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The Aviation Consumer®

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The Aviation Consumer

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WHEN DOES AN AIRCRAFT BECOME A THROWAWAY?

For our mutual amusement, my pal Brian and I make a particular country airstrip a motorcycling destination to check on a parked J-model Mooney. And it's really parked. Neglected, actually, which is a real shame. It's been sitting so long on its rims that the landing gear doors have actually pushed through the pavement in its tiedown, the aircraft seemingly trying to bury itself from the misery. I found one of the fuel caps loose during one visit and in the process of doing a good deed by securing them for whoever owns this thing, noticed ugly rust around the tank structure. A peek inside through the crazed windows reveals spiderwebs, decaying fabric and a Garmin GNS430 GPS in the panel. Somebody spent good money on that rig, and someone might consider spending a whole lot more to get this airplane airworthy. My friend Rob—an IA, a Mooney expert and a Mooney owner a couple times over—warned that this someone shouldn't be me. And that got me to thinking, when is an airplane such a basket case that it's better suited for a salvage yard than a maintenance shop?

A lot of that decision depends on the extent of corrosion, while the typical wholesale value of the aircraft could serve as a backstop. The current *Aircraft Bluebook* puts the typical wholesale price of a 1978 M20J at around $55,000. That's for a flying airplane, with good paint and interior, no damage, within six months of a recent annual inspection and with cylinder compressions at 85 percent of new. From what I see, this airplane doesn't hit any of these marks. I don't know what a compression check would reveal, but I have a sneaking suspicion none of the cylinders on the Lycoming IO-360-A3B6D would make numbers close to 85 percent. As one IA put it, for the money you'd spend getting the airplane back in the air (if you can find a shop or IA that will actually work on it and sign it off), you're better off buying one that's been flying and regularly inspected. "Tubular corrosion is an expensive cancer to cure, with no guarantees," he said.

I ran this scenario by Terry White at the long-established and respected aircraft salvage firm White Industries in Bates City, Missouri. According to him, for an abandoned piston single like a Mooney or Piper, salvage dealers heavily judge the plane with respect to three major points: corrosion, engine condition and avionics. White said that most salvage dealers are more interested in parts that fit models other than the one that's been scrapped, which is why they'll bid top dollar for an aircraft with lots of modern avionics. As for the engine, White said since most of the competitive bidding is done sight unseen, it will ask someone to pull the prop through to see if the engine is stiff or easily turns through. Yes, cylinder corrosion is high on the list of suspected troubles, but so is avionics corrosion. You can bet the circuit boards and other components inside the Garmin GPS in the neglected Mooney haven't been served well by sitting in the harsh and damp climate without use.

White also said that the aircraft's location in relation to the salvage dealer plays a big role in whether it even wants to bid on it. Remember, the airplane in most cases will be disassembled and trucked (not flown) away. A distant dealer wouldn't be competitive because the bid is based on delivery. "In the case of your Mooney example, we would probably refer you to a salvage dealer that's more local," he told me. Imagine that? Even among misfits this airplane is a misfit. As for its salvage value, White said there's tremendous variation, and that's partly based on whether the airplane is still flying. "Even if a plane has a hypothetical $10,000 book value, its salvage value might not be half of that," he said.

So my question of when an airplane is a throwaway isn't easy to answer. But the question of whether Brian and I should consider resurrecting this neglected bird by first making its owner an offer based on salvage value is easy. As one of the locals who's been watching the airplane rot in the tiedown put it, "Don't walk, but run away from it." —*Larry Anglisano*

SKYBEACON CERTIFICATION

I've been following your coverage of the uAvionix skyBeacon wingtip ADS-B/lighting system and I'm unclear of whether my airplane is approved (or how it can be approved) for its installation. It's a Mooney with the wingtip lighting enclosed in the fairing.

Steve Sorenson
via email

You don't say which model Mooney it is, but if it has the lights enclosed in wingtip fairings the current skyBeacon won't work. It's designed for external mounting.

As for the now-approved AML-STC, Mooney models are on it, but nothing later than the M20G. As we go to press, uAvionix says it has started shipping the skyBeacon systems to customers who have preordered. It's priced at $1895.

RESCUE BEACONS

I read the PLB (personal locator beacon) article in the November 2018 issue of *Aviation Consumer* with interest. My shop suggested I switch over to a 406 MHz model from my old Pointer 121.5 MHz beacon and connect it to my Garmin GPS for position encoding. It's a big number because they have to pull the leather interior in the Bonanza to route the new harness. My question is twofold.

First, am I better off going with a portable beacon, rather than permanent mount, and second, what is the exact process for rescue once either of these 406 systems activate? I'm a little fuzzy on who does what and when. And what happens if there's a false activation?

Sam Brenton
via email

One benefit of a permanent ELT—particularly a 406 MHz model that's required to have a remote control switch (which is why your install costs so much)—is the system can trigger on impact or you can activate it before or after ditching. The benefit of a PLB is you can walk with it, and use it for other applications. We think having both isn't a bad idea.

As for the rescue part, the signal is received by the Air Force Rescue Coordination Center (AFRCC). This is the United States' inland search-and-rescue coordinator—an agency responsible for coordinating on-land federal SAR activities in the 48 contiguous states, Mexico and Canada. It never sleeps and operates 24/7 from Tydall Air Force Base in Florida. It receives the signal from the satellite-based COSPAS/SARSAT network

The agency first tries to verify that it's dealing with a legitimate activation and tries to contact the ELT's registered owner. Then it's boots on the ground and aircraft in the air, coordinating efforts with the Civil Air Patrol, U.S. Coast Guard and other SAR resources. Here's hoping you never need to use them.

AEROSTAR CORRECTION

Overall you guys did an excellent job with the Piper/Smith Aerostar used aircraft review in your November 2018 *Aviation Consumer*. But you got something wrong—the model 700P doesn't have cowl flaps.

The IO-540-U2As are turbocharged and intercooled. I have owned a 601P, 602P and one of the 24 factory 700Ps. None of them have cowl flaps. Maybe you are thinking of Mooneys. I also recall that with the auxiliary fuel tanks, full fuel was 202 gallons. Everyone should have the aux tanks.

And, the beautiful picture of the right nacelle that you have in the article is from my 700P. My wife took that picture looking down at the Golden Triangle in Pittsburgh. I may have sent you that picture in the past while commenting on previous Aerostar articles. I have also used that picture maybe hundreds of times in presentations. I had just had N700WZ painted and new Kevlar inlet ducts made because 100 percent of the originals cracked.

The person who said the Aerostar is like a mini airliner got it right. At 25,000 feet in the winter jet stream, ATC would ask me what jet it was. If I pulled the power back, it would go nonstop from Santa Monica, California, to Chicago, Illinois. With regard to it being a maintenance hog, if the upgrades are installed—including the PM alternator and starter—the Aerostar is a normal complex twin. All three of mine were flawlessly and without surprises maintained by Star Aero in Hammonton, New Jersey.

Dennis Wisnosky
via email

GARMIN GMA345

Thanks for your thorough bench evaluation of Garmin's GMA345 Bluetooth audio panel in your November 2018 issue. I'm one who traded out my GMA340 for the GMA345 and as you reported, it really was a slide-in install with decent utility.

Bob Chetsinsky
via email

On The Cover: **Cornelius Braun gets the image credit for the Flying Bulls Cessna 337 Skymaster on the cover of this month's *Aviation Consumer*. The aircraft is unique for its centerline thrust, push-pull twin-engine design. We cover the Skymaster in this month's Used Aircraft Guide, starting on page 24.**

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Traffic Interfaces: TAS Still Beats ADS-B

But unless you're moving along at jet speeds, we favor cheaper ADS-B In tech. For target display, Garmin's relative motion technology is a standout.

by Luca Bencini-Tibo and Larry Anglisano

Selecting a traffic alerter used to be easy. For lesser budgets, there were toss-it-on-the-glareshield portables (remember the Monroy?), while big-league active systems like the Goodrich Skywatch TAS were for serious collision avoidance. The buying decision was muddied when Mode S datalink transponders came on the scene, and of course now there's FIS-B through ADS-B.

If you still haven't upgraded to ADS-B, but your aircraft has an existing traffic alerter (TAS or TIS-A) you could be faced with some confusing buying and interfacing decisions should you include ADS-B traffic in the mix. With a multitude of traffic sources, how might you logically display them so interpreting the data doesn't cause confusion and worse, a midair?

In this article we'll attempt to answer some of these questions, plus we'll look at the latest modern TAS products and compare the investment to ADS-B.

TRAFFIC TECH 101

Before even talking with your shop about a traffic system retrofit (including ADS-B) you need to wrap your head around the various technologies and their limitations. Based on the correspondence we get and in talking with other pilots, traffic systems are more common now than ever (mainly because of portable ADS-B), but not everyone understands precisely how their setup works. By clearing up the confusion, you can better interpret the data and even help ATC when they issue traffic advisories. For starters, correctly state the system you're using to avoid the confusion.

On a recent trip from Fort Lauderdale to Sarasota, Florida, we heard ATC giving another aircraft a traffic advisory, something like: "Traffic 12 o'clock at 6500 feet moving southeast." The pilot responded "No joy, but I see him on the fish finder, I'm going to turn left." We get the slang, but fish finders are for boats, not aircraft. Plus, the AIM says TAS and TCAS I are only to be used as a visual aid, not avoidance.

Traffic systems come in several flavors: They can be permanently mounted or portable, and they can be passive or active. By active we mean that the system is actively interrogating other transponder-equipped aircraft, like TAS and TCAS do. Let's look at the various technologies available for upgrade, and for those searching the used market, we'll start with old-school TIS-A datalink radar.

TIS-A is an older ground-based system that relies on the Mode

CHECKLIST

- A TAS and ADS-B combination is the ultimate traffic setup.
- But a full-up ADS-B system wins for cost, with a few limitations.
- Think twice about buying a used TIS Mode S transponder. It relies on older approach radar.

That's a Garmin GTN750 displaying relative motion traffic vectors by the GTX345 ADS-B transponder and GTS800 active TAS/ADS-B system.

S radar system (secondary radar surveillance) and is found in some approach control airspace. Availability of TIS-A services can be found in the AIM figure 4-5-5, reflecting areas of the greatest traffic densities and leaving most of the country without TIS-A services. Threat traffic must have a Mode A, C or S transponder and the ownship needs a Mode S transponder and appropriate display. Traffic information is captured during a single radar sweep and then it is uplinked to Mode S transponders during the following sweep, which results in an approximate five-second delay before it shows up as a target on the display. The maximum number of traffic targets is limited to eight and if there are more, the most significant threat aircraft are uplinked.

One of the more popular TIS transponders was the Garmin GTX330—Garmin sold this unit in huge numbers and it was commonly paired with the GNS-series navigators. With buyers stepping up to ADS-B systems, there are plenty on the used market, but we wouldn't invest in one given the fading TIS-A infrastructure.

