December 2017
Volume XLIX
Number 12

*The consumer resource for pilots and aircraft owners*

# The Aviation Consumer®


## Wingtip ADS-B:

**Is the skyBeacon the money-saving solution the market has been waiting for?... page 13**

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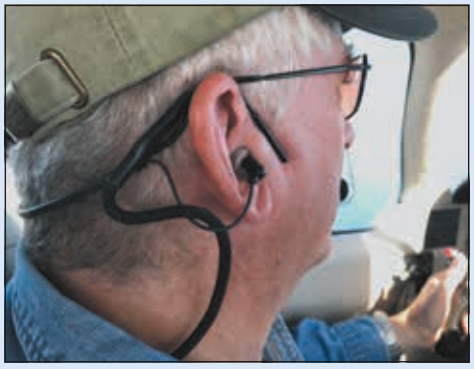

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The Aviation Consumer

**EDITOR**
Larry Anglisano

**SENIOR EDITOR**
Rick Durden

**EDITORIAL DIRECTOR**
Timothy Cole

**CONTRIBUTING EDITOR**
Paul Bertorelli

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

**FOR CANADA**
Subscription Services
Box 7820 STN Main
London, ON 5W1
Canada



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

Periodicals postage paid at Norwalk, CT, and at additional mailing offices. Revenue Canada GST Account #128044658. Subscriptions: $84 annually. Bulk rate subscriptions for organizations are available.


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



## NAVWORX SAGA: FAA ENFORCEMENT TO THE MAX

In the November 2017 issue of *Aviation Consumer*, we were happy to report that ADS-B manufacturer NavWorx announced a fix for its AD-stricken ADS600-B ADS-B system. The replacement model—the ADS600-B 2.0—was seemingly the upgraded transceiver NavWorx buyers were hoping for. The first-gen systems were essentially useless after the FAA ruled that the internal WAAS GPS module NavWorx used in the transmitter didn't meet the required TSO spec. As you've probably figured out, the November issue of the magazine didn't even make it off the presses before the company announced it had shut its doors.

Just one week before we went to press, NavWorx President Bill Moffitt spoke reassuring words in a press release to the many hundreds (perhaps thousands) of customers who bought ADS600-B ADS-B transceiver systems. In part, Moffitt said his company made "significant progress with certification of the ADS600-B 2.0," and said NavWorx had found a viable solution to the long-delayed actions with the FAA. Not so fast, said the FAA. A last strike, the replacement WAAS receiver was also deemed unworthy of meeting the stringent ADS-B position source specs. Not even worthy for experimental aircraft, where an official TSO stamp isn't required. I suspect the technical proof would be in the paperwork and the FAA obviously didn't find what it was looking for.

Showing that it's not fooling around, the FAA in an October 2017 press release of its own proposed a $3.7 million civil penalty against NavWorx for allegedly producing and selling ADS-B units that did not meet the FAA's ADS-B Out requirements. In the release, the FAA alleged that NavWorx misled its customers about the certification status of these products. The FAA went on to say that NavWorx advertisements omitted and materially misrepresented the essential fact that its units contain a GPS chip that is incapable of meeting the FAA's standards. "Customers of these products must be able to trust that their equipment meets our safety standards," said FAA Administrator Michael Huerta. It's not the first time the FAA flexed its regulatory muscles at a manufacturer. Recall that avionics supplier AmerKing met its demise last year when the FAA determined many of its products were misrepresented as being FAA approved when in fact they were not.

The NavWorx saga has racked up many chapters and it's one example of why I don't run news stories in *Aviation Consumer*, given the time lapse between editing and final production. That's why we're trying to make good use of the internet by supplementing our magazine with the obligatory social media presence on Facebook. Aside from posting video productions to chase some of the print articles only subscribers will have access to, we'll update the Facebook page between monthly issues to keep you posted on industry news like this odd NavWorx story. Still, this story was too important for us not to cover because I know it affected some of our readers who shelled out real money to equip for the ADS-B mandate with a NavWorx solution. You pay us for sorting through these kinds of issues.

There's a lesson here. To me this story is as much about a relationship with the FAA that went off the rails as it is about the FAA's zero tolerance for unapproved parts. In November 2016, the FAA issued an emergency order suspending NavWorx's manufacturing authority to build the affected ADS-B units after the company repeatedly refused (it eventually cooperated) to allow the FAA to inspect its records and manufacturing facilities. From my experience dealing with FAA inspectors on the shop level, neither is a recipe for success.

In the end, this situation hurts both the market and the FAA. Closer yet to the 2020 mandate, the fleet still lags behind in ADS-B equipage. A small operation, NavWorx sold in relatively small numbers, but it also means nearly 1000 more aircraft will need to find an alternative means of equipage. It sure would be easy if another manufacturer stepped up with a replacement product that could drop into the ADS600-B wiring. There is chatter that it could be in the works. I'm watching this closely—and suspect the FAA is, too. —*Larry Anglisano*

## MORE ON LAKE AMPHIBS

As a Lake owner with 25 years experience flying it from South Florida to all corners of the continent, I would like to correct certain information published about Lake amphibians in the September 2017 *Aviation Consumer*. Some of my quotes in that review were made over 10 years ago and deserve a refresh.

The Lake Amphibian Flyers Club (LAFC)—from which I retired after 15 years of managing it—was left with a rich heritage, but in my view lost the trust it had earned from Lake owners and pilots in its previous 27-year history. Members have reported that service center and flight instruction listings haven't been updated, phone calls and emails are unreturned and the Lakeathon annual four-day fly-in and safety seminar (which had been held for 27 consecutive years)—along with the long-published bimonthly Lake Flyer newsletter—has been discontinued. In 2016, some dissatisfied former LAFC members formed the Lake Amphibian Club (LAC).

The majority of the former LAFC members, myself included, have not renewed their LAFC membership and have now joined the LAC instead. At the invitation of the founders of LAC, I became one of its directors. The LAC has restored the tradition of an annual four-day fly-in and safety seminar (named LakeFest) and publishes its own newsletter (*Lake Club News*) in a fashion that, in my view, echoes and in some cases exceeds the past club's accomplishments. The LAC website is www.lakeamphibclub.com. The site has updated listings for service and instruction resources. The Lake Amphibian Club is now the bona fide Lake amphibian type club and its directors and members will be happy to assist any current or potential owner or pilot of a Lake amphib in any we can.

Some other statements in the article are in need of correction. The fuel capacity of the Buccaneer and the EP were listed as 55 and 90 gallons. The actual fuel capacity of a Buccaneer/EP is 40 gallons as standard, and 54 gallons with optional aux fuel. Only two or three EPs have been converted to hold 88 (not 90) gallons, which results from installing Renegade wings (with their integral fuel tanks) on the EP.

The article quoted me as saying that my forward CG condition goes away when loading passengers in the rear. This is incorrect as my Lake EP has a rear CG when empty and requires forward ballast when I fly solo. Adding passengers eliminates the rearward CG, but can result in a forward CG and the need for aft ballast. But, the point was well taken that the airplane is not a load-and-go airplane but requires careful calculation of CG for all different loading scenarios, both for takeoff fuel and landing fuel loads.

The structural cracks that you referred to in the article were addressed many years ago by two ADs, one on the tail and one on the spar cap. By now all Lakes should have had these fixes applied. The wing spar AD is one and if it has been accomplished, the AD is no longer a concern. Depending on the method used to comply with the tail AD, these can be one-time fixes with no recurring actions needed, or may need recurring inspections at annual, 50-hour or 850-hour intervals.

As noted in your article, the Lake absolutely requires specific training from a qualified Lake instructor, as it has some idiosyncrasies that are easy to deal with if you understand them, but can bite you badly if you don't.

I would like to point out that a Lake is not only a versatile seaplane but a very capable airplane in many other areas. Whether on land or sea, it has short takeoff and landing characteristics, handles crosswinds exceptionally well and can do a worthy job of cross-country flying. My Lake has taken me as far as Baja California and Alaska in the West, to the Caribbean and Newfoundland in the East. It performs reliably in more situations than any airplane I can think of, and while offering great transportation options, the Lake is more fun than any of the dozens of other single-and twin-engine aircraft types that I have flown.

Marc Rodstein
via email

*We reached out (via the last contact information we have) to the Lake Amphibian Flyers Club and haven't gotten a response as we go to press.*

## NAVWORX BAILOUT

I bought and installed a NavWorx ADS600-B system carrying part number 200-0012. Since your last NavWorx article, it looks like the company went out of business. What options do I have for replacing the system?

Are other manufacturers willing to take on these consumers at a reduced price to get them to switch?

Barney Schewenzer
via email

*ADS-B manufacturer uAvionix told us distributor Dallas Avionics (www.dallasavionics.com) will be announcing a limited-time program for NavWorx owners with experimental aircraft.*

*As for options, there are plenty of UAT-based solutions. We report on one new product worth considering on page 13 of this issue.*



## CONTACT US

**Editorial Office**
860-614-1987 (EDITORIAL ONLY)
Email: consumereditor@hotmail.com

**Subscription Department**
P.O. Box 8535
Big Sandy, TX 75755-8535
800-829-9081

**Online Customer Service:**
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# In-Ear Headsets: Clarity Link Gets Our Nod

*If you can tolerate earbuds, in-ear headsets have convincing benefits. If we had to pick one, it would be the Bluetooth-equipped Clarity Link from Aloft Technologies.*

*by Larry Anglisano and Robert McGuire*

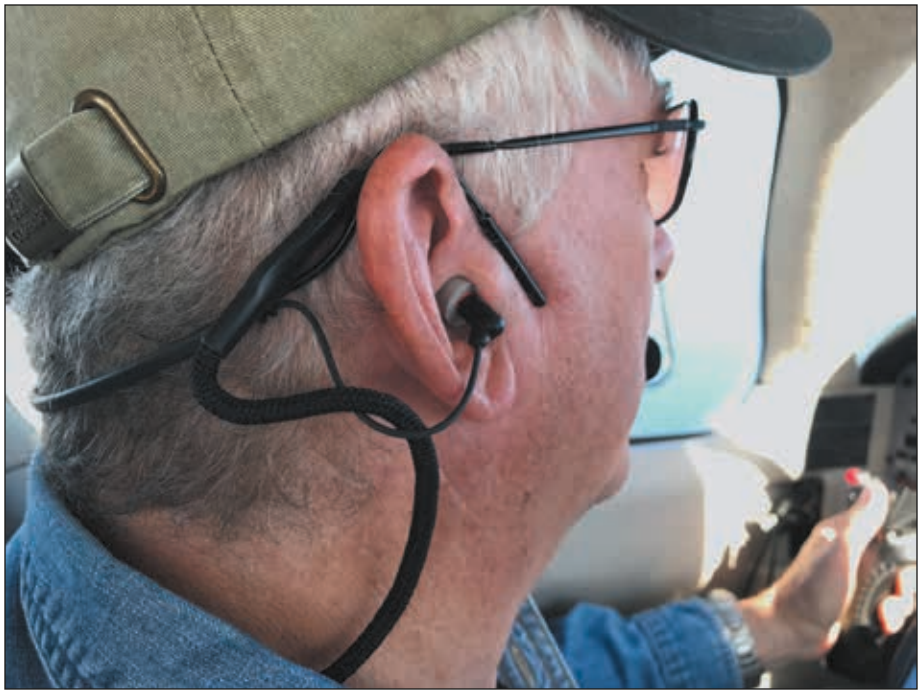
The logical alternative to circumaural (over the ear) and supra-aural (on top of the ear) headsets is an in-ear design. These are basically ear buds attached to a thin head frame that also accommodates a traditional microphone. Their purpose is obvious and simple, which is to allow more freedom and comfort than you might experience wearing a traditional headset.

But that's no easy task and there's far more to consider than comfort. In-ear headsets should protect your hearing, provide audio clarity and performance as good as the highest-end ANR headset and they need to be rugged. Like any headset, they need to have a simple and compact control module.

To see which models do this the best, we rounded up three aviation-purposed in-ear headsets to include the Clarity Aloft Link, the Quiet Technologies Halo Tubephones and the Faro Air. Here's a field report.

## HOW WE EVALUATED

We put each of the three models on our bench and looked at design and build quality of the frames (some are bendable so we tried to snap them), the wiring protection, the audio plugs and supplied accessories. Face it, ear buds get nasty (and accumulated ear wax deteriorates performance), so a healthy supply of fresh replacement buds in various sizes is high on our list of gotta-have parts. And as we learned a long time ago with traditional headsets, not every noggin is the same, so the ability to precisely adjust the frames for just the right fit when wearing a hat, eyeglasses and maybe even a flight helmet is important.



We've always advocated trying any headset before you buy it. Understand that in-ear headsets aren't for everyone because some simply can't tolerate buds in the cabin environment—especially unpressurized ones. See the sidebar on page 8 for custom ear mold alternatives. Based on our use, in-ears might not work to your liking in loud cabins, including open cockpits. We know they work quite well in jets and turboprops. For these missions, we bring along our own Clarity Classic model.

For performance comparison with a circumaural ANR design, we used the Bose A20 Bluetooth model as the benchmark for entertainment audio quality, since all of the in-ear models evaluated here accommodate music.

## CLARITY ALOFT LINK

The Clarity Aloft line consists of three available versions of in-ear headsets offered by Minnesota-based Aloft Technologies. The models—Classic, Link and Pro Plus—differ either by having wireless Bluetooth capability or FAA TSO certification. More on this in a bit.

The set we used in this roundup is the Link, plus the $525 Classic model. Weighing just shy of 2 ounces, the Clarity Classic (which weighs the same as the others in the Aloft lineup) isn't the lightest and

*We found that the Clarity, left, had the best no-fuss fit right out of the box.*

### CHECKLIST

- The Clarity Aloft Link offers exceptional build and audio quality.
- If you can live without Bluetooth, you can save $270 with the Clarity Classic model.
- In-ear headsets offer freedom, but might not work the best in loud environments.

that's obvious when it is on the head. But out of the sets we evaluated, we think it feels the most durable. The hardware—including the headband and attached microphone boom—have a high-end feel.

