Columbia pilot continuing VFR into IMC, including heavy fog. It wasn't aloft more than 30 minutes before spiraling at high speed into a lake. The NTSB pinned this crash as a classic spatial disorientation and subsequent loss of control.

Bottom line: While we couldn't find any evidence that the 300/350 is unsafe, it's clear that the speedy, high-horsepower composite demands precise speed control while in the runway environment.

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 airplane was over its max landing weight without any fuel. It was also 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.

MAINTENANCE/SUPPORT

Columbias have relatively simple systems. For example, the 310-HP, top-induction, Continental IO-550-N has been around a few years and mechanics should be familiar with it. The tubular-steel fixed landing gear and castering nosewheel shouldn't pose any Herculean maintenance challenges, either.

Any chronic avionics or panel-related problems should have been sorted out long ago, leaving only the occasional in-service issue to arise. Given the number of shops now familiar with the Avidyne Entegra product, getting quality avionics service shouldn't be a problem, either. Which leaves general airframe and systems issues as the 300/350's only real maintenance bugaboo, of which we can't find much evidence. A search of the FAA's service difficulty report (SDR) and special airworthiness information bulletin (SAIB) databases came up with only seven SDR entries. Six of them involved engine, magneto, prop deicing boots or turbocharger issues. Only one—involving loose main-wheel attach bolts—could be attributed to the airframe itself.

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're preparing a comparison article on the two systems for a future issue.

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 which was later determined to be related to the wing skin disbonding from the main spar. The issue produced an AD which only applied to one 350 on the production line and seven 400 models, also on the line.

Speaking of the assembly line, at the time, Cessna's former CEO Jack Pelton said the company would invest money in Columbia's Bend, Oregon, plant, ensure existing owners are looked after and keep making the two aircraft models under the name Cessna 350 and Cessna 400. "The Columbia models are a good fit with our existing product line," Pelton said in a news release at the time.

"We plan to make significant investments in Bend, in people and operations, to bolster customer satisfaction and business profitability. We will continue to improve quality, reliability and performance as we strive to deliver customer value and fulfill our commitments," Pelton added.

Still, in 2009 Cessna closed the Bend, Oregon, plant and moved production to its Independance, Kansas, location. The bright side? Among the big changes for existing Columbia owners was gained access to Cessna's full parts and service network.

Any early fears Cessna would fail to honor its support commitments have proven unfounded. To date, Cessna has earned high marks from Columbia owners on its product support efforts, even if there was some early uncertainty.

OWNER COMMENTS

I purchased my 2004 Columbia 350 after flying rental planes from the local FBO. With only ten hours of complex time, I was a little nervous about transitioning to a much faster, all-glass platform. However, with several days of training, the transition went very smoothly.

Flight characteristics are smooth, and stalls are a straightforward mush with aileron control after the inner part of the wing is stalled. Takeoffs and landings are as expected with a slippery 310-HP plane. On approach, energy and speed management is important as the low wing will float a long ways if too fast. However, a relatively small elevator requires carrying enough speed and/or leaving the speed brakes deployed to give enough nose-up control in the flare. This is particularly the case when CG is at the forward limit.

I fly primarily business trips of 300-700 miles. The plane flies best at around 10,000 feet and I generally cruise at 165 knots at 65 percent power, while burning 12.5 GPH lean of peak. A typical two- to four-hour flight is easy and comfortable in a well-designed cabin. The side stick (as opposed to a side yoke) is a nice design and makes hand flying fun. The design also opens up space, which makes the cabin feel bigger. At six feet one inches tall, I have plenty of head, shoulder and leg room. With its low wing and lots of windows, air conditioning is a must as the cabin heats up fast on the ground and the gullwing doors do not allow you to easily hold the door open while taxiing.

The Avidyne PFD/MFD, dual Garmin GNS 430W navigators and the S-TEC autopilot have been problem-free and create seamless automated flight support functions. The XM WX satellite weather, traffic alerting, lightning detection, plus the ability to look at METARs and forecasts while cruising along provides a great addition to situational awareness, in a very intuitive arrangement.

My operating costs have been reasonable, and there haven't been any

continued on page 32

The Aviation Consumer

Electro

(continued from page 7)

mended in the gasoline Alpha.) In the downwind, power is further reduced to about 40 kWh for an indicated speed of about 70 knots.

The Electro is designed to recuperate energy in the glide so on final, power is reduced to idle and, indeed, the power indicator showed the system returning charge to the batteries in the 3- to 5-kWh range. The airplane has a purpose-designed prop for this, which is much broader of chord for the first third of blade length outward from the hub. Pipistrel calls this a "propmill." Whether adjusting the length and steepness of the final glide makes much meaningful difference in endurance for the Electro's primary mission is debatable. But there's no question that the prop provides noticeable drag. With zero torque selected via the throttle, braking from the prop when the pitch is pushed over is quite noticeable.

Recuperation or not, our first flight lasted 20 minutes and included some flight outside the pattern. We landed with 51 percent capacity remaining. Duration of the second flight, including flybys, was 38 minutes, with 25 percent battery capacity remaining. Prior to the flybys, we did 10 touch and goes, which might be a typical lesson for a student using this airplane for its stated purpose. We estimate the Electro could have completed 15 or 16 landings with sufficient reserve for landing and taxi back.

A START

The Alpha Electro is, if nothing else, an impressive technical foray into the possibilities and limitations of electric flight. Given its limited endurance, we agree that it's a niche product for early adopters and then only in Europe and Asia. U.S. certification rules still preclude electric aircraft for other than experimental purposes.

As Ivo Boscarol told us, companies pioneering electric flight can't reach for off-the-shelf hardware to execute their designs. Everything has to be invented and developed on the fly for a market that's limited. Despite its short endurance, the Electro is capable of its narrow mission of teaching landings and takeoffs, with sufficient reserve for safe operation.

Although we can't predict how the market will warm to new electric airplanes, if electric flight is to sustain, the Electro clearly represents a first necessary step toward getting there.

Columbia 300/350

(continued from page 31)

real surprises or major inspection requirements except the 1000-hour inspection, which requires rebuilding the speed brakes, in addition to other systems requiring attention. I'm a happy Columbia owner/pilot.

Luke C. Peterson
Lake Elmo, Minnesota

I bought a Columbia 350 in November 2003. My airplane was the 15th delivered. It had the Avidyne avionics package, including Ryan TCAD, plus air conditioning. Upgrades include a Garmin GNS430W and revising the Avidyne PFD/MFD. I also upgraded to a 406 ELT.

I consistently cruise at 9000 to 11,000 feet and get around 11.5-12.0 GPH at max economy. Depending on altitude, weight, etc., that's usually about 160 to 170 KTAS. There is a Delta of about 8 to 10 KTAS between cruise at maximum power vs. max economy.

The airplane never did do 192 KTAS, no matter how hard the factory tried; too much extra gear creating drag. Also the wheel pants, baggage door and passenger doors could be adjusted better to reduce drag and this would, I believe, get me a few knots. Columbia at one time made some noise about a program to reduce excess drag, but that initiative went nowhere when the company folded.

John Stubbs
via email

FEEDBACK WANTED

PILATUS PC-12

For the November 2015 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Pilatus PC-12 turboprop single. We want to know what it's like to own these planes, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs (full-size, high-resolution) you'd like to share to the email below. We welcome information on mods, support organizations or any other comments. Send correspondence on the PC-12 by September 1, 2015, to:

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