Like many who invested in TIS-A transponders, you might think you don't need an ADS-B In traffic interface. Maybe you're playing the data on a Garmin GNS430 or 530, or even on a new Garmin GTN or Avidyne navigator. TIS-A will still work with some approach control facilities that have older approach radars (ASR-7 and -8 radar), but these radars are being replaced by ASR-11 systems, which do not support TIS-A. This means that as the older radars are replaced, TIS-A will be available in even less airspace and eventually become extinct. When TIS-A is available, it is usually within 60 miles of approach radars.

Another misunderstood traffic system is TCAS II, often confused with TAS. You'll find TCAS II systems in transport and mightier GA aircraft (it's expensive). It's an active system with transmitter and receiver to interrogate nearby transponder-equipped aircraft and provides position, altitude and directional movement. TCAS II usually provides alerts aurally and on the display of aircraft that pose potential collision situations; some bare-bones systems only have aural alerting, but that's rare these days.

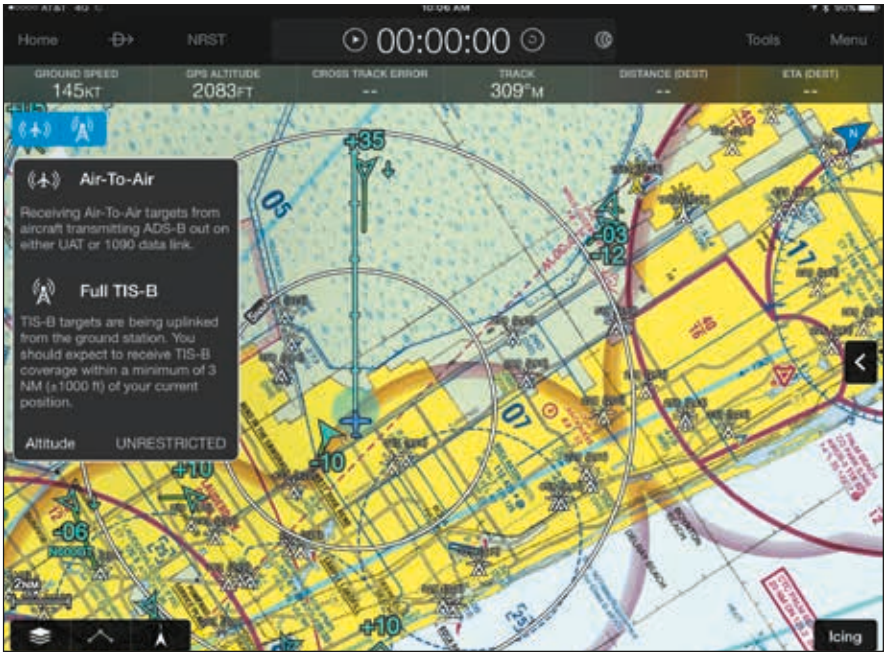
We think the L3 NGT9000 multi-function transponder, top, makes sense for a wide variety of interfaces. It's self-contained, has a good color touchscreen and can be used as a an ADS-B and TAS source. It also plays on the Aspen Evolution suite, middle. That's an Avidyne TAS processor mounted in the tail of a Seneca, bottom.

What distinguishes TCAS II from the older TCAS I is that it provides RA (resolution advisory) such as "descend" and "climb." Additionally, any TCAS-issued RAs that are received are to be followed over any ATC instructions. Furthermore, if both aircraft are equipped with TCAS II, they will coordinate with each other; for example telling one aircraft to climb and the other one to descend. For this system to work, aircraft must have either a Mode C or Mode S transponder.

TAS WITH BUILT-IN ADS-B

TAS was born from TCAS and grew to be the most common active traffic system found in light general aviation aircraft because of its price compared to TCAS II. Like TCAS II, TAS consists of a transmitter and receiver that are panel mounted (the L3 NGT9000 is the only TAS system that's panel mounted) or mounted remotely.

Unlike TCAS II, TAS does not provide resolution commands to climb, descend or turn to avoid the traffic. It simply flashes an onscreen traffic message, provides voice annunciation through the aircraft's audio system and displays targets using TCAS-like symbology. TAS is not dependent on any ground facilities and all it needs is the line-of-sight of potential traffic. It will display Mode A, C and S transponder-equipped aircraft and, except for Mode A, TAS will indicate the altitude difference between the ownship and the traffic.



If you had to play your traffic on a tablet, Garmin's Pilot app excels at providing an interactive display of ADS-B, top. That includes verifying that the system is seeing both air-to-air targets and those uplinked from ADS-R ground stations like the one at Boca Raton, Florida, pictured at the bottom.

It will also indicate if the traffic is climbing or descending in relation to the ownship.

Garmin has been offering the GTS800 TAS for a while and the standard version has 40 watts of transmit power. The jet-category GTS825 has 400 watts, as does the GTS855, which is a full-up TCAS I system.

In addition to active interrogation, the GTS800 has a built-in ADS-B In receiver to receive traffic transmitting on 1090 MHz extended squitter. There's no 978 MHz UAT receiver, so the system won't receive FIS-B weather and it doesn't have ADS-B Out. The GTS800 displays ADS-B targets as ADS-B symbols only on the TXi displays and GTN navigators.

A top-mounted directional antenna is used to derive the bearing of intruder aircraft, while an optional bottom omnidirectional antenna helps eliminate shadowing issues. Of course these antennas are used in the interrogation process, so you might expect sizable reconfiguration of other antennas to accommodate a sound installation. Additionally, the ADS-B In function requires GPS and magnetic heading inputs.

The base GTS800 with a single antenna is $10,000, while the version with dual GA58 antennas is $11,080.

Avidyne recently certified its long-proven TAS600 processor with an ADS-B In receiver and calls it the SkyTrax 600. Like the Garmin system, the SkyTrax correlates all of the received traffic data (TAS and 1090 MHz ADS-B In, including ADS-R ground station rebroadcast). The SkyTrax 600 has a starting price of $9999 with dual (top and bottom) directional antennas. Like the original TAS600, there are four versions of the SkyTrax system, with display ranges starting at 7 miles for ADS-B and TAS targets and on the high end, up to 21 miles for TAS targets and 40 miles for ADS-B targets. Which system you choose will depend on the service ceiling and speed of the aircraft.

The L3 NGT9000 ADS-B transponder is available in a version that has a built-in TAS processor. It's priced north of $10,000 with dual antennas. See the May 2017 *Aviation Consumer* for a full review of the NGT9000. We'll look more closely at these latest TAS systems in an upcoming dedicated comparison article.

ADS-B VERSUS TAS/TCAS II

If you're ready for a migraine, let's talk a bit about the real ADS-B In picture. For starters, ADS-B traffic is in the same octave as the 2020 mandated ADS-B Out, but related only by frequencies. No, you still don't need ADS-B In to satisfy the upcoming mandate. But the FAA encourages it and it's your ticket to a pretty decent traffic picture—if you understand and accept the limitations.

Get your T and F nomenclature in order. ADS-B In provides two subscription-free services: TIS-B (Traffic Information System-Broadcast) and FIS-B (Flight Information System-Broadcast). For our purposes here we're concerned with TIS-B because that's the traffic feed. Need a brief refresher on the weather data feed?

FIS-B weather information is transmitted continuously from ground stations (no, not satellite broadcast—that's subscription-based SiriusXM) around the country on 978 MHz UAT systems. You'll receive this data with portable UAT ADS-B receivers and some mandate-compliant ADS-B Out systems that also have ADS-B In receivers. Again, go to the buyer's guide in our December 2018 issue for a multi-page rundown of seemingly endless solutions.

Back to traffic matters, we think the ADS-B network has matured enough (that is, with more equipped aircraft) to the point that an ADS-B traffic systems is the worthy alternative to active TAS when you consider equipment costs and installation complexity. See the sidebar on page 7 for a summary. Still, as sold as we are on NextGen traffic data we'd still go with TAS or TCAS II for some if not all high- and fast-flying turboprops and jets. Add 1090ES

FLYING WITH TAS AND ADS-B

Unless you're starting from scratch, you could be faced with interfacing more than one traffic system with a suite of new displays, while also deciding which system to part with and how to play the data on multiple screens. These are some of the decisions I recently made when upgrading the avionics in my Mooney Ovation, which included Garmin's new G500 TXi primary flight display. That's my upgraded panel pictured here. Based around the busy southern Florida airspace, a reliable traffic suite is important to me, so this might be overkill for your airplane, or not.

I had a new Garmin Mode S extended squitter (ES) transponder (Garmin GTX345) installed to replace an older Mode S transponder (GTX330ES). Before the installation, I was already ADS-B Out compliant. The new GTX345 provides ADS-B Out through the extended squitter exactly like the GTX330ES did, so not much changed in the ADS-B Out interface. But unlike the GTX330ES transponder, the GTX345 has an ADS-B In receiver on both frequencies: 1090 MHz, which is the standard transponder frequency, and the ADS-B Universal Access Transceiver frequency of 978 MHz.

Like many who are doing ADS-B upgrades, I lucked out because the transponder antenna is the same as the one that was already installed on the bottom of the airplane—a blade-style L-band antenna. Still, be sure the antenna and signal cable are in good shape. Sweetening the deal was that the new GTX345 has a built-in AHRS that can interface with Bluetooth to both the Garmin Pilot and ForeFlight tablet apps to provide FIS-B, TIS-B and attitude information on an iPad. If you don't have panel displays to play the data, this is your ticket to making it work. Plus, as an option, the GTX345 can be purchased with a built-in WAAS GPS for aircraft without a compatible WAAS GPS receiver. But this isn't exactly a free lunch because a WAAS GPS antenna also needs to be installed on top of the airplane. Understand that this built-in GPS will not provide navigation capability— its only purpose is feeding the ADS-B transponder.

Prior to installing the GTX345, I already had Garmin's GTS800 TAS traffic processor, which I ended up retaining to coexist with the ADS-B traffic. This interface requires some tricky decision making and a learning curve once you get back in the air.

With the GTX345 ADS-B transponder and the TAS800 both installed, the traffic inputs are combined through software in the transponder to provide a blended solution, which is displayed on the GTN and TXi display—overlaid on the Map page or on the dedicated traffic page. What's useful here is that either traffic source can be tuned on or off independently of the other.

As the nearest ADS-R ground station is 10 miles away from my home airport (Pompano Beach Airport in Florida), and possibly because my TIS-B transponder antenna is on the bottom of the aircraft, I can't see aircraft in the vicinity while I'm on the ground using TIS-B. While normally the traffic functions (both TIS-B and TAS) are off on the ground, I can still turn on Garmin TAS and see aircraft on the field and in the traffic pattern. I found a real plus to having TAS for filling in the coverage gaps.

Garmin has the relative motion trend vector feature, which is only available on TIS-B, and it indicates (with a green line from a traffic symbol) where the traffic will be in the future (from 30 seconds to 5 minutes) relative to the motion of the traffic and ownship. If the motion vector does not intercept the ownship, then the two aircraft are not converging, although you have to consider the altitude. Still, this relative motion display feature is a plus to Garmin TIS-B systems. It won't work on legacy displays, but it does on the new GTN navigators, the TXI displays and also on the Garmin Pilot app.

But TAS isn't always the hands-down winner. Since TIS-B is not limited to transmitter power from the ownship, its range can be up to 48 miles, versus the range of the lower-power TAS at 12 miles. For the Mooney, this is a toss-up since any traffic more than 12 miles away really is not an issue.