The Clarity is worn over the ears and the band rests behind the head. There is some flex in the band to adjust it for a more precise fit, while the microphone always seemed to stay in just the right position over the lips without dropping or moving out of the way. We use the Clarity with and without glasses and hats and it always fits well without struggle.

All Clarity models come with what Aloft calls Comply Canal Tips. These foam tips come in small, medium and large and screw onto threaded posts of the set's speakers. We wouldn't believe it unless we tried them, but Aloft advises that you may need different size tips for each ear. That was the case with more than one evaluator who needed a small tip in the left ear and a medium one in the right. You'll want to experiment because if you don't get a full seal (with any of these in-ear headsets), performance will indeed suffer. You also have to properly insert the tips and that may not be easy for all.

Aloft instructs you to compress the foam by pinching it down, as opposed to rolling it. That can cause the tips to unscrew from the posts, it can stress the wires and also risk lodging the tip in the ear. The average canal tip lifespan when used daily can be up to three months, but waxy ears have us changing them far more often.

We found the Clarity's audio quality and noise attenuation impressive. Aloft says you can expect between a 29- to 47-dB noise reduction within the 125 to 8000 Hz frequency spectrum—that's nearly as effective as higher-end ANR models.

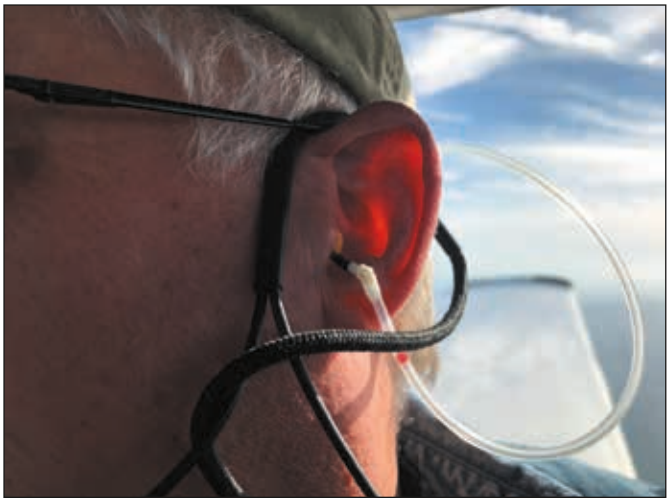
The directional noise-cancelling microphone also performed flawlessly. It never clipped and it was as crisp and clean as the mic on the Bose A20 or Lightspeed Zulu 3. But keep the correct side to your lips—there's only one "talk" side.

The volume control box is minimal and houses a single volume control knob, plus a stereo/mono switch. There's also a balance control potentiometer on the back of the box. While left and right channel balance is pre-adjusted at the factory for center balance, you can tweak the pot for more or less volume in either ear. This might be handy when used with a PS Engineering or Garmin audio panel that has dimensional sound, where audio is spatially positioned in the headset.

There is a music input jack on the control box for external wired audio input. While the music quality was quite good, it doesn't mute when there's radio or intercom chatter.

The $795 Clarity Link model has all of the same features and specifications as the Classic, but with a detachable Bluetooth module for wireless music and telephone audio input. Aloft doesn't build the BluLink module, but instead sources it from Pilot-USA. While the BluLink module has intuitive controls and a high-end feel, we wish it had an extension cable for more storage options in the cockpit. Weighing


*The downside of the Clarity Link model, top, is dealing with two controllers. The removable BluLink controller, middle, is fairly large and needs a longer cable for better storage. The main volume control, bottom, seems just right.*



*That's the complete Quest Technologies Halo kit spread out on our test bench, top. You can see that the dangling audio tubes might get snagged on something in the cabin, middle. That's the utilitarian control module at the bottom.*

4.2 ounces with two AA batteries installed, the BluLink tends to tug on the headset's audio cables if it isn't resting on something—like the aircraft floor or secured in a map pocket. Even the supplied attachment clip wouldn't keep the module secured where we wanted it in flight.

Of course, you don't have to use the BluLink module. The device has two quick-connect attachment points: One side connects with the volume control box and the other connects directly with the headset.

Pairing the BluLink with a newer iPhone was easy and there's a dedicated pairing request key on the face of the module, along with a Bluetooth status annunciator. There's also a power annunciator and a simple on/off key.

The quality of the music linked through the module was outstanding, in our view. The module has Digital Signal Processing (DSP) and our ears sensed an increase in audio gain and depth when the circuit energizes. Better yet, volume keys allow you to control the music level separate from the main Bluetooth source, plus you can advance or rewind through the song playlist with dedicated keys on the module. You can answer the connected telephone with the dedicated telephone key.

The BluLink comes preset to reduce the volume of the linked music when there's radio or intercom chatter, but you can make it mute entirely by pressing and holding the phone icon on the module for three seconds. Depending on how much Bluetoothing you do, battery life is listed as 15 to 20 hours, and it has automatic shutoff after 30 minutes when it's not connected to a Bluetooth source.

Aloft also offers a TSO'd version called the Pro Plus. It says the target market for the $725 model (which doesn't have the BluLink module) is airline crews requiring TSO'd headsets. These are manufactured in a different location than the other Clarity models (because of the stringent TSO standards) and utilize a slightly different microphone with a heavier boom.

All Clarity models come with a storage case, six pairs of small, medium and large ear tips, plus a three-year warranty and 30-day money-back guarantee.

## QUIET TECHNOLOGIES HALO TUBEPHONES

Maker of the $359 Halo, Mississippi-based Quiet Technologies boasts that it was the first company to develop a lightweight insert-style noise isolating foam tip headset for aviation. Company founder Phil McCandless said the design dates back more than 20 years ago as the UltraFlite and AuriComm models. The UltraFlite and the current Halo concept arose by studying the Etymotic Research ER-series insert earphones used by audiologists in clinical and research labs.

The basic Halo design—which is really an Etymotic Research ER-3 earphone fitted with an aviation-compatible noise-cancelling microphone—utilizes a balanced-armature speaker that delivers sound to the ear through a carefully designed "tuned" tube network inside a small box. The sound travels through the acoustic tubing network, exiting the box through a foot-long tube and out of a soft compressible foam ear tip sealed to the ear canal.

McCandless says studies show that significant noise isolation (attenuation) is possible using the ER earphones and can equal or exceed that of a single-walled audiometric test enclosure. This allows the audiologist to test patients down to the quietest threshold levels in typical physician examination rooms without the need to place the patient inside a massive and expensive noise-isolating test suite while wearing conventional earphones.

There's no fancy electronics here, which frankly gives the Halo a dated feel compared to the others in the

group. But what the Halo lacks in gee-whiz design, it could make up for in reliability. McCandless said the advantage of using tubes in the Halo (instead of a direct earphone driver into the ear) is obvious. Tubes are simple devices, requiring no wires or electricity, and when they become defective or clogged they can be replaced in the field by pulling the old ones off and slipping new tubes on. The Halo comes standard with replacement tubing.

Since the Halo can be worn either over the head, behind the head or rested on the shoulders, the tubes can be cut almost an inch for a better fit, depending on how you wear the set. For instance, longer tubes accommodate the frame resting on the shoulder (making the set more awkward, in our view), while shorter ones work best when the headset is worn behind the head. Still, it's easy for the dangling tubes to get caught under the headband or even snagged on a shoulder seatbelt.

The headband is flexible, and pulling or pushing on the stainless steel rod (which is contained inside a hollow portion of the headframe) allows for a fit that works best for your head shape and size. We tried all three fitting positions.

Wearing the set over the head seemed uncomfortable and made them unstable, if not difficult to wear with a ballcap. Worn on the shoulder, the microphone seemed to move out of position. Wearing the Halos over the ear worked best in our trials, easily accommodating glasses and a ballcap.

The tubes, according to Quiet Technologies, are critically damped and optimize speech and music (the headset accommodates a wired entertainment input—no Bluetooth) by restoring the natural resonant characteristic of an unblocked ear canal. We found the audio quality to be acceptable. The real test is with music piped in from an iPhone. The Halos, in our opinion, performed the worst out of the three headsets tested. But admittedly, this is with a critical ear.

The music input gain was low (even with the source cranked way up) and the set lacked the bass response that we enjoyed on the Clarity—and have grown to love on the Bose A20. Not even close.

The noise-cancelling microphone's sensitivity didn't seem to be as good as the one used on the Clarity, either. With the Halo, it has to be positioned precisely over the lips to avoid clipping.

As for the ear tips, the Tubephone can be used with triple-flange rubber inserts or disposable foam inserts. In our trials, the foam tips seemed to offer the best noise isolation. You can compress them better than any of the other tips, which is the key to the best attenuation. Once in the ear and fully expanded (which takes a few seconds), we found them to be comfortable and extremely effective.

The Tubephone has a basic control module (the set doesn't require batteries) that houses a stereo/mono switch and thumbwheel potentiometers for adjusting volume. No frills here. We do like the Kevlar reinforced audio cables that the company says are high strength and UV-resistant. They are routed into the hollow headband, which keeps them out of the way.

Quiet Technologies said it is still producing the Halo, but as we go to press it has suspended new orders due to product backorder. The company only fields questions and correspondence via email and you can't leave a message. In our dealings, the demo set arrived promptly.


*The Faro Air, shown in the photos above, is priced at $390 and the company vows to replace any set that breaks as a result of bending the frames for a custom fit. We wish the set had Bluetooth connectivity.*

## FARO AIR

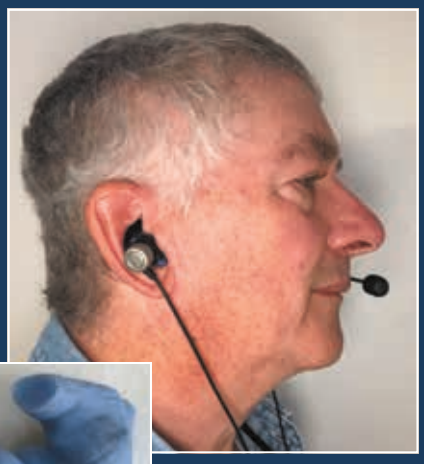
Despite brisk competition in the entry-level headset market, Las Vegas-based Faro Aviation has made inroads with several models, including the in-ear Air. The $390 Faro Air (along with a Clarity) has been in our long-term evaluation pool for roughly one year and we've been offering them to passengers and other pilots for feedback.

One pilot used them in his Arcus glider during a multi-day competition. The draw? A traditional over-the-head headset can break the

YouTube See a video review of in-ear headsets at http://tinyurl.com/j95ht2a

## DO CUSTOM EAR MOLDS STILL MAKE SENSE?

Of course I tried circumaural headsets years ago, but the pressure and bulk caused me discomfort and gave me headaches on long trips. The lightest headset at the time was made by Plantronics and was used by airline pros. I ordered a Plantronics model MS50/T30-2, but I didn't like the ear- piece that came with it so I adapted and mounted a firearms ear plug to the ear tube. I used this for years until I found a place that could make a custom ear mold for it. By eliminating the headband, the comfort level was increased exponentially. When Lightspeed came out with the Mach 1 stereo headset, I bought one with the custom ear mold option. The audio was much better, with both ears processing sound, plus the microphone was also a notch up in quality.



Today, the process is simple for getting custom ear molds for use with most in-ear headsets. The first step is to find an audiologist to get an ear mold fabricated. That's one in the inset photo to the right. Then you send the molds out to a company that makes the finished ear inserts. They'll customize the inserts to attach them to the specific headset you have purchased. The process generally takes a couple of weeks.

I always find vendors at Sun 'n Fun and AirVenture offering custom on-the-spot ear molds, but a web search generally turns up fewer options. One reputable mold maker is Avery Sound in Capo Beach, California. Its website is www.pilotstuff.com, which has a pilot-oriented section for custom mountings for a variety of headsets available today. The company I originally used for fitting to the Mach 1 ear molds was Sensaphonics in Chicago. Its website is www.sensaphonics.com.

But should you even mess with modifying something as good as a Clarity Link? I liked the build and audio quality so much I'm considering them and a custom mold. Aloft's Mike Feldbauer—an audio specialist—warned of some caveats. For example, the human body is flexible and when an ear mold is taken, the ear canal is in one state. The canal opening may be smaller or larger depending on the ambient temperature and other physical factors such as water retention, weight and diet. Think in terms of a finger ring—sometimes it slides right off, other times it's stuck. Similarly, the custom ear mold may be loose on some flights, which would let in some ambient noise. Aloft doesn't recommend using custom ear molds with its Clarity headsets because they can't guarantee the same noise attenuation with them as they can with the audio foam they use. It has also seen cases where the molds damage the threads on the speaker attachment posts.

After buying custom molds, I never looked back and have been flying all kinds of aircraft, including my Mooney, with huge comfort on long trips. The stereo audio quality has been very good and ambient noise is reduced considerably. But, I was so impressed with the audio quality of the speakers in the Clarity Link headset that I'm starting to think it's time to upgrade and ditch the molds for foam.

*—Robert McGuire*

aircraft's canopy when jarred in turbulence. Problem solved with an in-ear model. Unfortunately, the same evaluator reported what seemed to be an impedance-related audio problem when used with a passenger on the intercom. The problem was solved by using a different headset.

The Faro is comfortable and at 1 ounce, it's .5 ounces lighter than the Clarity. This might seem nominal, but the Air just felt easier to wear on longer hauls and there were no pressure points where the earband rests on the base of the ear. It helps that the headband doesn't need to fit tightly on the back of the head to stay firmly in place.

Don't look for slide adjustments on the metal headband and earloop frames—they don't exist. Instead, you simply bend the metal (expand or contract) to get the right size for your head. Faro says you won't break the structure by making these adjustments, and if you do, the company will exchange the set. And you likely will have to do lots of adjusting. One staffer dinged the Airs for being too loose on the head without sizable tweaking, and he thought the microphone felt heavy hanging off the frame.

But we think the Airs have the best foam ear buds in the group. This means they're comfortable in the ears and offer decent sound isolation. Our takeaway is the same as it's been in other in-ear headset trials. The performance of either in-ear model is greatly dependent on the fit of the slow-recovery composite foam earplugs. Faro provides two sizes to choose from: medium (Faro says the medium fits the majority of users) and large. Both are designed slightly longer than a typical earplug to fit deeper into the ear canal.

Faro says the Air provides up to 50 dB of noise reduction. Compare that to the Clarity Aloft, with specs rated at up to 49 dB of noise attenuation. But, for perceived audio quality, we prefer the Clarity. The Faro is accepatble, but we think the Clarity beats it in depth and tone.

Still, we like simplicity and the Faro's lightweight control module delivers. It has a slide volume control

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### CONTACTS...

Aloft Technologies
612-747-3197
www.clarityaloft.com

Faro Aviation
855-359-3276
www.faroaviation.com

Quiet Technologies
601-316-7160
www.quiettechnologies.com

# Restraint Systems: Repairs and Upgrades

*They keep us alive without our thinking about them, yet belts and straps wear out. Repair is surprisingly inexpensive and upgrades abound.*

*by Rick Durden*

It's routine: We get in, strap in without thinking about it and beginning running the checklist. Putting on and tightening up the restraint system is probably the most basic of automatic tasks any of us do as pilots—without the reassuring pressure of the belt and shoulder harness attaching our torso to the airplane, most of us wouldn't hit the starter.

Restraint systems keep us firmly attached to our seats in turbulence so we can control the airplane when it's gyrating and they make a huge difference in whether we're going to be injured or killed when things go south and the airplane comes to a stop in circumstances other than we desire.

While restraint system use is automatic for most of us, as aircraft owners and users we also need to inspect the restraints in the airplanes we fly. But, what are we looking for? How do we know when a seatbelt needs to be repaired or replaced? And, if it does, what are our options?

## HOW MUCH WEAR?

The FARs call for following the manufacturer's maintenance instructions; however, there simply are not definitive guidelines for what is acceptable wear and what isn't. As Scott Utz, proprietor of Arapahoe Aero in Denver, told us, "Restraint systems are on-condition replacement items, but there's nothing comparable to the guidance you get with other components that says such things as a quarter-inch crack is acceptable, a half-inch crack is not." He went on to tell us that anytime you observe frayed, torn, creased or crushed webbing (fabric), it should be repaired or replaced—any one of those items is a condition. So are broken, missing or frayed stitches. If the stitching pattern is inconsistent, it may indicate rewebbing by someone not qualified to do the job.

We also learned that the hardware should be inspected for wear or bending of hooks and end fittings, inoperable springs and rust—all are conditions that call for replacement. If the buckle shows wear or doesn't operate properly, it should be replaced. One of the big problems is the connection between the belt and shoulder harness of older Cessna restraint systems that had a separate seatbelt and shoulder harness—if the shoulder harness does not attach firmly to the seatbelt and stay attached through all flight operations, the connector(s) should be repaired or replaced.

If the restraint system is in use during a quick stop—there's been any damage to the airplane and the system was loaded by the occupant—it should be pulled and repaired or replaced. If a restraint system has been loaded there's no guarantee it will be able to handle its certified nine or 16 Gs if loaded again.

During our research the one consistent guideline we saw from manufacturers, repair shops and publications on restraint systems was that the useful life of webbing is 10 years. UV rays break it down, weakening it.

## REPAIR, REPLACE, UPGRADE

The good news is that there are a lot of options for the owner facing worn restraint belts and the most basic—rewebbing—is not particularly expensive and rarely takes even two weeks to accomplish, including priority shipping. If it is time for your restraint system to be rejuvenated, you may want to take advantage of the upgrades available, especially if your airplane doesn't have shoulder harnesses installed in all of the seats or it doesn't have at least four-point, inertia-reel harnesses in the front seats. We'll survey what's available.

## REWEBBING

While buying a new set of restraints from the aircraft manufacturer is fine, the more cost-effective method of getting the same result is to send the current set—hardware and all—

*The cabin of this Cessna 182 maintained its integrity during a crash—the sort of impact in which a good restraint system may be the difference between life and death.*

# SHOULDER HARNESSES: A MAGIC BULLET FOR SAFETY

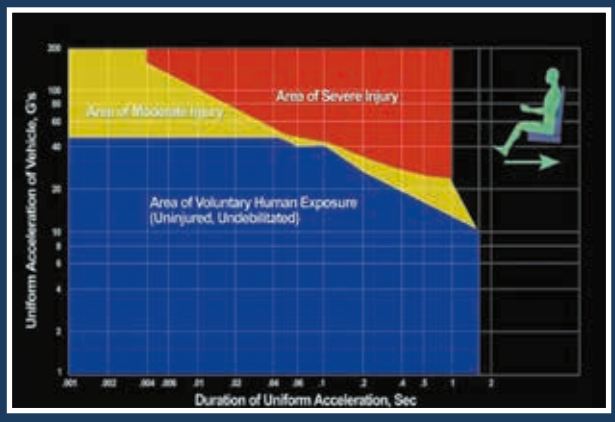
From the perspective of an aircraft owner, it seems that anywhere you look someone is trying to sell you something that is guaranteed to make your ride's panel the hottest on the airport, or reduce drag so that it's faster and more efficient or reduce the stall speed so that it can take off and land from a postage stamp.

Almost invariably, the advertising includes a claim that installing the product will make your airplane safer. It may even be true. However, for an aircraft owner on a budget, what is the one product that gives the absolute most bang for the buck in terms of increasing the level of safety of the airplane? The answer is: shoulder harnesses, for all of the seats.

While owners spend big bucks for avionics to avoid midair collisions, those make up only 1 percent of aircraft accidents. Interestingly, more than half of the people involved in midairs survive.

When you do the safety and accident risk analysis for GA aircraft it turns out that the big accident risk is runway loss of control on takeoff or landing (RLOC). In tailwheel airplanes the rate of RLOC accidents can approach 50 percent—and they tend to be the airplanes that don't have shoulder harnesses for all of the seats.

With the highest single accident exposure being RLOC events, the next step in the safety analysis is whether those accidents are survivable and whether installing a better restraint system would make any difference.





Stall/spin and inflight loss of control (VFR into IMC) accidents tend to involve a ground impact that generates a quick stop and very high G loads on the occupants, making most of those crashes unsurvivable. The reason: High G loads cause destruction of internal organs.

RLOC accidents more often involve speeds of less than 50 knots and an impact sequence that has the aircraft slowing to a stop over some distance—reducing the G load on the occupant.

The secret of survivability in an accident is to minimize the impact speed. One of the grim laws of physics is that force is a squared function—doubling the speed means quadrupling the impact. Hitting something as slowly as possible means the potential for survival goes up, which makes GA's most common accidents the most survivable if the occupants are restrained.

The chart below depicts the ability of a healthy human to withstand impact G loads straight ahead—toward the instrument panel—if properly restrained. The variables are the intensity of the load and its duration. If the G load on the occupant can be kept below about 10, the chances of surviving an impact go up dramatically, even if the impact sequence lasts some time.

The next factor in assessing crash survivability is the container holding the occupants. So long as it remains intact enough that the occupants don't slam into it during the impact sequence, the chances of surviving go up. However, even if it remains intact, it's still necessary to hold the occupant in position in the seat because the container isn't very big—there's not much "flail" space for the occupants.

That brings up the problem of a lap-belt-only restraint system. During an impact sequence of as little as one-G forward (toward the panel), it is impossible for the occupant to brace him or herself against the load and she or he jackknifes over the seatbelt. That means the head impacts the instrument panel or the back of the seat in front of the occupant, as shown by the photo at left of an impact sled test.

Head impact is likely to mean serious injuries. Even if the impact is light, it may be enough to stun or cause loss of consciousness that reduces or eliminates the occupant's ability to get out of the airplane without assistance. That can be critical if a post-crash fire starts. In addition, jackknifing can cause spinal injury and paralysis.

A shoulder harness—even the most basic single-strap version—will help keep the occupant in place in the seat and greatly reduce the risk of hitting some portion of the interior of the airplane during a crash sequence, which is the cause of most injuries and deaths in lower-speed crashes such as RLOC.

That's the analysis—shoulder harnesses will greatly increase the safety of your airplane. The real world agrees: FAA research shows 88 percent of injuries and 20 percent of fatalities have been eliminated through the use of shoulder harnesses over lap belts alone.

*This retrofit shoulder harness was installed for the rear seat of an Aeronca Champ as a minor modification per AC 23-17C and required only a logbook entry, above right. Sewing a seatbelt as part of the rewebbing process, below right.*

to a shop that specializes in rewebbing.

Cindy Vandereedt, office manager of Aviation Safety Products in Blairsville, Georgia (www.aircraftseatbelts.com), told us that her company normally turns around restraint systems sent in for rewebbing in five to seven days.

The procedure involves an inspection of the hardware—including the inertia reel, if part of the system—to confirm it can be reused. That is usually the case. The old fabric is discarded and new webbing is sewn onto the hardware using the stitching pattern and thread approved for the particular type of belt or shoulder harness so that it will meet the nine or 16 G (as appropriate) FAA requirements for it. Vandereedt told us that an X-pattern stitch is normally used. If any of the hardware has not met inspection criteria, it is replaced.

Once the belts and harnesses have been built up, each is visually inspected for conformity and condition of the hardware, including functioning of buckles and inertia reels. The FAA 8130 Airworthiness Approval tag is filled out and the assemblies are shipped out.

As part of quality assurance and confirmation that rewebbed belts conform to their type design and FARs, rewebbing operations periodically test that completed belts meet pull requirements and the webbing meets burn requirements.

Our survey of prices for rewebbing restraint systems showed that the industry is competitive. Prices for seat belts alone start in the low $60 range and increase with the complexity of the system to about $240 for the most complex system—a five-point, rotary release system with inertia-reel shoulder harnesses.

## UPGRADES

We strongly recommend that if you have an airplane that does not have shoulder harnesses for all of the seats that you install them if at all possible. It can be done on most, but not all, general aviation airplanes. We'll talk here about passive restraint systems (once installed, they do their job of protecting occupants without further ado) as we covered active (airbag) systems in the June 2017 issue.


In some airplanes, such as on most Cessna singles and the 336/337 series, the hardpoints/nutplates for shoulder harnesses were installed in the overhead structure when the airplane was built even if shoulder harnesses were not installed. Installing shoulder harnesses can be easy. We watched it done in 15 minutes for the rear seats of a Cessna Cardinal.

For many aircraft, the upgrade is

*We think the most important step you can take to protect those most important to you is ensure each person has, and wears, a shoulder harness, top. Hooker harnesses installed, middle. Whether it's rewebbing or upgrading, you can get a webbing color that complements your interior, bottom.*

nothing more than what the FAA refers to as a minor modification and requires only a logbook entry. AC 23-17C (at page 101) has guidance. Generally, if there is a hardpoint or structure where a shoulder harness can be attached, it's a minor modification. Hey, the FAA knows the value of shoulder harnesses and doesn't want to put roadblocks in the way of installation where there is good structure. The Advisory Circular applies to the front seats of airplanes built before July 19, 1978, and the rear seats of airplanes built before Dec. 12, 1986.

The second method of upgrading a restraint system is via STC, which is most often the way to go when adding the more sophisticated restraint systems.

The following is a brief survey of upgrade options available for most GA airplanes.

**Aero Fabricators** offers a Y-type, four-point harness kit—a shoulder harness over each shoulder attaching to the seatbelt—through **Wag Aero** (www.wagaero.com). They are STC'd for either the front or all seats for most of the Cessna 100 and 200 series, fabric-covered Pipers and the PA-24 and -28 series as well as Beech 35s, some Stinsons and Aeroncas. Starting at $162 per seat for these fixed (not inertia-reel) systems, we consider the prices so low that there is no reason not to upgrade.

**Alpha Aviation** (www.alphaaviation.com) sells replacement and upgrade three-point fixed-strap and inertia-reel kits for a wide selection of Piper, Beech, Cessna and Ercoupe aircraft. In most cases, the belts are for the front seats only. Prices start at $349 per set for fixed-strap kits with inertia-reels being about $100 higher.

**BAS** (www.basinc-aeromod.com) offers a line of inertia-reel four-point restraint systems manufactured by AmSafe. They are available for what seems to be an ever-expanding list of Piper, Beechcraft and Cessna aircraft as well as Luscombes—although they tend to be limited to front seats only. Prices begin at $1480 (black)/$1500 (color) for a pair of front seats. Check with BAS for exact pricing and rear-seat availability.

**Hooker Harness** (www.hookerharness.com) is known for its aerobatic restraint systems but it also offers a line of fixed three-, four- and five-point harnesses for the front seats of most GA aircraft. Prices start at $275 per seat.

## CONCLUSION

When your restraint system hits double digits in age, it's time for replacement of the webbing. While buying new is an option, we think rewebbing is the sensible approach.

If any seat in your airplane doesn't have a shoulder harness and it's possible to install one, we strongly recommend doing so. We like inertia-reel restraints for their comfort when flying, but their price may dissuade owners from a retrofit. We think that the prices of fixed-belt three- and four-point systems are so reasonable that they should be the next upgrade an owner makes to her or his airplane.