It's tough to argue that TAS comes out ahead when it's important to paint nearby airplanes prior to (or right after) takeoff. This is especially relevant in high-traffic areas and makes for a sound argument for equipping jets and speedy turboprops with TAS or TCAS as many are.

For others, ADS-B may come out ahead if the aircraft has ADS-B Out because that triggers a traffic uplink from ADS-R stations, plus you can see what ATC does. In my Mooney, I'm convinced that I'm getting the best of both worlds.

—Luca Bencini-Tibo

Two of the latest combination active traffic processors—Garmin's GTS800, upper left, and Avidyne's SkyTrax 600, upper right, have integral ADS-B In receivers. Expect an installation that flirts with $15,000 or more for either one.

ADS-B out to the mix and those aircraft are as well-equipped as it gets right now.

But if you're using ADS-B traffic, do you really know where all of the data is coming from? It's important to understand that TIS-B refers specifically to traffic information that is transmitted from an ADS-B ground station, or ADS-R (the R being a traffic data repeater from the ground station).

Core to the ADS-B concept, ATC collects data on aircraft position and altitude information through secondary radar (i.e., transponders) of Mode A/C and S-equipped aircraft (Mode A equipped aircraft will not provide altitude information), and also from ADS-B Out equipped aircraft. There's little latency because the positioning of ADS-B Out equipped aircraft is provided every second through LAT/LON positions derived from the ADS-B system's WAAS GPS. Another important point here is that TIS-B will only display transponder-equipped aircraft, and the same can be said for TAS and TCAS.

TIS-B takes the above-mentioned information, converts it to a compatible format for ADS-B and transmits it through the ADS-R ground station using the ADS-B In datalink. We already mentioned one, the 978 MHz UAT. The other datalink uses the transponder frequency of 1090 MHz.

There are many options for airborne equipment for TIS-B. Portable solutions include a portable receiver, preferably a dual-channel unit that receives both 978 and 1090 MHz frequencies (as most current ones are) and a tablet with compatible app. We covered the latest portable receivers, plus we published a buyer's guide, in the December 2018 *Aviation Consumer*.

Panel-mounted receivers include UAT, which would also provide ADS-B Out through its transmitter, ergo the T in UAT: Transceiver. There are two options for screens: a panel-mounted screen or if the UAT unit has Bluetooth or Wi-Fi capability, it could interface with a tablet.

MOUNTING IT

Now that you've got all that tech straight, decide how you'll display the traffic data. There are too many possibilities for us to list, so it's best to ask your shop what's the most practical in your installation based on software compatibility and the wiring. And if a tablet computer is your only option, realistically think about how you'll mount it, if you'll mount it at all. Thanks to Bluetooth, the possibilities are almost endless. But, we've seen some pretty illogical and frankly unsafe configurations, especially with tablets mounted in the worst possible locations. We know of one particular Mooney equipped with traditional flight instruments, vintage King Silver Crown avionics and a first-gen IFR GPS. None of this can display traffic data, but the iPad will, of course.

This Mooney's owner had two of them, actually. One was yoke-mounted (blocking the view of the flight instruments) for charts and another was attached to the Mooney's glareshield with an ingenious home-fabricated canted mount. This was the traffic (and weather) display, fed by a portable ADS-B receivers. Good plan, but the deal-breaker was the full-sized iPad blocked an awful lot of the windscreen. Having been in a crash and knowing how violent it can get inside the cabin during the drama, we don't like any hardware attached to and extending from the glareshield. Whatever is mounted there is usually in the flail zone.

DECISION TIME

For us, choosing one traffic technology over another really comes down to the kind of aircraft you fly and perhaps where you fly. We wouldn't yank a working TAS system from the aircraft during an ADS-B upgrade because as we describe in the sidebar on page 7, having both offers sizable belt-and-suspender utility.

But for new installs, unless you're moving along at turboprop or jet speeds, ADS-B wins for price. There are some limitations, including the potential of not seeing traffic targets while on the ground.

But the latest high-end TAS processors have limits, too. For Avidyne and Garmin TAS/ADS-B interfaces, realize they'll provide ADS-B In only (not Out) and won't do anything for satisfying the mandate. When interfacing them on legacy displays, they may not display the ADS-B targets in true ADS-B symbology, instead appearing as plain-vanilla traffic tags. That limitation, according to Avidyne, has more to do with retaining compatibility with older displays than it does the technology in general. We'll dive deeper into these systems in a future issue.

Higher LSA Weights: Not a Universal Thrill

Markets of all kinds detest uncertainty and although heavier light sports have appeal, the rule is at least two years away.

by Paul Bertorelli

A headline you've never read: Light Sport Aircraft Sales Explode in Fourth Quarter. One you might eventually read: FAA Approves Higher LSA Weight Limit. The latter is the fervent hope of some in the GA industry and as of late 2018, it's about to be officially on the table.

And while it may seem like a no-brainer—what's not to like about higher weight limits?—there's also a certain wariness in the light sport manufacturing segment because any new regulation or change in an existing one is like turning over a rock. You never know what's going to scurry out and proposed changes sans detail cause something manufacturers hate: uncertainty and market overhang.

Interviews with a half dozen people in the industry reveal a cautious optimism, but also reticence to offer definite opinions until the proposal is fleshed out. We may be a couple of years away from that, at the earliest. Don't mark your calendar yet.

CAT SCURRIES OUT

While discussion of a higher weight limit for light sport aircraft has been broached before, it gained some cred last fall at an AOPA Regional Fly-in in Carbondale, Illinois. In an informal talk, EAA's Jack Pelton announced that the FAA would roll out an NPRM potentially raising the light sport limit to a whopping 3600 pounds in early 2019.

The reaction was swift and not all positive. Later in the same week, EAA walked back the comment to clarify that Pelton should have said the FAA had agreed to consider an NPRM and actually the rule was at least two to three years away. The announcement of the process would occur in 2019. Details to follow. People who sell airplanes understand buyers are both fickle and fragile and the slightest whiff of uncertainty can tank a deal.

"Jack Pelton, God love him, he's a great guy and great for the industry, but he went out and said just one thing …" one sales executive told me. Customers heard or read the news and were soon asking if it wouldn't make more sense to wait awhile and see what shakes out. Other companies we spoke to reported variations on the same story.

The details of a potential NPRM remain sketchy simply because there are no details. The origin of the proposal appears to date to several years ago when a trial balloon of uncertain origin popped up in not-for-attribution reporting. The idea then was that the FAA was contemplating applying the same ASTM consensus standards used for light sport aircraft to certified aircraft up to 3600 pounds.

Although light sport manufacturers generally follow the guidelines described in FAR 23 in designing and building airplanes, ASTM consensus airplanes are not specifi-

CubCrafters' X-Cub, right, isn't a light sport airplane, but with a higher weight limit, it could be. The company, which makes about 70 airplanes a year (top photo) isn't sure that would boost sales.

A DOG'S BREAKFAST OF REGULATIONS

Most of us know that for U.S. buyers, the light sport weight limit is 1320 pounds for land airplanes and 1430 pounds for seaplanes or flying boats. But why 1320 and not, say, rounded off to 1300 or 1400 pounds?

That odd number suggests an engineer somewhere plugged some structural information into a program, punched run and ... aha, the airplane is structurally sound at this weight or below. But no, it has nothing to do with that.

The light sport aircraft rule wasn't developed in a vacuum, but with an eye toward where a lot of the airplanes would be coming from: Europe. So 1320 pounds is 600 kg, which happens to match the European Very Light Aircraft-weight limit. (Sort of.)

If regulators envisioned a brave new world of trans-Atlantic aircraft weight standards and a happy world of bilateral technical agreements, it didn't work out that way. For one thing, while European VLAs come here to be LSAs, few if any airplanes go the other way because bilateral agreements or not, EASA and individual countries place additional requirements on imported aircraft. The market is too thin and the competition too stiff for U.S. companies to bother.

Even within the VLA standard, there's variation in allowable weight and differences between countries. For example, Tecnam's P2008 is allowed 650 kg (1430 pounds) in Europe, but only 600 kg in the U.S. The current initiative seems likely to complicate this further since it will introduce yet another set of weight standards, not to mention more allowable seats and perhaps constant speed props, too. And that's before anyone has even thought about integrating new standards to grandfather legacy airplanes of all kinds, if that's even the plan.

cally "certified" airplanes. They're airplanes approved to an agreed-upon standard by the individual manufacturers. The FAA exercises essentially no oversight of the process, testing is streamlined and the industry is expected to police itself. That the previous proposal never went anywhere was thus of little surprise.

WHAT'S NEW?

Yet the 3600-pound limit lives on in the current discussion and Pelton mentioned it last fall. But EAA's Sean Elliott, the association's VP for advocacy and safety, cautions against obsessing on the number. Even if it has been mentioned, he said, the FAA is not far enough along to use it as anything other than a talking point.

Two other talking points include applying a formula of some kind to set new weight limits and/or a performance-based proposal rather than a specific weight limit. The entire discussion, Elliott says, is part of a larger regulatory reform package called MOSAIC, for Modernization of Special Airworthiness Certificates, that's been underway for about two years. Some of that work is aimed at experimental aircraft and much of it is being driven by an overwhelming need for unmanned aircraft regulations.

"It's a lot of the same work so it made sense to look at experimentals at the same time. The stars have sort of aligned," Elliott explains. Elliott and others have told us the FAA seems genuinely cooperative and eager to produce reformed rules, even though it will take at least two years. The icebreaker was EAA's initiative with Dynon Avionics to develop STCs to install non-certified, non-TSO'd avionics in certified aircraft.

"We're obviously a few years away from the NPRM, but it's moving forward. We've had good success with the dialog with the FAA. I've been pleasantly surprised and happy about how close our thinking is," Elliott added.

Lately, there's been more discussion about a performance-based rather than a weight-based formula for new and more capable light sport aircraft. Such limitations would probably include a maximum cruise speed—150 knots has been mentioned—maximum seats and limitations on configuration, such as fixed gear or controllable pitch props.

"The 3600 pounds is a notional point that we've gone in with. It seemingly makes sense on the continuum. What comes out the other side as far as weight is yet to be seen. There's a lot of work yet to be done. Everything is on the table," Elliott says.

INDUSTRY REACTION

And for the short term, everything on the table makes manufacturers nervous. Building and selling airplanes is fraught enough without introducing new variables whose influence and applicability are unknown. And some manufacturers have felt the effects immediately.

Tecnam has been having a banner year, but the company's Shannon Yeager says the news of potentially higher LSA weights chilled things.

"Spreading this kind of thing ahead of actually having something concrete does nothing but hurt the market," Yeager said. He explained that several buyers ready to push the button on a new airplane pushed pause instead. "They're asking, 'Why would I consider this when they're going to change the weight? Is this retrofittable?' How can I answer that? I can't," Yeager said.

Other airplane builders echo the same worry, even if they see a potential upside. "I guess it's certainly not going to hurt anything," says Kitfox's John McBean. "But my concern is why are they doing this and to what end?" Kitfox is primarily a

The Bristell LSA, right, is one of the lightest aircraft on the market. The company says higher allowable weights will improve performance and stimulate development.

kit manufacturer, but it sells some SLSA airplanes, too. And like others of its ilk, the airplane is engineered for and has been demonstrated at a higher weight, specifically 1550 pounds, 230 pounds heavier than the standard 1320-pound landplane LSA limit. The open secret in light sport flying is that the 1320-pound limit is often ignored. McBean says the advantage of a higher gross weight would at least make such operations legal.

CubCrafters' John Whitish is similarly inquisitive about applying a new limit to legacy airplanes, both CubCrafters' own previous models and the limited number of older taildraggers grandfathered into the light sport rule. He sees an opportunity, too.

The company's new X-Cub has proven to be a strong seller and might be more so if it could be sold to buyers who could fly it without need for a medical, including Basic Med. But, cautions Whitish, it might have no impact at all. CubCrafters noted a downturn in sales when Basic Med kicked in, with some buyers already migrating to either heavier kits or the X-Cub. Downside to the higher weights? "No. Our attitude has always been that if it's good for the industry, it's good for us," Whitish adds.

"Clearly, these airplanes could use some more weight profitably," says Dan Johnson, head of the Light Aircraft Manufacturers Association. Although Johnson doesn't agree with the accepted wisdom that light sports are too flimsy to survive the rigors of daily flight training, he concedes that adding structure to them could be a net positive. "And as the light sport community has developed, people want more and more stuff on the airplane, autopilots are one idea, but people are saying, could I have this, could I have that," Johnson adds. Bumping up the gross weight makes it practical and safe to add such accessories.

When light sport was first conceived, part of its intent was to ignite development of new models and new entrants and it has certainly done that. A higher weight limit could stimulate another round of development, especially with regard to new powerplants. McBean says he's finding good uptake for Rotax's new 915 iS. But because it's heavier than the 912 and has a constant speed prop, it can only be used in experimental amateur-built aircraft. A change in rules could fix that.

Dan Johnson of LAMA: "As the light sport community has developed, people want more and more stuff on the airplane, autopilots are one idea, but people are saying, could I have this, could I have that?"

"I believe it will help Bristell. We have other airplanes in the works. We've been working on a four-place airplane, testing that at 1600 pounds," says Lou Mancuso of Bristell Aircraft. EAA's Elliott says the association is confident that a new rule will allow more seats, although no promises can be made.

Manufacturers who build sleek composite models will be looking at a new rule with an idea toward top speed. Currently, many of those models—most of which come out of Eastern Europe—are already capable of exceeding the 120-knot maximum level flight cruise speed specified for U.S. light sports, while still hitting the 45-knot stall speed. With a higher weight and speed spec, it's easy to see how a range of two-seat cruising machines could emerge. Yeager says one of Tecnam's goals is to devise a way for such aircraft to be used in modest IFR operations.

CONCLUSION

In my view, Tecnam's Yeager is correct that aspirational rule changes roil market expectations, even if they're two to three years away. If a would-be buyer is interested in a light sport now, will it get a higher weight approval when the new rule is finalized? Our guess is yes, but no one can say for sure at this point and given the price of a new LSA, who wants to bet?

EAA's Elliott has seen this before. "We haven't spoken at length with the manufacturers, but I can tell you what we experienced with the STC process [on avionics]. Initially, there was a fair amount of negativity, about how it was going to be damaging and they put all their efforts into their process. And that very quickly morphed in a short period of time to the manufacturers saying, 'We can do this too, let's go ahead and follow this path,'" Elliott says.

Bose ProFlight Headset: Not For Pistons

Bose is targeting the jet market with the ProFlight in-ear headset. After an exhausting trial, we suggest trying before buying.

by Larry Anglisano

Last spring Bose introduced the ProFlight in-ear noise-cancelling aviation headset not as a replacement for the hugely successful circumaural (around the ear) A20 model. Instead, the ProFlight is targeted at applications where the A20 might be overkill, or for cockpits with less noise—mainly jets—and for crews who fly long stretches at a time.

Bose says the ProFlight is the smallest and lightest active noise-cancelling headset on the market, but reiterates that it isn't intended for noisier piston cabins. For this field report we tried the ProFlight in a variety of aircraft, including pistons, turboprops and jets.

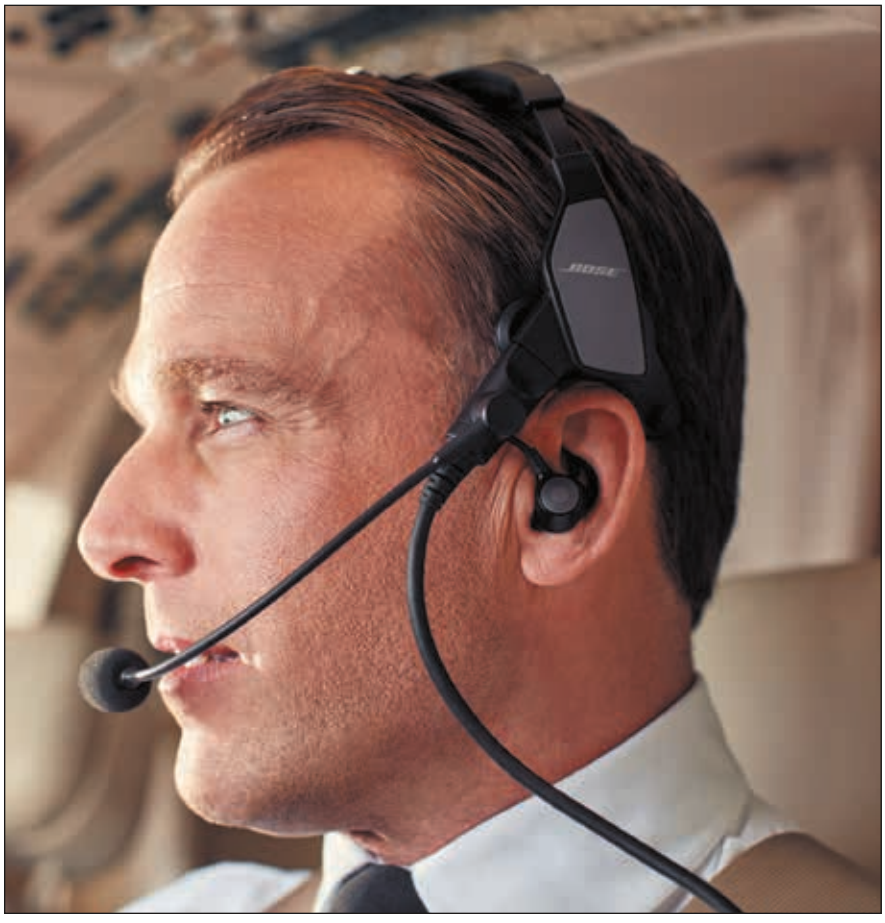
UNIQUE DESIGN AND FIT

At 4.9 ounces, the ProFlight really is a featherweight in the noise-cancelling headset market. It's reasonably compact, too. With the adjustable head sliders not extended, the set measures 8.43 by 6.34 by 3.15 inches. Check that against the circumaural A20, which weighs 12 ounces and measures 8.4 by 6.3 by 3.2 inches.

Worth mentioning is the ProFlight has FAA TSO and EASA E/TSO C139a certification, and Bose says the set is compatible across multiple TSO-certified avionics systems. The headset is available in dual-plug general aviation, 6-pin Lemo, 5-pin XLR and 7-pin XLR configurations. The dual-plug set runs on AA batteries, while the rest are powered by bus voltage.

The phone audio passes through earbuds, but the set's electronics sit atop of rotatable side pads that rest on each side of the head. While we didn't find the set uncomfortable, every person in our trial commented that it takes a few uses to acclimate to the set's fit—and that includes fitting the correct sized earbuds. That's an extremely important thing to get right, otherwise performance will be seriously compromised.

According to Bose, it may take several flights wearing the ProFlight before it becomes as routine as using a traditional headset and it's right. It starts by selecting the proper Stayhear+ eartip size and Bose provides a pack of small, medium and large tips inside of the supplied storage case. Bose says the medium tips are the default size that fits roughly 80 percent of users.



We think the fit and finish of the ProFlight, main photo, is consistent with other Bose products, which is quite good. The boom microphone can be quickly swapped to either side.

CHECKLIST

- The ProFlight has an edge over the model A20 for long-term comfort.
- But for pistons and some turboprops, the ProFlight doesn't have enough noise cancellation.
- The set has a finicky fit compared to circumaural headsets. Selecting the right eartip size is critical.

BOSE PROFLIGHT AT A GLANCE

* Weight, dimensions: 4.9 ounces, 8.43 by 6.34 by 3.15 inches

Also, you might find that you need one size in one ear and another size for the other ear. Experiment with this fitting process before going to the cockpit—it will save a lot of time and effort.

Since the ProFlight has active noise reduction and Bluetooth, the standard set uses two AA batteries that are loaded into the control module. Battery endurance is listed as over 45 hours when the Bluetooth circuitry is off and at least 25 hours with the Bluetooth on. The module seems just the right size in the hand and has a high-quality feel.

The set has a quick-release side-swappable microphone and down-cable, which enables you to mount the boom mic and cable on either side. By default, the set ships from the factory with the reversible microphone attached to the left side of the headset. The microphone is properly in place when it falls roughly 0.5 inches from the lips, with the white surface facing the lips.

We like that there are no tools required to release the down-cable—simply unplug and reattach it by hand in a matter of seconds. Speaking of cables, it's apparent that the set's main interface cable is stiffer and thicker than ones used on other sets. Bose says it used the thicker flame-retardant and mold-resistant cable so the headset performs better in high electromagnetic interference environments and under high electrostatic discharge conditions. It also insulates and wraps the required additional conductors separately from the audio interface harness. All of this contributes to a thicker and stiffer cable with less flex than you might be accustomed to. But we think the tradeoff is worth it because the main cable on aviation headsets is the most failure-prone component, especially around the area of the plugs. Bose said the ProFlight passed flex tests that lasted tens of thousands of cycles.

Bose put a lot of thought into the way the earbuds are wired from the headset frame/main chassis and route into the ear, although our group of evaluators unanimously commented that getting the buds correctly into the ear the first time is a definite challenge. The buds have umbrella-shaped silicon tips that really don't need to fit deeply into the ear. That's a plus for folks who generally are intolerant of earbuds, especially when wearing them for long periods of time.

When fitted properly, the wing of the silicon tip should fit just under the ridge of the ear. There's a process for ensuring you've got it right. The drill is to try speaking aloud while

PROFLIGHT IN A CITATION: PERFECTLY ADEQUATE

Most of the headsets I've used are heavy and have high clamping forces. My experience with the Bose A20 in my Mooney and then in my current Cessna Citation Mustang is that they provide the best sound quality and fit, and with less clamping force and weight. On the other hand, the A20 is a bit overkill in the quiet Mustang cockpit. I measured 76 dBA in cruise at FL 410. That's why I was anxious to try the Bose ProFlight on for size, which is what I did on two coast-to-coast trips to contribute to this *Aviation Consumer* review.

Compared to the comfortable A20, the ProFlight is lighter and in my view more comfortable still, but more finicky, not as quiet and doesn't quite have as good of a sound quality.