ADS-B TECHNOLOGY

# Wingtip ADS-B: uAvionix Gets Creative

*We think the bolt-on skyBeacon is the most innovative ADS-B solution yet. Not only is it an easy install, but the concept has legs to grow.*

*by Larry Anglisano*

To date, even the lowest-priced mandate-compliant ADS-B Out solutions require opening the airframe for a major installation. Whether installing a remote ADS-B transmitter or a new transponder, it's realistic to plan on nearly two days of shop time. In round numbers, that could mean a $1600 invoice—just for labor. But not with the uAvionix skyBeacon, a bolt-on, two-wire solution.

With roots in the UAS market, uAvionix brings fresh thinking, creativity and slick modern tech to the GA market still struggling with equipping for the FAA's 2020 mandate. Is the skyBeacon—an ADS-B Out transmitter that serves double duty as a position light—the easy solution the market's lower end has been waiting for? We ordered one for a close look.

## THINKING OUTSIDE THE BOX

Palo Alto, California-based uAvionix Corporation has plenty of experience doing just that because outside-of-the-box thinking is what's required in the rad world of UAS electronics. In our view, there hasn't been much innovation when it comes to easy ADS-B retrofits for the typical GA aircraft, which has put the market in a real pickle as ADS-B equipage continues to lag.

The uAvionix team of RF, avionics, software and hardware engineers has a proven track record. For unmanned applications, uAvionix has a diverse line of forward-thinking avionics, including the Ping line of Mode S transponders, ADS-B transceivers and perhaps most important, mandate-compliant WAAS GPS engines. There's also the echoUAT, a remote ADS-B transceiver for LSA and experimentals that's 2020-compliant and is compatible with everything from an iPad to a Garmin GNS430 and even the current Garmin GTN navigators. Good start.

All of this tech trickles to the skyBeacon ADS-B device, a product design that's so simple we wonder why other companies double the size haven't acted on the concept.

## NEAR ZERO-INSTALL

That's how uAvionix describes the device in the overview section of the current revision of its installation manual. The product is no joke. A look at the specs reveals that it's a 2020-compliant Class B1S UAT transmitter that meets the FAA's 14 CFR 91.227 criteria. The skyBeacon is limited to lower altitudes (below 18,000 feet) because it transmits on 978 UAT and not 1090ES that's required in the flight levels. But in our estimation, the idea behind the skyBeacon—which also includes a red wingtip LED position light—is easy equipage for lower-end, basic aircraft that only fly at lower altitudes.

Moreover, owners of these kinds of aircraft likely wrestle with a dilemma that's been present in the ADS-B upgrade market since day

*That's the uAvionix skyBeacon installed on a Flight Design CT in the lead photo. The device has a see-through lens partly because it serves double duty as an LED position light, photo upper right.*

## ADS-B COMPLIANT IN AN HOUR OR LESS?

**Maybe. According to uAvionix, shops that have already installed the skyBeacon report that some jobs might be completed in an hour when using the existing lighting wires. We took the device into our shop and had it lit up in minutes. This is wiring at the absolute simplest level. There's a red wire for switched power and a black one for ground. No worries about smoking it, either. It works out of the box for 14- and 28-volt systems without additional wiring considerations.**

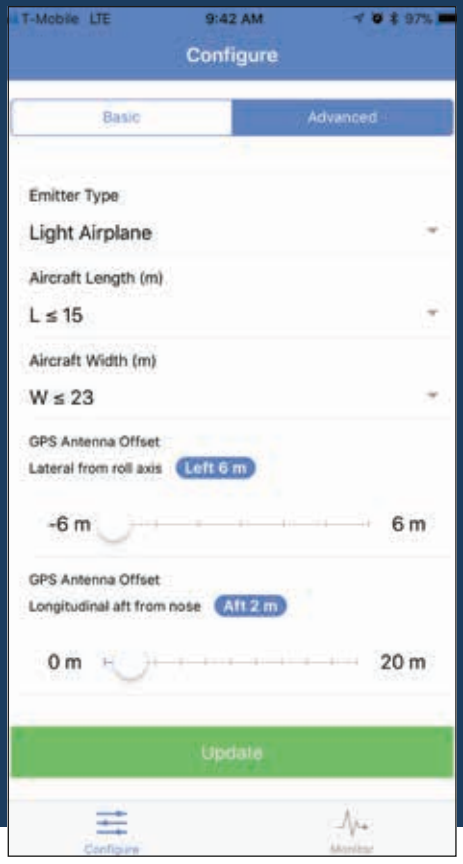
**One concern we have about using existing power and ground wiring (which in most cases is as old as the airframe it's routed through) is shielding, or lack of, which can lead to interference and degraded performance. While this technical tidbit will likely be high on the FAA's list of technical concerns when issuing the STC or TSO, uAvionix is no stranger to solving these kinds of issues and the skyBeacon is built with shielding issues in mind. "Our engineers come from the drone world where EMI and other considerations come into play," said uAvionix's Shane Woodson.**

**The mandate requires that ADS-B Out systems are powered all the time and on the primary bus. The current skyBeacon for experimental and LSA applications doesn't require a pullable circuit breaker, but uAvionix isn't sure what the final requirement might be when the device is approved for certified aircraft. The whole idea behind the concept is to use the existing power and ground lighting wiring that exists at the wingtip.**

**The physical installation couldn't get easier for aircraft that have a position light with the same footprint as the skyBeacon. The kit is supplied with a mounting gasket and three button-head machine screws that are inserted through the device and thread to the existing light mount.**

**The image at the lower right is a screen grab from the installation configuration app and you'll need to allow time for this step, plus a flight test to obtain a performance report.**

**So can a skyBeacon retrofit get your aircraft ADS-B-compliant in an hour? Based on our technical observations, we believe it can, but some jobs might take slightly longer—but not much.**




one: Their aircraft lack a mandate-approved WAAS GPS—a pricey upgrade with relatively few options. But uAvionix solves the dilemma and built a WAAS receiver into the skyBeacon, which also houses a WAAS antenna. There are two antennas, actually—the WAAS, plus an L-band pulse antenna for the UAT transmitter. That's why the fiberglass-enclosed device is shaped like a typical transponder blade antenna.

The skyBeacon has transponder monitoring circuitry that's smart enough to keep the aircraft's transponder and ADS-B squawk codes and Ident status in sync without a separate ADS-B control head, something that could be required with other lower-cost UAT systems. This requires panel space and more install time. uAvionix shows a healthy list of compatible Mode A/C/S transponders, including the vintage King KT76 series, Garmin, Becker and even old Terra systems. The skyBeacon will work with most all existing Mode C altitude encoders without any additional wiring.

The internal LED position lamp (standard aviation red) has a 40-candela intensity and it's located on the main PC board. The entire device draws a measly 3 watts of operating power. While handling the device (that really isn't much larger than a transponder blade antenna), we wondered why uAvionix designed the housing with a see-through lens, making the PC board fully visible. uAvionix said it exposed the electronics mostly for the gee-whiz factor. Hanging out there on the wingtip, it will surely be a conversation piece on ramps, plus it shows the competition that this can be done.

The sidebar above is a brief summary of a skyBeacon installation and not all will be a direct bolt-on. There are current deal-breaking limitations. In its current form factor, the skyBeacon isn't a bolt-on for wingtip lighting enclosed in a fairing. To work correctly, the skyBeacon's antenna needs to hang in the same configuration as a

YouTube See a video overview of the skyBeacon at http://tinyurl.com/j95ht2a

belly-mounted transponder antenna, and many wingtip fairings won't accommodate it.

## APPS AND STROBES

uAvionix is already a few steps ahead of the version 1.0 skyBeacon concept. The companion product will replace the green position lighting (with LEDs) in the right wingtip and house an ADS-B In receiver, plus a Wi-Fi transmitter for delivering weather and traffic data to the cabin. It's smart—ADS-B Out on one wingtip and ADS-B In on the other.

Given the current relationship uAvionics has with ForeFlight (it supplies the Scout portable receiver that's only compatible with ForeFlight), we're confident about ForeFlight tablet app compatibility, but uAvionix didn't talk about third-party interfaces.

uAvionix said it's nearly certain that every skyBeacon will include the LED position light (the device is currently in the certification process for Part 23) and it's also developing a strobe lighting interface option. Shane Woodson described a strobe light interface that's controlled on and off from a tablet app. Woodson made a good point that strobe lighting may be a common accessory on newer aircraft, but still not retrofitted to older ones. Strobes or not, there's an efficiency benefit of any skyBeacon upgrade. "Instead of consuming 26 watts per incandescent bulb, LEDs might reduce that to 3 watts each," Woodson reasoned. We don't disagree. Near-limit power draw is indeed an issue with older electrical systems. LED lighting helps. Plus, given the long lifespan of LED lamp technology, you can keep them on all the time.

**CHECKLIST**

- Mandate-approved ADS-B installs in an hour? That's easily possible.
- A skyBeacon is a two-for-one upgrade with efficient LED lighting as a bonus.
- It can be installed in experimentals and LSA aircraft now, but Part 23 certification is pending.

Since all ADS-B Out systems transmit aircraft-specific data, the skyBeacon is configured with the uAvionix skyBeacon Installer app on iOS or Android and it connects with the skyBeacon over Wi-Fi. Program the call sign, ICAO number (the app is smart enough to fetch this 24-bit number from the FAA database), emitter type or category, plus for the paranoid among us, an anonymous mode.

When the anonymous mode is enabled, the skyBeacon transmits a self-assigned call sign when the transponder is squawking 1200. Word is that aircraft transmitting anonymously won't be eligible for ATC services.

## CERTIFICATION WRAP

The skyBeacon is already shipping for experimental and LSA installs. Since that crowd doesn't need equipment that has a TSO (the skyBeacon does not, but it does meet the specs of the ADS-B TSO-C154c), it's fair game at the current price of $1400.

As for the certified version, uAvionix is hoping to reap the benefits of rewritten Part 23 regs. We see the logical argument already. The typical skyBeacon retrofit is far from a major modification to the airframe, with the benefits of reducing power consumption. Why not certify by way of an approved model list supplemental type certificate, or AML-STC? That's the plan. It's a similar approach we saw most recently with EFIS and autopilot certification via AML-STC.

*The current iteration of the skyBeacon won't easily replace enclosed wingtip lighting because the UAT's blade antenna needs to be positioned as shown above. uAvionics said it's working on a future solution for fairing-enclosed lighting.*

We're told the skyBeacon could have a wide-reaching AML-STC by February 2018.

In our view, uAvionix is on solid ground with hardware (including a WAAS GPS) that already meets the stringent specs of the TSO. Better yet, it manufactures and tests its own WAAS GPS engine and isn't relying on a third-party vendor to vouch for its performance.

uAvionix has a patent pending for the skyBeacon and we think the overall concept will lead to other time-saving retrofits. It's not often we get excited about a new product, but unlike most ADS-B solutions to date, we think the skyBeacon is the most innovative and cost-effective solution yet. We'll be watching its certification progress closely and so should you.

## CONTACT...

uAvionix Corporation
844-827-2372
www.uavionix.com

# Premier's Dakota Redo: Like New, Half Price

*In the Dakota, Piper found a sweet spot for owners hauling lots of people and stuff. Premier wants to bring it back with a nose-to-tail refurb.*

*by Paul Bertorelli*

It's axiomatic that four-place airplanes are flown with two or three seats empty for most trips. But it's just as true that some owners want not just four seats, but a bunch of payload even beyond that. That's why we have the Cessna 182 and the Piper PA-28-235/236 series. That there aren't many of the latter suggests that owners hungry for hauling are a fraction of the market, at least for Piper.

Premier Aircraft is betting that the fraction is large enough to constitute a modest business in refurbing the PA-28-236—the Dakota—to new standards and we recently got a look at what the company is doing with this airplane. As new single-engine airplanes reach nearer the million dollar mark, Premier, a well-known Florida sales and modification shop, thinks owners will find value in a refurbed example of an airplane that's no longer built, but has niche appeal for buyers bored by the everyman humdrumness of a Skylane.

Interestingly, Premier has discovered that buyers who may push back on the $259,000 asking price of a restored model are willing to pay a premium for an example that's repaired and gussied up, but not to the extent of a bare-metal redo.

## BACK IN THE DAY

The Dakota's DNA traces right back to the original PA-28 Cherokee, but the model emerged when Piper and Cessna were in pitched head-to-head competition for all the buyers they could find. The basic Cherokee was fine and all, but it couldn't carry much very far or very fast. By the early 1960s, Cessna was doing well with the 182 Skylane and Piper's answer was to stuff a Lycoming O-540 into the PA-28 airframe and christen it the PA-28-235.

In 1973, it got a formal name: the Charger. And a few years later, it was renamed the Pathfinder. The 235 series came into its own in 1979 with a new engine—the O-540-J3A5D—to replace the original B4B5.

The airplane also got a longer fuselage and a semi-tapered wing to replace the old Hershey bar design that celebrated its draginess with sink fests on final approach that put more than one hapless pilot into the weeds short of the threshold.

Premier's target donors for their refurb market are the 1979 airplanes forward. The Dakota actually survived in the Piper lineup all the way to 1994 and none have been made since.

The Dakota's claim to glory was load hauling and it didn't disappoint. Factory numbers gave it a useful load of 1392 pounds and even if it was 100 pounds less in the real world, it could still carry full fuel and four people with enough payload left for reasonable baggage. For hauling the kid to college, it could cross several states with a Baby Grand in the back. By comparison, the 182 could carry a load too, but it was often just a little shy of what the Dakota could muster, so Piper found

*Premier's Dakota redo, left, looks very much like a modern Archer. But it's 13 inches longer and has 55 additional horsepower.*

### CHECKLIST

- The Dakota is a true heavy hauler and outdoes even the 182.
- Premier offers a tiered upgrade program that includes basic improvements on an old airframe.
- Refurbed is like new, but not new; depreciation is an unknown.

buyers. But not a lot of buyers. Piper built nearly 33,000 PA-28s, but fewer than 3000 were the six-cylinder variants and fewer still were Dakotas. Premier estimates that just over 830 airworthy Dakotas remain on the registry.