Still, for the professional jet pilot who wears a headset all day and wants to travel light with the best possible comfort, I think the ProFlight can be a great solution—especially if that pilot finds that the A20 is too much headset. It can also be an alternative to other deeper-fitting in-ear headsets.

But you have to be certain you use the right size eartips and place the set in the correct position on the head. It's a bit more complex than plopping on a traditional headset.

The ProFlight is also more sensitive to jostling and movement from items as seemingly unobtrusive as a cannula because the set is so light. But the comfort factor is unparalleled and makes the A20's light clamping forces seem high by comparison, while the noise reduction isn't as good as the A20's.

But for light turbine aircraft like the Citation Mustang, the ProFlight's noise attenuation and overall performance is perfectly adequate. For long flights, the set's comfort is a real plus. It took some getting used to, but the more I wore the ProFlight, the more I liked it. I'll likely buy one. —*Joe Musumeci*

wearing the headset while it's powered off, or in passive mode. Make a low-pitched "eee" sound and your voice should sound amplified and balanced in both ears. This is sort of like it sounds when plugging the ears with fingers. If it doesn't quite sound balanced, try a different size tip or a combination of sizes.

Swapping the Stayhear+ earbuds is also a learning experience and there is a specific process that we initially botched, breaking one of the tips. While holding the earbud, gently grasp the tip and peel it away from the earbud by the base—and not by the tip wing—otherwise it will tear.

To install the new tip, align the opening of the tip with the earbud nozzle and rotate the tip onto the nozzle until it clicks into place. If you want to wear the set with one earbud, you can stow the unused bud using the earbud storage hook on the back of the side pad. It works.

NOISE CANCELLATION, TAP CONTROL

The ProFlight has three profiles of active noise cancellation, or ANC. Bose is careful not to refer to these profiles as "levels" of ANC because that's not what they are. Just about everyone who tried our demo set incorrectly and understandably assumed that the set's low, medium and high profile settings coincided with the amount of noise cancellation the set would provide. It doesn't work that way and Bose thinks of the settings in terms of fitting an appropriate environmental factor.

In some cabins, the medium ANC profile works better than the high profile, while the high is better suited for others. Interestingly, the low setting is a "hear-through" mode, which optimizes voice frequencies outside the intercom circuit. That's so the crew wearing the ProFlight might be better able to hear what's going on around them.

For instance, while at the gate on turnarounds, airline crews generally always have the need to talk with others who might be coming in and out of the flight deck. As a result, the low setting is only for use on the ground and eliminates having to remove the earbuds. In our trials, the low setting was nearly useless in flight, even in the most quiet cabin.

One of the most clever functions of the ProFlight is the patented tap control talk-through communication, which works when the headset is in the medium or high ANC profile modes. Double-tapping either earbud simply opens up the audio (for the specific ear) so you can hear what's going on around you, or from a specific direction. As a real-world example, you're wearing the set, settled into cruise flight and a passenger or flight attendant wants to talk to you. Double-tap either earbud for talk-through communications, then double-tap it again to go back to the previously set ANC profile.

BLUETOOTH, INDICATORS

Like the A20, the ProFlight has a decent Bluetooth feature set, made better by the Bose Connect tablet and smartphone app. The app smartly allows you to connect two ProFlight headsets to the same mobile device to share music and audio alerts from cockpit apps. The headset can connect with two sources at the same time, plus you can also answer, end and decline phone calls from the module's Bluetooth/multifunction key. Adjust the volume with controls on the side of the module.

The multifunction key is also used for Bluetooth pairing, and there's a status annunciator right above it. It blinks blue when connected and purple when the set is ready to pair.

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

When the headset is connected to aircraft power, the annunciator slowly blinks green and blinks faster when the set is using the AA batteries. When there's less than eight hours of AA power remaining, the annunciator blinks amber and it blinks red when there's less than two hours remaining. This lamp is dimmable by double-pressing the power key—a nice touch.

Bluetooth paring is fast and reliable and you have the option of controlling when the connected audio source will mute or mix with the headset's native audio with a Mute and Mix slider switch. In Mute, the Bluetooth audio temporarily mutes when there's intercom chatter and all audio is combined when it's in Mix. Off is just that—there's no Bluetooth.

Music quality through the set is good, although we give the A20 an edge. You can use the ProFlight for listening to Bluetooth audio (or for phone calls) when it's unplugged from the intercom.

PERFORMANCE

Bose makes it clear that the ProFlight doesn't touch the level of noise-cancelling performance of the model A20 and it wasn't intended to do so. Remember, the ProFlight is intended for airline and bizjet applications where the cabin noise is low. Still, we realize that some pilots of piston models with reasonably quiet cabins (newer Cirrus and Piper PA-46 models are two that come to mind) might be willing to sacrifice some performance for comfort. To them we say stick with the A20, the Lightspeed Zulu 3 or even the Clarity Aloft Link in-ear model, which we crowned the in-ear headset champ in a shootout for the December 2017 *Aviation Consumer*.

We tried the ProFlight in a new Cessna 206, a new Cessna 182 and in a Mooney that has an upgraded interior with lots of soundproofing. We quickly reached for our A20 in each of those aircraft—not even close to the level of performance the A20 offers.

For piston and turboprop cabins, we favor the Clarity Aloft Link, top photo, where the headset is positioned to the left of the ProFlight for a size/styling comparison. Speaking of size, ProFlight's interface module is just right, bottom.

But the real disappointment was when we tried the set in turboprop singles, including a Pilatus PC-12NG and also a Quest Kodiak. Not only did the ProFlight not offer the noise-cancelling performance of the A20, but the set's ANC circuit had the tendency to cut in and out under what seemed to be vibration—including landing and even during takeoff. Our sense was the vibration triggered the talk-through mode, although Bose says you may experience a brief reduction in noise cancellation as the headset compensates for a momentary pressure change.

"The set's performance was acceptable on the medium ANC setting and slightly better on the higher setting, but at certain power settings the headset was actually better when it was turned off (passive)," said one evaluator in the Kodiak. "I wouldn't give up the Clarity Link for the ProFlight," another said after flying with the Bose in the Pilatus. But everyone in our group seemed to agree that you'll need to put on your eyeglasses before putting on the ProFlight, and the set is designed well for wearing over a baseball cap. Overall, it got high marks for comfort when wearing eyeglasses.

CONCLUSION

The ProFlight is $995—the same price as the non-Bluetooth A20. Our conclusion is easy: If you fly a piston, this headset isn't up to the task. It could work for some turboprops, but we strongly advise trying it first.

For light jets, we can recommend it based on its proven performance in a Citation Mustang, but still suggest trying it before buying it. Still, that's smart advice we always give before investing in any headset.

CONTACT

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Taming Corrosion: Inspect, Treat, Repeat

Rust never sleeps, which means an ongoing program of corrosion inspection is in order. Anti-corrosion treatments are worth the effort.

Staff Report

We've seen it plenty of times. It's pretty easy to fool some airplane buyers into thinking the machine is a cherry by slapping on a fresh coat of paint and a spiffy interior. All is good until the airplane hits the hangar floor for the first annual inspection and the mechanic delivers the dreaded news: The airframe is corroded.

Truth is, even well taken care of 30-plus-year-old aircraft will have varying degrees of corrosion, some of it in structurally critical areas. The exception might be planes that have spent all those years in a climate-controlled hangar and hardly ever flown. We've seen those, too, and they're worth a premium.

The good news is there are some things owners can do to keep this airplane cancer from spreading deeper into the airframe, and with luck, keep it from forming in the first place. Here's a common-sense primer, with a general overview of common types of corrosion and where you might spot it.

CORROSION 101

The best way to control corrosion is to keep it from forming in the first place, and understanding the requirements for building corrosion is the first step. Think back to high school science lab. First, there must be the presence of metal that will corrode—usually not a shortage on the typical aircraft. Sure, composite aircraft have an advantage, although many have metal wings and plenty of other metal accessories. There must also be the presence of a dissimilar conductive material that has less tendency to corrode. And, there has to be the presence of an electrolyte (water, for example). Then there's the electrical contact between the cathode and anode—think metal-to-metal contact of a fastener, as an example. But remove any one of these basic requirements and you're doing some good in controlling corrosion.

We all know corrosion when we see it, from the white powder-like substance you can swipe off the surface to red and black rust that has eaten through the metal. It's all ugly, no thanks to the electromechanical deterioration of metal due to chemical reactions in the surrounding environment. Corrosion can spread quickly (or slowly) and for the purposes of maintaining an aircraft, it's unquestionably the enemy because it eventually compromises the strength of the structure and control surfaces.

We also know that aircraft living in coastal regions (saltwater is the enemy) are more susceptible to

The Cessna pictured at the left is the victim of oxidation—and likely other forms of corrosion—from sitting uncovered in a heavily industrialized area and wet climate. We think the CorrosionX product, top photo, is one effective preventive measure.

rapid corrosion, but aircraft that operate in and are parked around industrial areas are equally susceptible.

It's complex because aircraft are made of several different lightweight metals that have an undesirable trait of a high electrode potential. This means that they are very reactive to any contaminants in the air, supporting the general rule that storing your bird in the right hangar is the way to go.

LIKE CANCER, THERE ARE MANY FORMS OF CORROSION

Corrosion can take many forms, most of which are thought of as gradual processes. Multiple forms can be at work at the same time. Examples are surface-etch corrosion, pitting and exfoliation, which we'll get to in a minute. But there are also forms of corrosion that can occur more rapidly, such as stress corrosion cracking, environmental hydrogen embrittlement and fatigue corrosion. These latter forms are influenced by both chemical and mechanical aspects of the environment and can cause catastrophic structural failures without a great deal of warning. Yes, as in a wing or tail coming off in flight. It happens.

A common type of gradual corrosion is oxidation, also known as atmospheric corrosion. Whenever a metal is exposed to a gas that contains oxygen atoms along with atmospheric moisture, a reaction occurs. Two atoms from the metal join with three atoms of oxygen to form an oxide. How serious is this type of corrosion? It depends on what type of metal is involved. When an aluminum surface is involved, the corrosion byproduct is aluminum oxide. When this layer is formed, it provides a penetrated barrier between the aluminum surface and oxygen elements. Keep in mind that even mild surface oxidation might mask a serious level of corrosion below.

Never trust an oxide film to protect aircraft components from further deterioration. There is a form of oxide film that forms a tight bond with the surface of some metals and it creates what is called a passive film. Stainless steel and titanium are also examples of such metals. Once formed, further deterioration is stopped unless the film is broken. Unfortunately the film is all too flimsy to provide useful self-limiting.

Regularly washing contaminants from the surface and underside of the fuselage is a must for avoiding some forms of corrosion, but digging into the surface with a buffing wheel, bottom photo, can invite the start of corrosion.

Pure aluminum is very resistant to corrosion, but not strong enough to be used in any real structural capacity. It is used on sheet metal as a very thin coating called cladding, but it is easily broken through to the less corrosion-resistant structural component of the sheet. Scratch it or get a bit too aggressive with a buffing machine and you'll penetrate the cladding.

When an iron surface is involved, the corrosion byproduct is iron oxide. That's rust—and it never sleeps. The iron oxide forms a porous film that cannot seal out the oxygen. The reaction between the surface and the oxygen will continue until the metal is completely eaten away.

Surface-etch corrosion occurs when an unprotected metal surface is exposed to salt air, exhaust fumes or acidic fumes. You can spot this by looking for a uniform, dull appearance caused by microscopic amounts of salts being formed. If these salts are not removed and the surface is not treated to prevent further decay, this type of corrosion will reach the next level, known as pitting, which can be deceptively destructive. In its early stages, pitting makes its presence known by producing small clumps of white powder on the surface. You see it often on aging chrome vehicle wheels, among other places. In its later stages, it can be detected by using a small flashlight to shine light through the holes in the surface of the metal.

No metal is immune from the effects of cyclic stress with some corrosion tossed in the recipe. Fatigue corrosion occurs in two stages, starting with pitting and cracking and then progressing to a fracture.

How well do you inspect—and we mean really inspect—the rivets on the skin? Smoking rivets doesn't mean you're the fastest Bonanza pilot in the West, it means you have fretting corrosion. It happens when

Ignoring deteriorated antennas is a setup for ugly corrosion. Notice the compromised sealant at the base of a VHF antenna on top of a Cherokee in the top photo. The bottom image reveals what's growing on the skin below it.

two surfaces are held tightly together but can still move relative to one another, even ever so slightly. This allows the surfaces, and in some cases rivets and fasteners, to wear. These surfaces generally are not attached tightly enough to keep out oxygen. The oxide film is destroyed just as rapidly by the rubbing action of the two surfaces. If all that isn't bad enough, when this type of corrosion is started, the movement between the surfaces is too small to allow the powdery deposits to escape, and they act as an abrasive to further accelerate the damage. In fact, this could be one of the worse types of corrosion, in our view, because the more the airplane flies, the faster it will spread. Beware of the smoking rivets.

Galvanic corrosion, also known as dissimilar metal corrosion, can occur any time two requirements are met: Two or more dissimilar metals must be connected in a manner that provides a path for the flow of electrons, and their common surfaces must be covered with a form of electrolyte. It can be easily recognized by the buildup of corrosion at the joint between metals.

To see the process in action, the next time it rains go out and put your eyeballs on the wing. You'll find steel screws attaching aluminum inspection panels to an aluminum wing covered with water. Another problem area is where a stainless steel firewall is riveted to an aluminum fuselage skin. Throw in a couple of minor exhaust leaks and some blow-by oil to help trap and hold dirt, and guess what's next.

Another close relative of intergranular corrosion is stress corrosion cracking. It occurs when a metal under tensile stress is subjected to a corrosive environment, and may be caused by internal or external stress. As with intergranular corrosion, the stress can be caused by improper quenching after heat treatment, or uneven deformation during cold working. Parts that have an interference fit—such as the bushings in a landing-gear strut housing—can also cause it. Susceptibility to cracking increases with stress and if a crack does occur, it will grow rapidly because the corrosion attacks the end of the crack more so than the edges.

TREATING AGING METAL

An aftermarket whole-airplane anticorrosion treatment can be effective if it's done thoroughly and regularly. Two common products, the Corrosion Technologies CorrosionX (www.corrosionx.com) and the Lear Chemical Research ACF-50 (www.learchem.com) fluid thin-film coatings (FTFC), have earned respect over the years as valuable tools for fighting the ongoing battle of airframe corrosion. We covered the products in a field report in the August 2016 *Aviation Consumer*, so we'll lay down the basics here.

FTFCs are compounds that consist of complex molecules that have one end that attaches to metals and the other that blocks moisture and electrolytes. FTFCs are not like previous barrier products in that they do not remain on top of existing corrosion and keep further moisture out—they penetrate through existing corrosion to the metal.

Once there, the engineered molecules bond to the metal and often displace the existing corrosion to the point of falling off. This isn't a repair for corrosion-induced damage, of course. The film penetrates into lapped skin surfaces and around rivets, and it does so remarkably quickly. It's a messy job and done correctly, the skin weeps the oily film for some time. It's important to treat the entire aircraft, not just the wings and tail. Cabin windows are notorious leakers and that water is a superb source of electrolytes to spur corrosion. That means pulling the interior and treating all of the fuselage. It doesn't make for a pleasant-smelling aircraft, either. Smell the stuff once and your nose will forever sniff out planes that have been treated.

Whether and when to apply CorrosionX or ACF-50 depends on the age of the airplane and where it primarily flies. Over the last 15 years, manufacturing changes have meant that new airplanes come out of the factory with far superior corrosion-resistant treatments than previously.

We think if your airplane is older

than 15 years and it has not had an FTFC treatment in at least five years, it would be wise to seriously consider fogging it at the next annual, especially in areas where corrosion is a way of life. Coastal New England is high on the risk list for its acidic rain and humidity, temperature swings and salt-laden air. The Gulf Coast and southern Atlantic coast also come to mind.

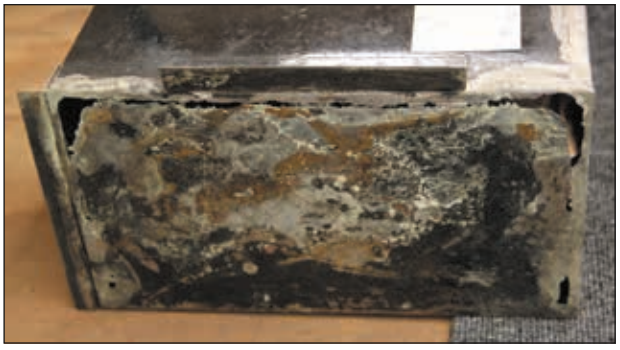
Still, just because your aircraft is based in a low humidity area such as central Colorado does not mean you can ignore the risk of corrosion on a legacy machine. Where your aircraft lived before you owned it has to be considered along with whether you ever fly to higher corrosion risk areas, such as the Midwest during a hot and humid summer day. When shopping for a used aircraft, find out exactly where it has lived. Some respected aircraft sales firms, like Aircraft Sales Inc. in Ohio (it performs the Pristine Airplane total refurbishment mods) won't touch airplanes that have lived in corrosion-risk areas.

The shops we've talked with that do a fair amount of anti-corrosion treatments with both CorrosionX and ACF-50 recommend fogging the airframe at least every two years.

ROLL YOUR OWN INSPECTION PROGRAM

You can accomplish some of this on your own as you tinker with the machine in preparation for an annual inspection, or when doing some owner-performed preventive maintenance and repairs. But you have to know where to look. Start by talking with a trusted IA who is familiar with your model because chances are, he or she will have a general idea of where problem spots might exist in the airframe, and where you might look. As an example, interior sidewalls on Cessna models (the area where the black nylon/lead panels may touch the skins and the inboard wing spars on 210s and Cardinals) are problem areas. On Mooneys, it's the area around the fuel drain and lower fuselage. Visit the hangar when the airplane is opened up for an annual—you'll have a better lay of the land.

One overlooked component that's a corrosion factory is the battery enclosure. That's a new Bogart battery box in a Comanche, top photo. The photo below is the OEM box, or at least what's left of it.



Worth mentioning is that some mechanics are more serious about inspecting for corrosion than others during routine annual inspections. While one tech might dig deep into the airframe specifically looking for signs of corrosion (we know of one trusted tech who climbs deep into the fuselage with a magnifying glass in one hand and a flashlight in the other), another might give the airframe a quick look and close it back up. Ask for as detailed an inspection as you're willing to pay for.

For what it's worth, we've seen some owners and mechanics make a case for too much inspection and disassembly that can end up doing more harm than good for obvious reasons. You need to find the right balance because face it, tearing an airplane down to its core can be a pricey and time-consuming job. Moreover, the regulations governing an annual inspection give the inspector a wide degree of latitude in how to dig for problems.

Last, when looking at well-worn used airplanes, make corrosion inspection high on the priority list during the prepurchase evaluation, and favor those that have been treated and stored indoors.

TIPS FOR TAMING CORROSION

- ✔ Discuss the level of routine inspection with your mechanic.
- ✔ Parking the aircraft in a climate-controlled hangar is best.
- ✔ But operating in industrially contaminated areas isn't.
- ✔ Be gentle when cleaning the paint, especially with machines.
- ✔ Do not neglect aging antennas, pay attention to the sealant.
- ✔ Discuss anti-corrosion treatment intervals with your shop.
- ✔ Even hand-treating problem areas is better than nothing.
- ✔ Pass on used planes with serious corrosion. It's a cancer.

WingBug ADAHRS: AoA, Data Recording

Think of the WingBug external ADAHRS pod as a movable secondary backup pitot static system. Third-party app interfaces could make it better.

by Phil Lightstone

CHECKLIST

- Priced under $1000, the WingBug is a worthy backup for the primary pitot static system.
- The simple flight recording function can be useful for flight training.
- We think users will want a PFD display, but the program only displays traditional round gauges.

If you've dealt with a pitot static system failure you probably recognize the value of electronic air data computers. This tech is hardly new, of course, but portable wing-mounted pods with built-in air data sensors/computers are fairly new and a company called Straight & Level Technologies (SLT) has been selling the $950 WingBug.

The WingBug device packages ADAHRS, GPS and an ADS-B In receiver in a relatively compact chassis that easily mounts to a wing strut or nearly any surface of the aircraft with a variety of common mounting hardware. I flew with the system in a variety of aircraft and prepared this field report.

WHAT'S IN THE POD?

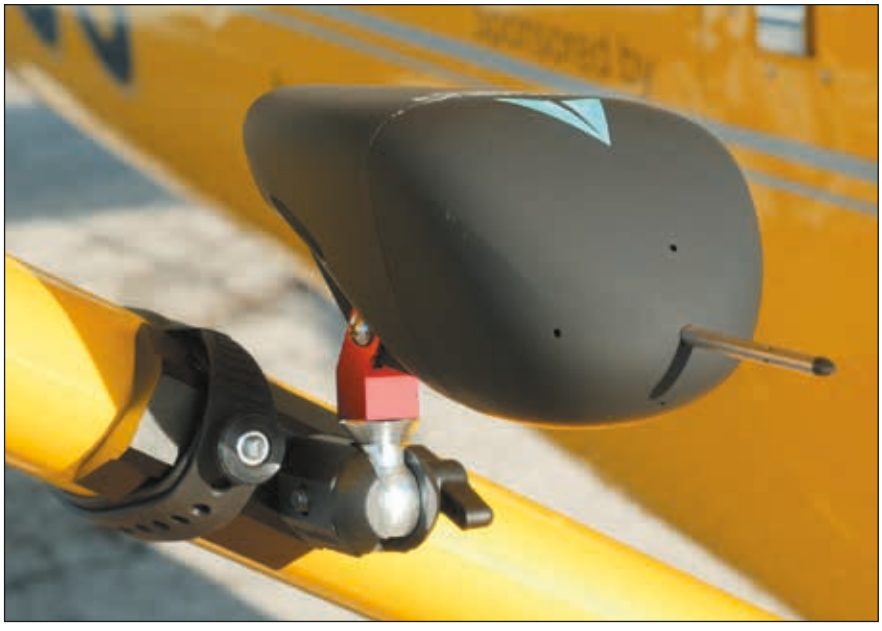
ADAHRS, of course, and that includes attitude data to accompany the heading and air data flight instruments. The sensors include pitot static, temperature, barometric altimeter, accelerometer, electronic gyro with magnetometer and GPS. A micro controller converts these sensors into digital data, delivered to the WingBug app for iOS tablets and smartphones over a Wi-Fi connection.