## WHY THE DAKOTA?

"We kind of got brought into it," says Barry Rutheiser, Premier's regional sales manager. "One of Fred's very good customers had a son getting into flying and wanted him to have a very nice airplane. He thought a Dakota would be the perfect airplane." (Fred is Fred Ahles, Premier's principal and an aircraft marketing guy who has sold just about every brand and model ever made.)

Although the refurb market remains somewhat of a mixed bag, Premier figured that if one buyer was interested in a ground-up redo of a niche model like the Dakota, others would be, too. The instinct proved correct, but the numbers remain an unknown.

"We're getting a lot of calls on this airplane and when they hear the price, there's sticker shock," Rutheiser told us. We can understand why. Premier is offering three levels of refurbishment for the Dakota. The base offering, what Premier calls the Silver Edition, is $259,000. For $299,000, you get the Gold model and $329,000 buys the Platinum Edition.

What's the difference? All three levels get an overhauled engine from Certified Engines, a new three-blade prop, a complete strip and repaint and a new interior. From there, it diverges with various avionics and instrumentation choices.

The Silver Edition, for instance, gets a pair of Garmin G5s (one for the AI, one for an HSI), a GTN650 navigator with a GTN225A backup comm and ADS-B In and Out. The interior is basic vinyl. The Gold upgrade includes leather upholstery with wool carpet and an S-TEC 55X autopilot. The top-of-the-line Platinum version adds a Garmin G500 display, a GTN750 in place of the 650 and the same autopilot. Customers are free to mix and match and Rutheiser says Premier is flexible on how the airplanes are equipped.

And perhaps the most interesting offshoot of this exercise is that customers may not want any of the higher-end upgrades, but will instead settle for a clean, carefully inspected and repaired airframe with modest avionics upgrades. Premier's Ahles said another thing common to the Dakotas the company is selling is that all of them—whether fully refurbed or just brought to a higher state of airworthiness—get a comprehensive annual that averages about $20,000.

*Premier offers tiered upgrades. The panel above, with G500 and GTN750, is the top-tier Platinum Edition. All of the upgraded aircraft get an overhauled O-540, right, and a new Hartzell three-blade prop, lower.*

"There 832 Dakotas in the U.S. Less than 10 of them are for sale," says Ahles. "They're all at about $80,000. Some are high-time engines and probably high-time airframes. And not one of them has seen a Piper service center in 20 years for a real annual," he adds. Not surprisingly, Premier has discovered stratification in the market. One tier of buyers wants a higher-quality airplane and will pay a small premium while another will pay a much larger sum for an airplane that presents as new, but isn't new and costs two-thirds to half what a new airframe would. The unique thing about the Dakota is that there's no stratospherically priced new version of it to compete and the airplane still has unique capabilities.

## NEW OR NOT?

We spent a few hours looking over and flying Premier's full-boat refurb of the Dakota. It generally lives up to the claim as "like new." The paint—the only part of the job done out of house—is well detailed and designed in a modern scheme. In fact, viewed at a distance, the restored Dakota is

## DAKOTA VS. SKYLANE

**Comparing the Dakota to the rather more numerous Cessna Skylane is a study in cost-benefit matrices. That's an indirect way of saying it's not that straightforward.**

**What became the Dakota—the PA-28-235—first appeared in 1964. It had a whopping 1465-pound useful load, but as the model aged, it got fat. Later models claimed a useful of 1392 pounds, but in the real world, they're closer to 1200 pounds or a little less.**

**Comparable vintage Cessna 182s never reached that kind of payload, even though they too are considered prodigious load haulers. Mid- to late-1960s Skylanes could carry just under 1200 pounds, but as with the Dakota, real numbers are lower than that.**

**The most desirable of the Pipers are the true Dakotas, the PA-28-236 that first appeared in 1979. Like Premier's Dakota redo, these have useful loads in the 1150- to 1200-pound range.**

**In the Skylane line, that gets you into the Q and R models, which have similar useful loads, but probably just a bit less than the Dakota in the real world. The Dakota is also faster than the Skylane, cruising at an honest 130 knots. The 182 is nearly 10 knots slower.**

**But perhaps because the Dakota is more desirable and there are far fewer of them, retail prices are higher. You'll see Dakotas on the market for $80,000 to slightly over $100,000. Skylanes are a little lower, although a pristine, low-time example—if such a thing exists—will command about the same price.**

indistinguishable from a factory-new Archer. It's actually 13 inches longer than the Archer, but unless the aircraft are side by side, only a Piper expert would notice.

The interior in the example we reviewed was flawless. The only oversight we would complain about is that the flap handle bore the dings and chipped paint of nearly four decades of use and one of the panel placards was peeling.

The panel is well conceived, within the limitations of fitting new equipment into an old airframe. The G500 serves as the primary flight display, backed up by a Sandia SAI-340 Quattro standby gyro. That combination allows the ditching of the airplane's stock vacuum system. Navigation is provided by Garmin's GTN750 (or GTN650) with a Garmin GTN225A navcomm for backup, all piped through a GMA35 audio panel/intercom.

If we had our druthers, we would place the JPI engine monitor and backup gyro on the right side of the radio stack for a less cluttered and neater arrangement. But this shows the limitations of retrofit, since the standby gyro has to be within easy view of the pilot, forcing a bit of a jumble. Functionally, it doesn't matter much, but it's not ideal, in our view. Noticeable is what's missing: the engine instruments and power gauge, which would normally occupy the lower panel left of the throttle quadrant. Power and engine instrumentation are handled by the JPI EDM900, a welcome refinement.

While late 1970 to early 1980 Dakotas had a claimed useful load of as much as 1392 pounds, Premier's Dakota falls well short of that, at 1180 pounds. That still allows full seats and full tanks, plus 70 pounds of bags. A factory-new Archer can't touch that and neither can recent model Skylanes. And therein lies the attraction of the Dakota.

You'll pay for it in fuel burn. The O-540 is not the most efficient large-displacement engine in the fleet, burning between 13 and 15 GPH for best-case true airspeeds in the mid-130s. With 72 gallons aboard, that gives the airplane a little over four hours of endurance with a 45-minute reserve.

## MARKET POTENTIAL

The McGuffin here is that because new airplanes of this class cost nearly half a million bucks, if not more, there ought to be a brisk market for remanufactured airframes that cost half that. Maybe. The Premier Edition Dakota joins a handful of refurbs pitched at building market share on this premise. While these have found buyers, the volumes have been smaller than we would have expected.

Premier encountered market disinterest when it launched a diesel conversion of the Cessna 172 three years ago. The shop hasn't sold one yet, but Fred Ahles says he's undaunted. The diesel rolled out just as Continental announced approvals for a higher horsepower version of the engine—155 HP vs. the 135 HP available when the conversion was planned. Moreover, the conversion was aimed at flight schools and Ahles says few of them have the capital for such investments.

The Dakota project isn't intended for schools, but for owners who have the wherewithal to buy their own airplanes, but either can't afford new or don't see the value in new, as many buyers clearly do not. Ahles says new airplane sales slowed to a crawl when Cessna, Diamond and Piper crossed the $400,000 mark for new aircraft.

"I'm looking at it like if people are unwilling to buy a new 172 or a new DA40 because of the price and I can give them the same or better features for $300,000, I think there's a market there. We don't know how big it is yet," Ahles says.

Premier has had surprisingly good response to the Dakota refurb program and could have made a couple of more sales if the airplanes were available.

"We had a lot of people say, well, you don't even have the airplane in stock, but I want an airplane now. The kind of people who are serious about it don't want to wait for a customized airplane, particularly when we didn't even have one. So we bought two other Dakotas to have them in inventory," Ahles says. Those airplanes, and more Premier will purchase, may or may not get the full-boat refurb treatment. Some buyers will be happy with an airplane wrung out through a comprehensive annual and upgraded with modest avionics, including ADS-B Out to meet the 2020 mandate.

Ahles says he isn't necessarily swinging for the fences on the Dakota program. "For a little company like ours that's going to sell 100 airplanes a year, four Dakota sales is a 4 percent increase in business," he adds. In the current market, where sales have been flat if not declining for several years, that counts for a stand-up double, if not a home run. For more on the Premier Edition Dakota, see www.premieraircraftsales.com.

# Lease-Back Part 135: Worth it for Your Plane?

*Leasing your airplane to a Part 135 charter operator to generate income sounds great. The increased cost of maintenance means it usually doesn't work.*

*by Rick Durden*

One of the questions we get from readers is whether they can cut their aircraft ownership costs by entering into a lease agreement with their local Part 135 operator. They'd like their airplanes to generate income by being flown on charters by the operator's pilots while the owners sit comfortably at home in front of the TV. Our response: It sounds good if you say it fast, but the downside can be terribly expensive for the owner. Anyone considering leasing her or his airplane to a Part 135 operator should go in with eyes wide open and a full understanding of the procedures and costs involved in putting an airplane onto a 135 operating certificate and keeping it there.

**CHECKLIST**

- Inspection requirements are onerous and expensive.
- If your airplane flies enough to make money, you may not get to use it.
- If your airplane makes money, wear and tear may be unacceptable.

## 85 PERCENT OF REVENUE

Often the person we're talking to will come back with, "But I'm going to get 80 (or 85) percent of the revenue from each flight, that's a great deal, isn't it?" Our research indicates that the going rate for payment by Part 135 operators to lease airplanes is in the 80 to 85 percent of revenue range. However, unless the airplane is flying charters regularly—as in at least a couple of times a week—and the owner is willing to put up with the wear and tear on his or her pride and joy—as well as potential lack of access to it—even 85 percent of charter revenues can be a money-losing proposition. After all, the owner is also responsible for all of the cost of maintenance and fuel and, usually, training for the pilots who fly the airplane.

We'll tell you our conclusion as to whether it's a good idea economically to lease your airplane to a Part 135 operator and then go through

***Leasing your airplane to a Part 135 operator to fly charter sounds like a money maker, above. The reality may not be quite so attractive—starting with probably the most extensive and expensive inspection your airplane has ever undergone, below.***

*Bringing an airplane that has been flying under Part 91 for years into conformity with the maintenance requirements of Part 135 requires replacing all components that are beyond TBO, including hoses.*

what's involved with putting an airplane onto a Part 135 certificate.

## PROBABLY NOT

We think it is almost never worthwhile to lease a personal airplane to a Part 135 operator due to the cost of complying with the maintenance requirements to qualify it for Part 135 ops—especially with older airplanes for which manufacturers have created continuing airworthiness requirements after they were built—and keeping it in mechanical compliance once on the certificate.

Let's say that you own an airplane (usually a high-performance single, piston twin or turboprop) that a local charter operator thinks could make money for both of you if you were to lease it to the operator. Having the airplane that you picked out so carefully and love to fly, but costs a little more to run that you'd hoped, bring in some money each month sounds pretty good. So, what's involved in going forward?

The first part of the process is to negotiate a lease with the Part 135 operator while spending quality time with an aviation attorney, your accountant (there are tax consequences) and your insurance broker to make sure you are protected. Since you'll be paying for maintenance and fuel, you should get a reduced shop rate and fuel price from the operator and a good-faith estimate of what it is going to cost to do the upgrades to the airplane needed to meet Part 135 maintenance requirements initially.

## THE OPERATOR'S ACTIONS

If you decide to go forward, the operator begins the process of adding the airplane to its certificate—which you can figure on taking at least a few months. The operator informs the FAA that it wants to add an aircraft to its certificate via a format specified by the FAA that gives the local office a heads-up as to what's happening. In doing so, the operator also sets out a timeline for when it anticipates completing the various steps along the way and when it thinks the airplane will be ready for the FAA to examine it for conformity. The operator then sets out to inspect your airplane and take any and all action required to bring it into compliance with its manuals and Part 135.

## THE RIGHT OPERATOR

Here is where selection of the right charter operator can make the difference between actually making some money and writing big checks to the operator each month. If the operator already has an aircraft of the same type on its certificate the process of adding yours is much easier than if yours will be a new type. That's because each operator is required to have documents known as Operations Specifications (OpSpecs) and a General Operating Manual (GOM) that set out all of the procedures that the operator is to follow in conducting its charter operations.

The manuals contain the maintenance and training procedures for each type of airplane it operates. When an operator adds a new type of airplane, it must amend its manuals to show how it's going to maintain that airplane and the training program for its personnel.

The amendments are submitted to the local FAA office having oversight over the operator and must be approved. Depending on the sophistication of the operator and the workload and subtle factors involving willingness of the persons at that office to work with the operator, getting an amendment to the OpSpecs and GOM can take a few weeks or several months.

Usually, the operator will be required to maintain the airplane in compliance with the manufacturer's maintenance instructions as set out in the Service Manual, Service Bulletins, Airworthiness Directives and Instructions for Continued Airworthiness. That includes all manufacturers—airframe, engine, components and STCs. Some operators with extensive experience in specific types of airplanes have their own maintenance procedures that have

been approved by the FAA—which may be a little less onerous if they can be applied to your airplane.

## MANDATORY MAINTENANCE

The bottom line is that your airplane will become subject to the far more rigorous maintenance requirements of Part 135 of the FARs rather than those of Part 91. When you were operating under Part 91 and the manufacturer published recommendations or guidelines for maintenance as well as Service Bulletins, Instructions for Continued Airworthiness and maintenance procedures for aging aircraft, they weren't mandatory for your operations. Under Part 135, all of those recommendations become rules—hard and fast ones.