Now the standard cabin connection protocol, Wi-Fi provides a more stable connection than Bluetooth. Plus, Wi-Fi is more tolerant of elec tromagnetic interference (EMI)—and there's plenty of it generated by charging systems and magnetos. But wireless connectivity is another challenge. The WingBug pod creates concurrent point-to-point Wi-Fi connections to multiple tablets or smartphones at once. But consider when multiple Wi-Fi devices like ADS-B receivers, satellite hotspots and action cameras are fighting to connect to the pilot's tablet in a point-to-point peer connection. In a peer-to-peer connection, only a single device may be connected to a tablet or smartphone, requiring the user to manually select the device (in Wi-Fi settings). A portable Wi-Fi access point provides the fix, but the devices and applications must be able to support access-point connectivity. Not all do.

The onboard battery delivers 12 hours of use and recharges in six hours via Micro-USB, and is not user replaceable. The pod measures 7 by 3 by 2.5 inches, weighs 11.8 ounces and has a small pitot tube positioned in the center of the pod's front case. No, it's not heated.

MOUNTING IT

Since it isn't STC certified, the WingBug pod was designed to be completely removable from the airframe, and it's the operator's responsibility to keep it that way on certified aircraft. Drill through structure and the installation could require a field approval. On the other hand, for electronic pods that are permanently affixed to the airframe, the NORSEE (non-required safety enhancing equipment) guidance might be utilized. As we've reported, the NORSEE process addresses equipment that is not required by any federal regula-



That's the WingBug ADAHRS attached to the wing strut of a Cessna. It's completely self-contained and has a rechargeable battery with 12-hour endurance.

That's the WingBug app's six-pack instrument presentation in the top image. It occupies most of the screen on an Apple iPad. The bottom image is the WingBug mounted to a GoPro adhesive surface mount on the underside of a wing.

tion with the intent to measurably increase aircraft safety, but this still requires sizable interpretation.

The WingBug ships with a variety of GoPro-style action camera mounts. The mounts use 3M UHB mounting adhesive strips, providing a fairly secure bond, but can also be removed from the airframe with some effort. Still, we've had action cams come off the aircraft using these adhesives and know plenty of others with the same story. The mounting bracket allows the pod to be quickly and easily attached to the mount.

I used Flight Flix's (www.FlightFlix.net) Rock Steady GoPro tiedown aluminum mount ($59.99) to evaluate the WingBug on a variety of aircraft. The Flight Flix mount turns any standard tiedown ring into a device attachment point. This mounting system is constructed of aircraft aluminum with a low profile designed for both Garmin and GoPro action cameras. The mounts are slimmed down to a basic GoPro adapter and base. Adjust the WingBug's position by rotating the aluminum adapter on the 1/4-20 threaded stud and locking it in place with the jamb nut. The aluminum base uses a thumb screw with a hex drive head. The aluminum centering nut allows quick attachment to any tiedown ring with up to a 1-inch diameter hole. The centering nut has a grooved outer edge allowing a perfect fit on most standard aircraft, including Cessna and Piper tiedown rings. I added two additional locking nuts to ensure that the screws never come loose in flight.

Use common sense and don't mount the WingBug to any control surface or vulnerable locations on the aircraft, around loose or chipping paint, oily surfaces and surfaces susceptible to heat. A suction cup mount likely won't be strong enough. Also, since the device is a calibrated instrument, don't blow into the pitot tube or any of the ports.

Mounting must be in the direction of flight (pitot tube facing forward relative to the aircraft's direction of flight). The WingBug logo can also be used as an arrow indicating the direction of flight. WingBug produces the most accurate results in the upright or upside-down positions. Mount it at least 3 inches below the leading edge with the pitot tube extending beyond the leading edge for most accurate readings. The WingBug pitot tube should be horizontally aligned, parallel to the chord of the wing. The aircraft's pitot tube can be used as an angle reference. Mounting WingBug near the aircraft's pitot tube would be best and avoid mounting it behind the propeller's arc in order to avoid propwash from the affecting the readings.

FLYING WITH IT

The WingBug's internal battery is charged in six hours using the supplied charger and Micro-USB cable. There is an On/Off switch with a red LED that flashes when the pod is charging and it turns solid red when the device is powered on. The light on the button will stop flashing once a GPS signal has been acquired.

Before the first flight, your iPad must be set to work with the WingBug hardware. The process begins with downloading and installing the free WingBug app from Apple's App Store. The initial installation process requires the creation of an account and the registration of the WingBug hardware through the app. You'll need a reliable internet connection for the initial setup. Tip: During the setup process, don't power up the WingBug until prompted to do so and have the pod's serial number handy.

Once the WingBug is mounted in the optimal location, turn it on and allow to sit for 30 seconds. This allows the device to gather its data necessary for accurate readings. Prevent wind from entering the pitot tube during this time.

I evaluated the WingBug in a Rockwell Commander 114, a Cessna 172M and a Piper Cherokee, and the Flight Flix RS tiedown ring worked well on all three of these aircraft. Installation of the RS tiedown ring mount took under 5 minutes. The WingBug fit well with the Flight Flix aluminum

The WingBug's control set is limited to a power switch, status lamp and Micro-USB port.

GoPro style bracket; however, I added a small amount of tank sealing tape to add a modest amount of friction. To ensure that the WingBug did not move in flight, I used a long Philips screwdriver, nut driver and 7/16-inch wrench to ensure a snug fit of the screw and nut. The Flight Flix bracket allowed the WingBug to be adjusted to be level with the wing's airfoil.

THE WINGBUG APP

The software currently only supports Apple iPads and smartphones. You'll want a large screen because the six-pack application utilizes the screen's ample real estate to display the electronic round flight instruments. The app requires that you add a pilot profile and the aircraft's information, including the year, type, model and registration number. You'll also set up data for the airspeed indicator and angle of attack display.

Setting the airspeed indicator requires the following information to be entered: Vs, Vno, Vne, Vmc, Vso, Vfe, Vyse and the indicator style (90, 140, 220 knots). The sideslip and angle of attack information are entered in degrees. Consult your aircraft's pilot's operating handbook for the correct data, although some older aircraft may not have all of the V-speeds documented. Those values may be kept at zero.

The maximum displayed airspeed is 260 MPH/225.9 knots, the maximum altitude indication is 25,000 feet, the maximum vertical speed is +/- 2000 FPM and the maximum bank angle indication is 180 degrees.

The pod is water- and shock-resistant, making it worthy for use on seaplanes. Aerodynamically, the product was designed to be used at speeds up to 260 MPH. Wind tunnel tests demonstrated 1.1 pounds of force against the device at this speed.

With the WingBug hardware charged, securely attached to the aircraft, the iPad charged, the WingBug app installed and configured for your aircraft, it's time to fly. During my initial flights, I focused on the app and did not fly the aircraft. Sitting in the right seat, I focused on learning and using the app and found it is intuitive to use and requires very little time to master. That's refreshing in a world where many aviation apps are layers deep. The WingBug requires the current barometric pressure setting and tapping on the airspeed indicator changes the units between MPH and knots.

With the WingBug powered on and connected over Wi-Fi, open the WingBug app, select the stored pilot and the aircraft for the flight. Then tap the Let's Fly button, which displays the flight instruments. Worth mentioning is there was no PFD presentation in the app I evaluated, but that's planned for a future revision, perhaps by the time you read this. There's also a planned ADS-B In interface.

Tap on the altimeter to enter the barometric pressure and calibrate the altimeter to the known airport elevation. Before takeoff, tap the flight recording button (lower left-hand corner) and all of the captured data will be saved until the flight recording is turned off. In the lower right-hand corner of the screen is a Note icon. When tapped, this will open up a notes pop-up, allowing you to add notes to the flight. When recording a flight, an "event marker" button (circled in red) will appear in the flight instrument. Use this button to mark events during your recorded flight for later reference. They will be clearly marked in the flight playback section when replaying the flight. The My Flights icon displays a list of recorded flights. There's a Play/Pause button as well as a timeline, which allows you to move the slider to a specific time in the flight.

CONCLUSION

With four years of hardware product development under their wings, the developers at SLT are focusing their energies into the WingBug application as well as the website and cloud infrastructure. We think third-party app interfaces can step the product up to another level and the company says it's working with a number of companies to incorporate support of the WingBug into mainstream apps. The goal is to utilize the pod's air data reference to drive other PFD displays, rather than using AHRS and GPS-derived data from a portable ADS-B receiver, for example.

SLT will offer an annual maintenance plan for the pod, which will cover internal cleaning and calibration, battery replacement and other tasks. We suspect the device will take a beating with regular use. SLT's co-founder Alex Rolinski said that by using state-of-the-art components, the WingBug's hardware platform will outlive the software builds. The company has a no-questions-asked one-year replacement warranty.

SLT has partnered with Flight Flix, which manufactures a CNC aluminum mounting system for action cameras. Flight Flix offers mount bases for tiedown ring and wing strut attachment, as well as surface screw attachments, and has created a custom adapter for the WingBug that's priced around $100 and will be available on the SLT website.

For the price, I think the WingBug can be an invaluable tool for backing up the aircraft's existing pitot static system and instruments. It's also a useful tool for the training environment given its flight recording and playback. Still, as mentioned, third-party app interfaces can make the product better. Plus, an ADS-B In function can rid portable receivers from the glareshield.

Visit www.wingbug.com.

New FAA Reg Review: Sims Even More Useful

New FARs allow expanded use of Aviation Training Devices to meet IFR recency of experience requirements. This can be a big cost savings.

by Rick Durden

We have used and reviewed flight simulators in this publication since shortly after the first issue. We long ago formed the opinion that even the most basic desktop model can help a pilot learn new techniques, skills and procedures faster than in an aircraft in flight—airplanes truly are lousy classrooms—and that simulators are excellent tools for keeping VFR and IFR skills honed.

As technology advanced simulators became more and more capable of replicating the aircraft they mimicked. Along the way, the FAA updated its regulations to allow credit for time spent "flying" certain sims toward pilot certificates, type ratings and required recency of flight experience.

The most recent regulatory update on flight experience credit for operating a sim kicked in as of November 26, 2018, and will, we believe, cut the cost of meeting the recency of experience requirement for filing and flying IFR.

As of that date, pilots can use an Aviation Training Device (ATD), as defined in FAR Part 61.1, to meet the recent experience requirements of Part 61.57(c)—filing and flying IFR—in the same fashion as the pilot could previously only in an aircraft, full flight simulator (FFS) or flight training device (FTD). FFSs and FTDs are more sophisticated, and expensive, flight simulators than ATDs.