That means that your new partner in aviation is going to pull your airplane into the shop and peer closely at its maintenance records. If a manufacturer issued a Service Bulletin applicable to your machine, and the logs don't show that it was performed, the operator is required to take the action called for in the SB.

You're going to be writing big checks for maintenance before the airplane goes online.

Scott Utz, proprietor of Arapahoe Aero at Denver's Centennial Airport, talked with us about what's involved in initially putting an airplane onto a Part 135 certificate. He pointed out that the manufacturer(s) set out maximum times—hours of operation or calendar—between overhaul for components of your airplane. Every one is now mandatory. If it's been more than six years since your prop was overhauled, no matter how much time is on it, it has to come off and be overhauled—inspect and repair as needed (IRAN) doesn't cut it. That applies to the engine, all hoses (figure on $2,000 to replace all of them), the engine controls, prop governor, aux fuel pump, vacuum pump(s), manifold valve if you have more than one vacuum pump and fuel indicating system, to name a few.

## STCs

If the airplane has any STCs those must be researched to ensure any maintenance guidelines or instructions for continued airworthiness have been complied with—something that can be time consuming on older airplanes.

We spoke with Derek DeRuiter, owner of Northwoods Aviation in Cadillac, Michigan. He uses a number of single-engine Cessnas in his Part 135 operation. He recently added a 182 to his certificate and told us it took several months to do all that was required. He described the 182 as "nice" and said that his shop spent 90 hours on labor to get the airplane into compliance with Part 135 maintenance requirements and 15 hours on paperwork. He is in the process of adding a Cessna 185 on amphibious floats to his operation, and is amending the OpSpecs and GOM for water operations. Thus far in the process of complying with Part 135 maintenance requirements he has had to have overhauled or replace everything forward of the firewall—which has cost $53,000, not including his shop's labor.

Once the operator has completed the needed work on your airplane and associated paperwork, the FAA will send a team in to do a conformity inspection. That takes a day or two as the personnel go over the paperwork and spot check the condition of the airplane. If all has been done correctly, the FAA will approve the operator's actions and, assuming pilot training has been completed, the airplane is ready to start flying the line.

***Once your airplane is on a Part 135 certificate, the more stringent maintenance requirements continue in place, which can make complying with TBO limitations expensive.***

Once in service, the maintenance requirements of Part 135 mean that if the airplane is flying enough to hit component TBOs via flying hours before calendar hours, it may be generating enough income so that you get a check most months. It also may mean it's not going to be available to fly when you want it and it's getting beat up enough that you're going to need to spring for paint and interior work so that it remains attractive enough for charter work.

If the airplane is hitting calendar TBO times before flight hour TBO times, the chances are that it's not generating enough income to offset your increased costs of maintenance of Part 135.

## CONCLUSION

If you have the opportunity to lease your personal airplane to a Part 135 operator in hopes of reducing your cost of ownership, proceed with extreme caution. We haven't seen much evidence indicating that it will provide the result you desire.

# Carburetor Idle Issues: Check the Mixture First

*If you live in a climate with seasonal temperature swings, adjusting the carburetor idle mixture may be required more often than you think. There are some clues.*

*Staff report*

Have you noticed that carbureted engines behave differently in varying temperatures? We have, and it's a pretty good argument for the simplicity of fuel injection.

But if you're stuck in the carb age, tweaking the idle mixture (perhaps often) for the intended operating climate could be a necessary evil for properly maintaining it. Unless you're an A&P, adjusting carburetors may not be an approved owner-performed task. But you can help your tech get it right to your liking by knowing the basics. Here's a primer.

## BY THE BOOK, BY THE TACH

Face it, from a fundamental standpoint, the carburetor on your Cessna is hardly much different than the one you maybe had on your small-block Chevy engine. Dealing with its maintenance is the familiar nuisance of dealing with stuck float bowls, chasing fuel leaks and doing preventive rebuilds.

At the least, if you want your engine to run well on and off idle, commit to frequent adjustments. Lycoming even suggests resetting idle mixture on a seasonal basis, if you live in an area with wide swings in density altitude. But we say only if there's an issue. With finicky carbs, we've long subscribed to the "if it isn't broken, don't fix it" theory. And, we wouldn't attempt any adjusting without a current service manual, plus service data for any modifications made to the fueling system.

If you're still using an analog tachometer, don't go any further without knowing when it was last calibrated. If there's doubt, send it to an instrument shop for a bench cal.

As for symptoms that suggest it's time for an idle mixture adjustment, you might observe the engine running rich in summer and lean in winter temperatures.

Some engines are more affected than others due to carb location, intake plumbing, baffling and so on. In warm weather the tipoff is, first, a noticeable RPM gain on pulling the mixture control to idle cutoff—maybe as much as 100 RPM or more. The reverse may be the case when it's cold. You might also find that spark plugs are fouling easily, even with a lean mixture set for taxiing.

## PULL IT BACK

Don't adjust anything unless you're confident in the health of the magneto timing, the condition of the spark plugs and obviously the carb itself, although attempting the adjustment is the first step. Head to the runup area (or fly it first) to warm the engine. With carb heat off and a clean air filter in place, face the airplane 90 degrees to the wind and adjust the throttle to give minimum RPM. This is typically around 650 RPM. Secure the throttle friction lock to keep it from creeping. Move the mixture control toward idle cutoff and monitor the tachometer.

As you come to the last inch or two of mixture travel, you should notice a 25- to 50-RPM rise in engine speed before the engine falters from lean misfire. Keep it running and record the actual RPM rise, whatever it is. If your lean-out gave more than a 50-RPM rise, your carburetor (or fuel injection—the same test applies) is set too rich and needs to be compensated in the lean direction.

Conversely, if you saw little or no RPM rise, your idle mixture is set too lean. The idle mixture adjustment on a Marvel-Schebler carburetor is in the form of a large knurled screw (or small slotted knob) on the throttle casting, high on the carb. On MA-3 and MA-4 series carbs, for example, find the bowl drain plug, then run your finger (or eyes) straight up the side of the carb until you come to a slotted knob with arrows on it pointing to "R" (rich) and "L" (lean). That's the idle mixture adjustment. Give this screw a turn in the desired direction, then repeat the lean-out procedure described above.

Of course, alterations in idle mixture have an effect on idle speed as well. If your engine was set too rich (i.e., 150-RPM rise on shutdown) and you corrected this by turning the idle mixture screw as needed to give the desired 50-RPM rise, your engine will now probably idle about 100 RPM faster than before. Accordingly, you'll want to adjust the idle speed to put it back in the 650-750 RPM range. Any changes require supervision by an A&P.

On a Marvel-Schebler carb, as on an automotive carb, the idle speed adjustment is made with a set-screw on the low-RPM stop at the throttle arm on the carburetor. Make adjustments as needed to bring the idle RPM back to 650-750. Repeat the idle mixture lean-out check. You want no more than a 50-RPM rise on lean-out.

Obviously, several iterations of the basic procedure may well be necessary to get the carb set up correctly for both idle mixture and idle speed, since one affects the other. Try not to idle the engine so long on the ground, however, that CHT reaches in-flight indications.

And, be aware that with prolonged ground operation at full-rich mixture and a low RPM, spark plug fouling is encouraged, even with a perfectly adjusted idle mixture. That's because in the 700-RPM range, the plugs operate too cold to burn clean. It really helps to have even the most basic graphic engine monitor for maintenance and normal ops.

Once you have it set, record the RPM rise on every shutdown. It can help you spot float saturation and internal leakage. And while you're at it, record the date and outside temperature. After a while, the calendar will tell you it's time to do this all again.

# 2017 EDITORIAL INDEX




STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION (Required by 39 U.S.C. 3685). 1. Title of Publication: Aviation Consumer. 2. Publication No.: 0908-2600. 3. Filing Date: 9/22/17. 4. Issue Frequency: Monthly. 5. No. of Issues Published Annually: 12. 6. Annual Subscription Price: $84.00. 7. Known Office of Publication: 535 Connecticut Ave., Norwalk, CT 06854-1631. Contact person: Greg King, 203-857-3119. 8. Headquarters or General Business Office of the Publisher: Same as above. 9. Publisher: Same as above. Editor: Larry Anglisano, Belvoir Aviation Group, LLC. 535 Connecticut Ave., Norwalk, CT 06854-1631. Senior Editor: Rick Durden, Belvoir Aviation Group, LLC. 535 Connecticut Ave., Norwalk, CT 06854-1631. 10. Owner: Belvoir Media Group, LLC 535 Connecticut Ave., Norwalk, CT 06854-1631. 11. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amounts of bonds, mortgages or other securities: None. 13. Title: Aviation Consumer. 14. Issue date for circulation data below: August 2017. 15. Extent and Nature of Circulation (Average No. Copies Each Issue During Preceding 12 Months/ No. Copies of Single Issue Published Nearest to Filing Date): a. Total No. of Copies Printed (10,275/9,925) b. Paid and/or Requested Circulation: 1. Paid/Requested Outside-County Mail Subscriptions Stated on Form 3541 (8,868/8,721). 2. Paid In-County Subscriptions (6/0). 3. Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Non-USPS Paid Distribution (364/361). 4. Other Classes Mailed Through the USPS (0/0). c. Total Paid and/or Requested Circulation (9,237/9,082). d. Free Distribution by Mail: 1. Outside-County as Stated on Form 3541 (780/778). 2. In-County as Stated on Form 3541 (0/0). 3. Other Classes Mailed Through the USPS (0/0). 4. Free Distribution Outside the Mail (129/47). e. Total Free Distribution (908/825). f. Total Distribution (10,145/9,907). g. Copies not Distributed (120/18). h. Total (10,275/9,925). j. Percent Paid and/or Requested Circulation (91.0%/91.7%). 17. I certify that all information furnished on this form is true and complete. Gregory M. King, VP Circulation, 9/13/17.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# Cessna 120/140

*With stone-simple systems and benign handling, the Cessna 120/140 is a good choice for affordable flying.*

The first of Cessna models to be built in volume was the diminutive Cessna 140, followed a month later by a stripped-down version called the 120. At the time, the Cessna 120/140s were perfectly serviceable and practical two-place airplanes. They were reasonably priced to buy and economical to own. There was a reason for that.

During WWII, tens of thousands of Americans were either taught to fly by the U.S. military or were exposed to the routine use of air transport to cover long distances quickly. Aircraft manufacturers naturally assumed this fertile crop of newly released soldiers, armed with the recently enacted G.I. Bill of Rights, would generate a sales boom of staggering proportions.

It did. While it was of far shorter duration than even the most pessimistic forecasts, huge numbers of new airplanes were manufactured. Piper was building Cubs and, soon, Cruisers and Pacers pretty much as fast as it could.

With a few exceptions—Beech's Bonanza or the Ercoupe, for example—most offerings were tailwheel machines. So equipped, the Cessna 120/140 was easy to own. Although they all initially had fabric wings, they were made mostly of metal, avoiding the periodic need for re-covering.

***Buyers look for vintage aircraft for many reasons and one of them is the low cost of operation.***

The good news is the qualities making them popular in the late 1940s are still present. Today, what little they give up to Piper's Cubs in panache, they more than make up for in reduced acquisition costs and arguably more-forgiving handling qualities.

## MODEL HISTORY

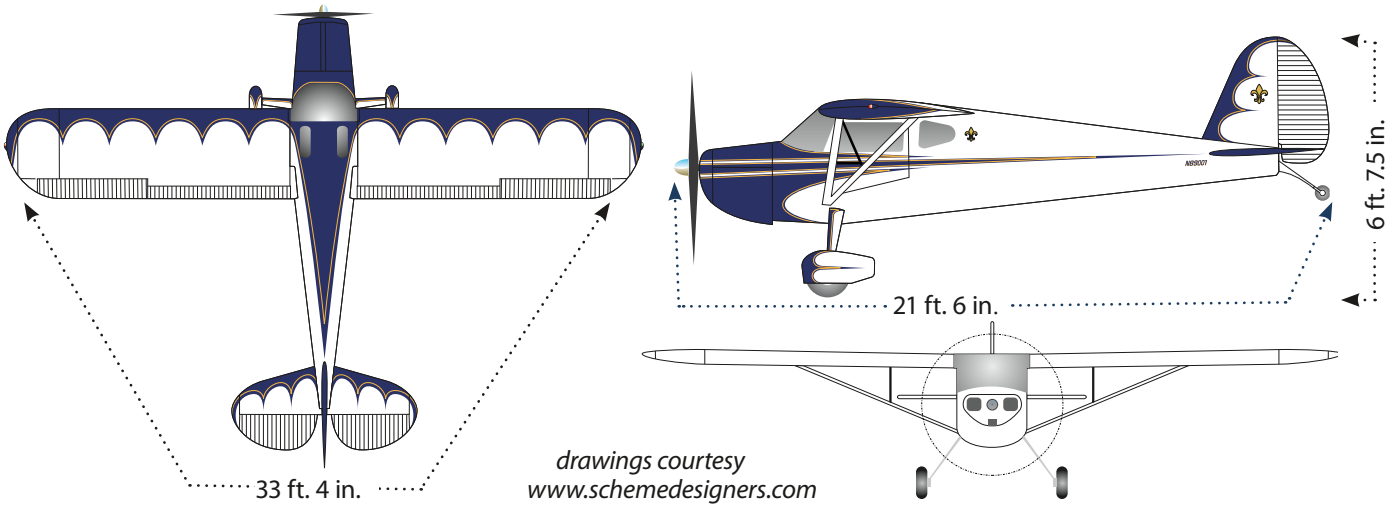
The 120's model history is rather short, since it was produced only for four years, from June 1946 through May 1949. Since Cessna had the training market firmly in its sights, the 120 initially sold for a mere $2695.

That amount is equivalent to just under $31,000 in current dollars. Try to find a new, FAA-certificated, mostly-metal trainer for that kind of money today.

Cessna made the 120 about as simple as airplanes get, with side-by-side seating, yokes rather than sticks, no flaps and no rear window. Because it was cheaper than building cantilever wings, Cessna—which had never put a wing strut on an airplane since it started production in 1927—hung struts on the 120/140 series, forever changing the public's perception of the product line. Standard equipment did not include an electrical system, although a generator was available as an option. The International Cessna 120/140 Association tells us that none left the factory with one; however, most 120s have an electrical system these days.

*That's Russ Niles' 1948 Cessna 140 ready for takeoff in the lead photo.*

# CESSNA 120/140

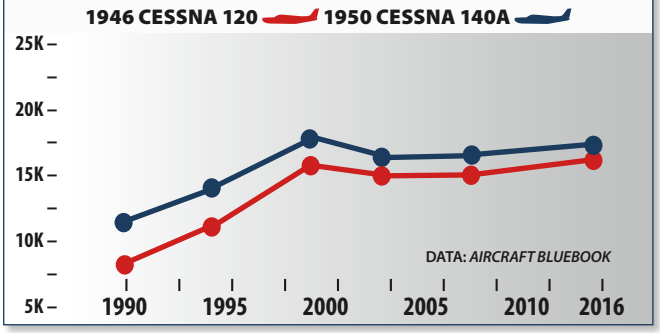



*drawings courtesy*
*www.schemedesigners.com*

## CESSNA 120/140 SELECT MODEL HISTORY

| MODEL YEAR | ENGINE | TBO | OVERHAUL | FUEL | USEFUL LOAD | CRUISE | TYPICAL RETAIL |
|---|---|---|---|---|---|---|---|
| 1946 CESSNA 120 | 85-HP CONTINENTAL C-85-12 | 1800 | $16,000 | 25 | 632 LBS | 100 KTS | ±$15,250 |
| 1946 CESSNA 140 | 85-HP CONTINENTAL C-85-12 | 1800 | $16,000 | 21 | 650 LBS | 88 KTS | ±$15,500 |
| 1947 CESSNA 120 | 85-HP CONTINENTAL C-85-12 | 1800 | $16,000 | 25 | 632 LBS | 100 KTS | ±$15,250 |
| 1947 CESSNA 140 | 85-HP CONTINENTAL C-85-12 | 1800 | $16,000 | 21 | 650 LBS | 88 KTS | ±$15,750 |
| 1948 CESSNA 120 | 85-HP CONTINENTAL C-85-12 | 1800 | $16,000 | 25 | 632 LBS | 100 KTS | ±$15,250 |
| 1948 CESSNA 140 | 85-HP CONTINENTAL C-85-12 | 1800 | $16,000 | 21 | 650 LBS | 88 KTS | ± $16,000 |
| 1949 CESSNA 120 | 85-HP CONTINENTAL C-85-12 | 1800 | $16,000 | 25 | 632 LBS | 100 KTS | ±$15,250 |
| 1949 CESSNA 140A | 90-HP CONTINENTAL C-90-12F | 1800 | $16,000 | 21 | 650 LBS | 90 KTS | ±$16,250 |
| 1950 CESSNA 140A | 90-HP CONTINENTAL C-90-12F | 1800 | $16,000 | 21 | 650 LBS | 90 KTS | ±$16,500 |

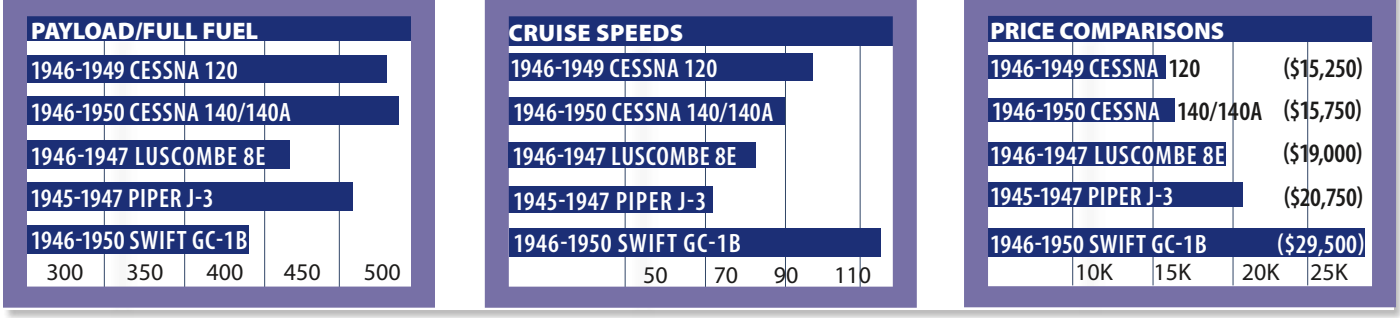
## RESALE VALUES




## SELECT RECENT ADs

| | |
|---|---|
| **AD 2006-03-08** | REPLACE CERTAIN AERO ADVANTAGE VACUUM PUMPS |
| **AD 2004-19-01** | INSPECT/MODIFY CESSNA KIT SHOULDER HARNESS ADJUSTERS |
| **AD 98-01-06** | INSPECT/REPLACE PRECISION AIRMOTIVE CORP. CARBURETORS |
| **AD 79-10-14** | INSTALL VENTED FUEL CAPS AND FUEL SERVICING PLACARDS |
| **AD 79-08-03** | REPAIR/DISABLE CIGARETTE LIGHTER WIRING |

## SELECT MODEL COMPARISONS



*The 120/140 has limited panel space and a non-standard instrument layout, but has sufficient space for a short stack of radios to the left of the pilot's yoke.*

To go even more upscale, Cessna followed the automotive industry of the time and offered a "luxury" version, dubbed the 140. It came with flaps, an electrical system, fancier seats and a pair of rear windows on either side of the fuselage (but not the wraparound, Omni-view configuration that later became standard in Cessna's single-engine line).

That was the company's entry-level, post-war lineup. These airplanes sold well and although there was demand, there was also competition. For example, Piper was building acres of Cubs. Other companies—Taylorcraft, Aeronca, Globe, ERCO and Luscombe—also offered two-place airplanes and, although Cessna was shoving some 30 airplanes out the door daily in August 1946 and eventually made some 7000 120s and 140s, by the end of 1946 the bloom was off the rose. Sales dropped annually. In 1949, the company realized it needed to revamp the platform to stay competitive.

In that model year, Cessna built its last 120 and brought out the 140A. The revised model came with a redesigned, all-metal tapered wing with a single strut, presaging what was to come from Cessna's singles. The strut replaced the two-piece struts of its predecessors, with a single attach point at the fuselage and two attach points under the wings.

Also, the 140A offered a choice of engines: Available was an optional 90-HP Continental four-banger in place of the 85-HP engine common throughout the 120/140 series. At a glance, the easiest way to recognize the 140A is by the single strut. Despite its changes, the 140A didn't sell as well as the 120/140. Only about 500 left the factory before the line was shut down in 1951, after which Cessna turned to other models, including the 195.

But Cessna wasn't through with light singles, regardless of whether the 140A's demise resulted from competition or a tired market. In 1959, Cessna hung a nosegear on the basic 120/140 airframe, creating the most successful trainer of all time: the Cessna 150. Thousands were built and many a pilot owes his or her basic skills to the 150 and its successor, the 152. In turn, the 150 owes its existence to the 120/140 line.

## CONSTRUCTION, SYSTEMS

As noted and in contrast to Piper's Cub, the 120/140 is an all-metal design, at least for the fuselage. The skins are riveted over ribs in conventional monocoque construction. Even for the 1940s, this was nothing special; all-metal Luscombes were on the market before the war. But it also was durable and easy to fix, especially by the hordes of aircraft mechanics trained by the military during WWII. Early 120s had fabric-covered wings, a "feature" carried over to the 140, as well. When Cessna upgraded the line to the 140A, the wings were all metal. The additional, aft-cabin windows and single strut were retained. Many of the older airplanes originally delivered with fabric wings have been converted to metal.

While there's certainly nothing wrong with fabric wings, they do require care and maintenance. If the airplane will be a ramp dweller, we think the 140A—or at least an airplane with the all-metal-wing conversion—is the better choice. Oddly, buyers may also find a few 140s sporting 120 wings, i.e., a 140 without flaps. On finding one, we'd be very interested in learning more about the airframe's damage history.

No matter the model designation, systems are stone simple. The

*With 12.5 gallons per side, you won't spend a fortune fueling these airplanes, top. 120s and 140s had two wing struts; single struts did not come along until the 140A. 120s also had no flaps and no rear window; the one in the bottom photo had a rear window mod.*

fuel system includes a 12.5-gallon tank in each wing, connected through a left-right-off valve. Later models had a "both" position and a fuel-tank crossover line. When originally delivered, airplanes with electrical systems had generators and a few flying have them still. These days, the better setup is an STC'd alternator conversion.

As far as engines go, the 120/140 came from the factory with only two choices. The 120/140 has the 85-HP Continental C-85-12 while the 140A got the 90-HP C-90-12F, all with metal propellers. Even a cursory glance at today's market, however, reveals all manner of engine upgrades, including the Continental O-200 used in the Cessna 150—said to be a bolt-on conversion—and the O-235 used in the Cessna 152. At least one STC involves installing an O-200 crankshaft and cylinders to a C-85 crankcase.

While these newer engines may improve performance, the real reason for having them is serviceability. While parts remain available, the older C-85 and C-95 engines grow ever more difficult and expensive to support.

As noted, the 140s have flaps while the 120s don't. Do you need them? Probably not. One owner wrote a few years ago to say he considered the 140 flaps to be a "joke." In any case, these airplanes fly so slowly that the benefit of flaps is questionable. Any pilot worthy of the title should be able to put one of these into a pea patch without need for flaps.

## CABIN, ACCOMMODATIONS

Push your nose against the window of a Cessna 120/140 and scan the panel. Although there's not much there, it can resemble a 747 compared to other basic airplanes from the same era. Sure, panel equipment in these airplanes tends to be Spartan at best. Still, it should come as no surprise some owners have jazzed them up with GPS and other goodies. But there is enough space for basic IFR gauges and avionics.

In fact, there's no reason these aircraft, if properly equipped, can't be flown in a little light IFR. Most aircraft of this vintage sport exterior venturi horns for vacuum, although some have vacuum pumps, too, depending on the engine. Although some think it's insane to fly a venturi-equipped airplane in actual IFR, we don't see the problem. The venturi is actually more reliable than a pump, as long as you can keep it from freezing up. (Heated versions are available.)

Moving into the cabin, you'll find primary controls consist of a pair of side-by-side yokes grouped in the center of the panel. Anyone with passing familiarity with a Cessna 150 knows how cramped the seats and interior are. The Cessna 120/140 is no better; the

## CESSNA 120/140 ACCIDENTS: RLOC

Our review of the 100 most recent accidents involving the Cessna 120/140 series uncovered a situation in which the airplanes may have too much of a good thing—effective brakes that are easy to use. That, combined with a landing gear geometry that could be a little better, led to an unusual problem. While the airplanes evidenced decent ground handling—for a tailwheel machine—in the form of only 35 runway loss of control accidents, we counted 43 accidents that resulted in the airplane flipping completely over.

In most cases the pilots simply got on the brakes too hard during rollout or on an aborted takeoff, although two pilots were simply taxiing downwind and combined mispositioning the elevators with assertive brake use. A couple of pilots were penalized with a close-up view of the runway during a noseover for the offense of landing on a soft surface or hitting a big puddle on rollout. We witnessed a student pilot flip a 140 on rollout after a downwind landing while on a solo cross country—the Unicom operator had reported the wind direction precisely backward. The student was coming to the end of the marked grass runway and got on the brakes too hard.

A few pilots reported brake failures or lockups, but not many. In our opinion, the brakes on the Cessna 120/140 series are so effective and the main gear located far enough aft that braking should always be done with great care.

We also strongly recommend retrofitting shoulder harnesses for occupant protection because of the high risk of an overturn accident.

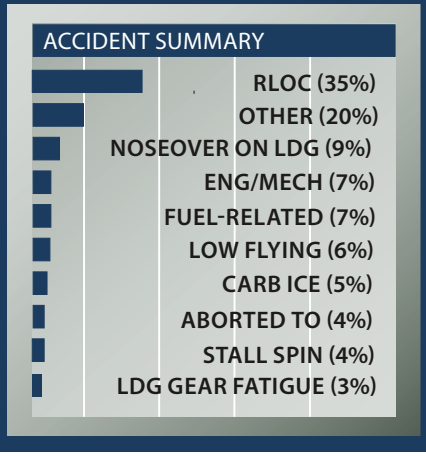
The 35 percent RLOC accident rate is about in the middle for tailwheel airplanes. While there was not enough information provided in the accident reports, we noted that where the type of landing—wheel versus three-point—was reported in a crosswind landing loss of control accident, it was a wheel landing. With the low wing loading of the Cessna 120/140 series, extra energy/speed on touchdown is not a pilot's friend.

There were only seven engine power loss accidents—a low number, in our opinion. Three involved improper maintenance; the cause of the remainder could not be determined. Carb icing led to another five forced landings, not surprising for airplanes powered by small Continental engines.

Neither the 120 or 140 is blessed with excessive power, but most pilots seem to make appropriate allowances. There were four aborted takeoff accidents when the airplane wouldn't climb and then couldn't get stopped. We had no sympathy for the pilot who took off downwind from the midpoint of a runway and couldn't understand why he couldn't clear the obstacles off the end.

Three airplanes suffered corrosion-caused fractures and separation of an axle. There were only four stall accidents, all on takeoff or go-around—a relatively low number for modestly powered airplanes.

Six pilots crashed due to combining low flying with what appeared to be disengaging their brains. Two airplanes and their crews were lost to midair collisions and two airplanes were wrecked as their pilots successfully evaded deer on the runway but couldn't keep the airplane under control.




seats are 1940s-style bench designs and both shoulder and leg room are limited.

Taller pilots may find their knees colliding with the yokes, while short ones may need a pillow to reach the rudder pedals. The seats are fixed in place and, unlike more-modern fixed-seat types, the rudder pedals do not adjust fore and aft. As one result, we've seen a few of these airplanes modified with later-model Cessna 150 seats.

Visibility from the cockpit is marginal, at best. It's not bad out the side windows, but 120s without a rear-window modification essentially blind the pilot from getting a good look at what's behind and to the sides. The 140s, with their rear windows, are a bit better. Meanwhile, visibility out the front isn't up to modern standards, either.

Trainers like the 152, Diamond Katana or even the Piper Tomahawk excel in this area in large part thanks to their tricycle gear. But the 120/140's taxi stance is not so sharply pitched a pilot can't see over the nose; the short cowling and somewhat flatter deck angle are a real plus compared to other tailwheel airplanes.

You don't need to sashay down the taxiway making S-turns to keep from creaming another airplane coming the other way. But it might not be a bad idea. One thing that aids ground handling is toe brakes, a vast improvement over the heel brakes found in the typical aircraft of this vintage.

Owners often complain about one 120/140 shortcoming: cabin noise. The cabin is small and the engine is nearby, with the exhaust dumped overboard very near the occupants' feet. The results can be deafening—perhaps more so than in contemporary types. We'd consider an active noise-canceling headset mandatory (but we do, anyway).

Finally, it should come as no surprise that cabin heating and ventilation in the 120/140 is not up to modern standards. Owners say it is adequate, however, and many airplanes have been fitted with vents in the wing and/or blast vents in the side windows to improve airflow in hot weather. The front cabin windows are openable for ventilation during taxi.

## PERFORMANCE, HANDLING

Even though the 120/140 does better than other two-seat tailwheel airplanes of similar vintage, owners tell us performance can best be described as "thrifty." A pilot can expect to see between 95 and 105 MPH true from the 85- or 90-HP engines Cessna installed while burning about 5 gallons an hour. That's in keeping with a slightly faster Cessna 150 burning 6 GPH. Results from installing a more modern engine like an O-200 or O-235 predictably push up cruise speeds.

Regardless, this is not really a traveling machine: A cross-country of any length will take most of the day. If several states must be spanned, plan on a couple of days, or find another solution. Too, getting to and staying at altitude is another challenge. There simply aren't many of the 85-to-100 horses left at any altitude above 10,000 feet. Climb rate in these airplanes is about what you'd expect: adequate at mid-weights but somewhat anemic at gross.

Max gross, by the way, is 1450 pounds for the 120/140 and 1500 pounds for the 140A, with a typical useful load of 600 to 650 pounds. Obviously, a load-hauling, utility airplane the 120/140 isn't. Perhaps not so obvious, however, is the two airplanes are too heavy to be considered a so-called "legacy" light sport aircraft, or LSA. Since 1320 pounds is the max gross weight for an LSA (1430 for a seaplane), the 120/140 miss the cutoff maximum weight by a fair margin (along with contemporaries from Aeronca, Luscombe and Taylorcraft, to name three).

For its size, the airplane has large elevator and tail surfaces, which probably account for its good crosswind characteristics on both grass and paved runways. As post-war tailwheel airplanes go, despite the RLOC accident record outlined on the sidebar on the previous page, the 120/140 handles quite well. Ailerons are brisk and crisp—if not aerobatic in roll rate—and pitch is a bit lighter than expected from the typical Cessna.

Overall handling is quite forgiving, with few bad habits in the air. Wing dihedral gives it stability the J-3 Cub lacks, and the 120/140 does not have the massive adverse aileron yaw of the Cub or Champ.

As tailwheels go, it is not as forgiving on the ground as a J-3 Cub, but contemporaries from Luscombe and the like generally are considered "touchier." Of course, all tailwheel airplanes are ditch lovers compared to tricycle-gear airplanes, which explains why the 150 became so popular.

Landing a 120/140 is not especially difficult. The fact that it has better visibility over the nose than most airplanes of its ilk helps. So, too, does the side-by-side seating, which obviates some limitations, like the need to solo it from the rear seat. Being relatively light, it does have a tendency toward ballooning on landing if the mains are forced on at too high a speed. But the airplane will happily do three-pointers or wheelies all day if the pilot's skills are up to par.

Because it doesn't have the option of placing much weight rearward, the airplane has a tendency to nose over. Owners say it's likely that any 120/140 on the market has a noseover or two in its history. That's no big deal if any needed repairs are done correctly. But nosing over is a big enough "deal" in this type that many have been equipped with "wheel extenders"—spacer blocks on the main gear legs that move the wheels a few inches forward. This reduces the tendency to nose the airplane over and if you're looking at an example that doesn't have the extenders, we think it's worth considering them.

*A polished 140 screams nostalgia, photo above shot at AirVenture at Oshkosh, but be prepared for a lot of work keeping it shined.*

## MAINTENANCE, ADS

Owners buy vintage airplanes for many reasons and one of them is low cost of operation. While that's not true of every post-war spam can out there, it's certainly true of the 120/140. Despite post-war competition, it occupies that sweet-spot niche of having been produced in large enough numbers to provide a good parts reservoir while not being so rare it has classic collector value.

The stock engines can be kept perking along with effort and/or upgraded with newer versions, the latter being our preference. Try to find an airplane with an engine conversion already done.

Other than engine overhaul, the major cost for a 120 is re-covering the wings, if they're still fabric. Depending on the fabric and whether the airplane is hangared, re-cover intervals range between seven and 20 years. Metal wings are, of course, heavier than the fabric versions by about 30 to 40 pounds. But most owners consider the penalty worth it in reduced maintenance costs and, in any case, these airplanes aren't bought for the massive load-hauling capability.

As do all airplanes, the 120/140 models have some weak spots. Here are some things to look for:

- Look for damage in the lower door posts, near the strut attach point. This critical structural member may be damaged by rough field operation, groundloops or corrosion.
- Corrosion in the carry-through spar can be a problem. The cabin skylight leaks water into this structure, and years of moisture will take a toll.
- Cracks in the tail structure

*A Cessna 120/140 works on wheels, floats and skis. But, don't expect blistering performance trying to get one off the water.*

and rear fuselage. Those familiar with the 120/140 tell us the airplane's tail is the weakest part of the design. It's especially vulnerable around the tailwheel attach point. This is repairable, but make it a condition of the sale during prebuy.

• Landing-gear boxes take a beating on all Cessnas and the 120/140 is no exception. The gear box—the support structure for attaching the landing gear to the fuselage—may have taken abuse from pilots over the years, thanks to hard landings and maybe even a groundloop or two. The box can be inspected from the outside by removing an inspection plate in the cabin floor.

• Broken tailsprings are fairly common. Check to ensure that the steel leaf-type tailwheel spring is still springy but not saggy. A broken spring will cause complete loss of control on landing and could do major damage to the airplane, particularly the elevators. Even if the springs look good at the time of purchase, they should be inspected regularly.

The list of ADs that apply to the Cessna 120/140 is quite long—more by dint of age than in any serious shortcomings in the aircraft. Some of the ADs are absolutely ancient, dating back to the late 1940s, when the airplane was new. Many are shotgun-type ADs that apply to the engine and may or may not require compliance in the model 120/140 at hand. One of the most recent applies to the Lycoming O-235 engine, calling for inspection of the crankshaft.

## MODS, TYPE CLUBS

The list of mods and STCs for these airplanes is nothing short of awe-inspiring. The International Cessna 120-140 group maintains an exhaustive list on its website, including contact information. The fact that the airplane has been the subject of so many mods speaks well of both its basic design and that it remains flying in large enough numbers to make such mods economically worthwhile.

Some of the more interesting mods include the aforementioned engine upgrades, including the Lycoming O-235, metal and fiberglass coverings for the wings, alternator kits to replace the older generators, improved brakes and instruments, autogas STCs and even approval to install an engine-driven vacuum pump in lieu of a venturi.

As for groups, the International Cessna 120-140 Association maintains a terrific website and support network. It can help with buying advice, parts and other support. Find them online at www.cessna120-140.org.

Another group is the Cessna Pilots Association (CPA), which bills itself as the largest type club in the world. Either organization should serve the new 120/140 owner well. Find the CPA at www.cessna.org

## OWNER COMMENTS

I bought a Cessna 120 just after I graduated high school and earned my commercial and CFI ratings in the 120. I'm now a captain on the 737.

In the Cessna 120, I learned to enjoy doing spins. I flew to many Iowa flight breakfast gatherings, to the Playboy Club resort and to the big Oshkosh, Wisconsin fly-in.

I've operated the 120 in and out of grass strips and hard-surface runways around the Midwest, plus a number of Central Iowa alfalfa fields.

Learning wheel landings provided many laughs for my instructors, but overall, the Cessna 120 instilled a lot

*In a 120/140, wheel and three-point landings can be done equally well. This makes it a good first tailwheel aircraft.*

of confidence and enjoyment in my flying.

Wendell Moeller
via email

We became joint owners of a 1946 140 and found it inexpensive to own, maintain and operate. Fuel burn runs 4-4.5 GPH at 105 MPH (not knots).

Ours came with a metalized wing, which we dislike because it reduces useful load by 50 pounds. The original Goodyear brakes were maintenance intensive and moderately effective, but good on grass strips.

The original straight stack exhaust, no muffler, on the airplane was just plain loud. The Eisemann magnetos gave a strong spark but were heavy for such a light aircraft. The airplane came to us with the horizontal stabilizer mod, which reinforced the horizontal stabilizer spar.

The Cessna 140 is a lot of fun to fly because you have to fly it; it doesn't fly itself. As a tailwheel machine, takeoffs and landings require full pilot attention. It requires prompt and timely use of the rudder—wooden feet need not apply.

Tom Tann
Michel Litalien
via email

I purchased my 1947 Cessna 140 to commute from my home in Algonquin, Illinois, to the Chicago Executive Airport. To drive to work is 50-60 minutes in Chicago traffic. My door-to-door commute using the 140 is 30 minutes, including a 12-minute flight.

Unfortunately, we hurried through the prebuy and found out at my first annual, which cost $4000, that previous mechanics were pretty much "pencil whipping" the annuals. I found corroded wing bolts, corrosion under the propeller and numerous items that should have been caught.

My 140 has an O-200 engine, Cleveland brakes, VGs, metalized wings and a Scott tailwheel. In my commute, I rarely get above 1800 feet, fly at about 100 knots and burn about 5.7 GPH. With the commute putting about 0.3 hours each way on the tach, I burn 3.4 GPH.

The aircraft has a fairly low wing loading, so it doesn't handle the bumps very well. If it gets too bumpy, I just slow down a bit and it seems to ride a little better. The rudder is large and sensitive. This is an advantage in crosswind landings, but takes a little practice and a light touch to keep from yawing around in flight. Adverse yaw is pretty strong.

The aircraft is inexpensive to operate, and its benefits far outweigh the cost for me. Normal annual inspection, oil changes, fuel burn at 100 hours of flying a year and debt service make my cost of ownership about $70 per hour before storage.

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## IN-EAR HEADSETS

*(continued from page 8)*

for each ear that proved to have a linear adjustment, plus there's a stereo/mono slide switch that's easy to get to. But, the cutouts for the volume sliders seemed too exposed, potentially susceptible to trapping dust and other contaminants over time.

There is a mono/stereo selector switch nicely positioned on the face of the control module. What you won't find on the module is controls for Bluetooth. The only way to pipe music into the set is to connect an audio patch cable from the music device to the module, like the Halo.

### AN EASY WINNER

We like the build quality, audio quality and fit of the Clarity Link the best, although we don't think you should have to pay extra these days for Bluetooth capability. At $795, the Link comes at a $270 premium over the Classic model.

The runner up is the Halo. We think it has good audio quality and it's a fair price at $359. We're concerned, however, about the company not accepting new orders.

Last, as with any headset, we strongly suggest trying before buying.

***We think every modern headset should have Bluetooth for tunes and telephone audio. The Clarity Link, with the BluLink module shown below, is the only in-ear model so equipped.***


## CESSNA 120/140

*(continued from page 31)*

(I have a rather expensive hangar.)

The market has settled on Cessna 140s costing anywhere between $15,000 and $32,00. If you look around at other aircraft of similar class, that's pretty cheap. I chose it over the Cessna 150 because of the tailwheel. This gives the airplane better performance and makes me a better pilot. It can make you a crosswind superstar.

Mark Zakula
Algonquin, Illinois

I've owned my Cessna 140 for well over 20 years and really didn't plan on keeping it more than five years—tops. But every time I look at a replacement that goes faster, flies farther, carries more people and more stuff, I fall more deeply in love with the 140's affordability.

Thorough annual inspections are rarely more than $2000 (and I rarely ever defer any items uncovered), although I've had a few pricey ones. We replaced a couple of cylinders during one event, did some exhaust work during another and most recently did a corrosion treatment, based on *Aviation Consumer's* report suggesting to do so.

Someday I might step up to a Cessna 180, but for now the 140 is just reliable, affordable fun.

Bill Stephens
via email

**FEEDBACK WANTED**

## CESSNA 414

We're preparing a report on the Cessna 414 in an upcoming Used Aircraft Guide in *Aviation Consumer*. We want to know what it's like to own these Cessna twins, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your 414 to appear in the magazine, send us any photographs **(full-size, high-resolution please)** you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments that can be helpful for buyers considering a 414. Send correspondence by January 1, 2018, to:

**Aviation Consumer**
Email at:
**ConsumerEditor@hotmail.com**