The reason this is a big deal for pilots is that (1) an ever-increasing number of flight schools, flying clubs and individuals own ATDs—prices start just north of $5000; and (2) previously there were restrictions on the use of ATDs for instrument currency that were onerous enough that pilots were not taking advantage of the fact that it was cheaper to stay current in a simulator than shelling out the bucks to do so in an airplane.

CHEAPER, BETTER TRAINING

Back in the June 2018 issue of *Aviation Consumer,* we railed at what we considered to be the foolish restrictions on the use of ATDs for instrument currency. We were, and are, convinced that recurrent training in an ATD, with its ability to fly approach after approach without flying for several minutes to reposition and its ability to safely practice emergency procedures, meant that pilots should be able to use one in the same manner for instrument recurrent training as they could an airplane.

Now they can.

Now, instead of finding a safety pilot to ride along in an airplane as you do the instrument work you've tailored for yourself to meet the FARs for recent experience, you can do it in an ATD. It will cost less and you can shoot more approaches in the time you spend. When you get current using an ATD, it will be good for six months, just as if you used an airplane, FTD or FFS.

There is one caveat: You'll need to make a logbook entry or keep some sort of training record that specifies the type of ATD (we read that as make and model), the time you spent and what you did—number and type of approaches, etc. The FAA issues Letters of Authorization (LOA) to approve ATDs; it recommends that you make a copy of the LOA for the ATD you use and keep it with your records.

The new regs do not allow you to use just any desktop simulator for instrument recurrent training. It has to have been certified as meeting certain standards for realistic re-creation of flight by the FAA as an ATD. That process is described in detail in FAA Advisory Circular 61-136B. It further describes the split of ATDs into two classifications: Basic Aviation Training Device (BATD) and Advanced Aviation Training Device (AATD). Both BATDs and AATDs fall under the new regs on recurrent training.

FlyThisSim's TouchTrainer VM falls into the Basic Aviation Training Device category—so its utility is enhanced by the pilot-friendly change to the FARs.

Cessna Skymaster:

It may not be a speed demon and it's definitely an unconventional twin, but Cessna's push-pull model 337 is a lot of airplane for the money.

The Cessna 337 Skymaster is arguably the most commercially successful so-called push-pull attempt, at least in terms of numbers built. And although the 337 Skymaster isn't the most popular twin ever marketed, it's done just fine for itself and has achieved its primary goal: eliminating asymmetric thrust and simplifying the pilot's workload in the event of an engine out. Unfortunately, as you'll see in our accident scan on page 30, some Skymaster pilots find plenty of other ways to NTSB fame.

Still, the idea of the push-pull twin makes such fundamental sense that it has been applied to aircraft designs in one form or another for nearly 100 years and in literally dozens of models you've never even heard of. Remember back in 2005 when Adam Aircraft tried the idea again with the A500 push-pull piston twin? We do, and like many before it, it failed more by market reality than by a fundamental flaw in the idea. We really wanted that one to work.

If the push-pull concept was seamless, the execution of it by Cessna was a little less so. The Skymaster acquired a reputation as a bit of a maintenance hog and although its performance is respectable, other twins do just as well, if not better, on less fuel and on fewer dollars spent on wrenching. Like most used twins on the market today, some Skymasters are a bargain, but others are premium priced. When avgas prices started to climb, market values of twins started downward and today, you can find a reasonably well-equipped Skymaster for under $100,000. Airframe values seem to have stabilized since we first examined them several years ago, which is more than we can say for other piston twins.

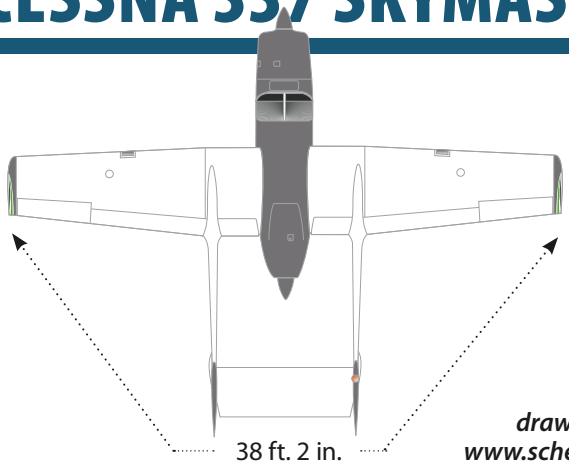
A potential Skymaster ownership nightmare is runaway maintenance costs, especially in pressurized models.

NOT REALLY SIMPLER

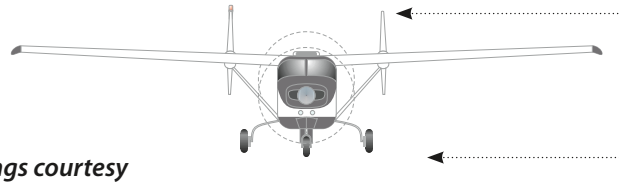
When Cessna began to develop the Skymaster in the mid-1960s, the accident history was horrid for twins. Part of that was due to training. The doctrine in those days was to actually surprise the pilot with a real engine shutdown to simulate losing one. In the hairy-chested thinking of the day, instructors would even do this on takeoff. As a result, loss-of-con-

The Flying Bulls Skymaster in the main image is a 1969 337D. Aircraft Bluebook says the average retail price should be around $42,000, but pristine ones demand a lot more.

CESSNA 337 SKYMASTER



29 ft. 10 in.



9 ft. 2 in.

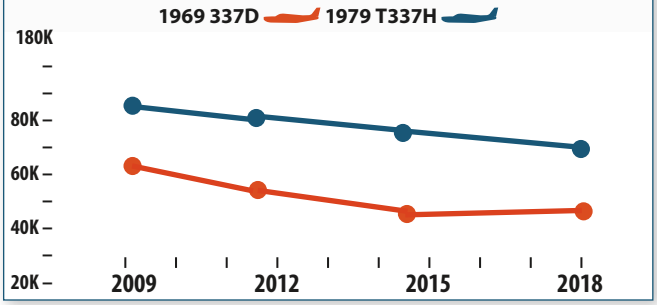
38 ft. 2 in.

drawings courtesy
www.schemedesigners.com

SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1963-67 337A,B SKYMASTER	CONTINENTAL IO-360-C/D	1500	$30,000	93	1585 LBS	167 KTS	±$35,000
1968 337C SKYMASTER	CONTINENTAL IO-360-C/D	1500	$30,000	93	1750 LBS	166 KTS	±$40,000
1968 T-337C TURBO SKYMASTER	CONTINENTAL TSIO-360A/B	1400	$30,000	93	1705 LBS	195 KTS	±$45,000
1969-70 337D,E SKYMASTER	CONTINENTAL IO-360-C	1500	$30,000	93	1780 LBS	166 KTS	±$42,000
1970 T-337E TURBO SKYMASTER	CONTINENTAL TSIO-360-A	1400	$30,000	93	1780 LBS	194 KTS	±$49,000
1971-73 337F,G SKYMASTER II	CONTINENTAL IO-360-G	1500	$30,000	90	1705 LBS	169 KTS	±$51,000
1975 T-337G-P PRESSURIZED SKYMASTER II	CONTINENTAL TSIO-360-C	1400	$30,000	150	1516 LBS	204 KTS	±$68,000
1976-77 337G II SKYMASTER	CONTINENTAL IO-360-G	1500	$30,000	150	1705 LBS	169 KTS	±$69,000
1978-1979 337H II SKYMASTER	CONTINENTAL IO-360-GB	1500	$30,000	150	1592 LBS	169 KTS	±$83,000
1978-1979 T-337H II SKYMASTER	CONTINENTAL TSIO-360-H	1400	$30,000	150	1596 LBS	200 KTS	±$88,000
1980 337H SKYMASTER II	CONTINENTAL IO-360-GB	1500	$30,000	90	1705 LBS	169 KTS	±$78,000
1980 T-337H TURBO SKYMASTER II	CONTINENTAL TSIO-360-HB	1400	$30,000	90	1592 LBS	200 KTS	±$93,000
1980 T-337H-P PRESSURIZED SKYMASTER II	CONTINENTAL TSIO-360-CB	1400	$30,000	150	1516 LBS	204 KTS	±$95,000

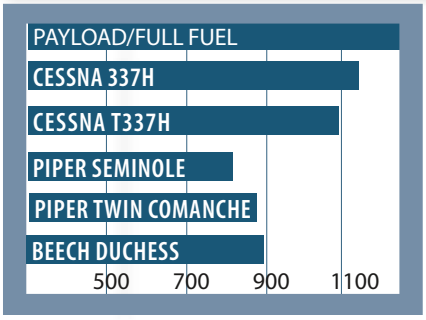
RESALE VALUES

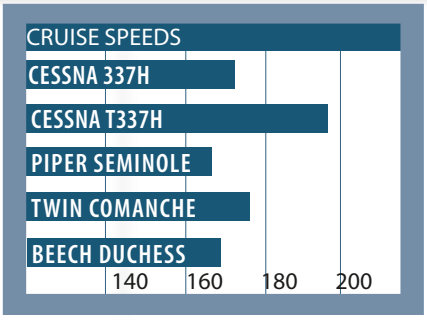


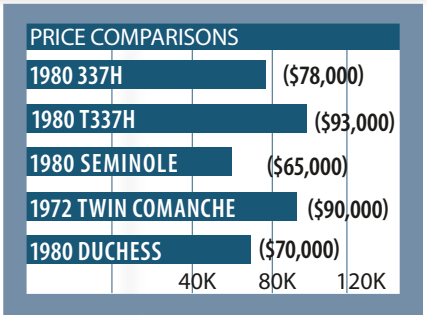
SELECT RECENT ADs

AD 2011-15-11	WING DAMAGE INSPECTION
AD 2011-10-09	SEAT RAILS AND ROLLERS
AD 2007-04-19	SUPERIOR AIR PARTS CYLINDERS
AD 2004-21-05	INSPECT COMBUSTION HEATERS
AD 2004-19-01	SHOULDER HARNESS ADJUSTERS

SELECT MODEL COMPARISONS







The original instrument panel on a 337, top, looks much like the one in a 210. The Rocket II Pristine Airplanes refurbishment from Aircraft Sales Inc., bottom photos, makes an existing Skymaster as modern as it can be. It includes a custom leather interior, a full panel of Garmin avionics and twin digital engine monitors.

trol accidents due to VMC rollovers were, if not common, more prevalent then they are today.

In an engine-out situation, conventional piston twins generally need to be handled with kid gloves lest the airplane get too slow and roll over on its back. So Cessna approached this problem just as other designers had going back to the Caproni Ca.1 of 1914: They aligned the two engines with the airframe centerline, offering pilots the safety of a second engine without the penalty of adverse handling. If one quits, identify it, feather it and don't worry about the dead-foot, dead-engine drill. The FAA even granted the 337 its own class rating, limiting pilots to centerline-thrust twins only. It was much easier—and probably safer—to earn a multi-engine rating in a Skymaster than in a conventional twin.

Part of Cessna's plan worked, since there's little question the Skymaster is easier to fly on a single engine than a conventional twin. But, since the VMC rollover accident doesn't happen that often in the real world because training doctrine moved to zero thrust instead of an actual engine shutdown, the airplane's overall accident record isn't that much better than conventional twins.

A pilot looking to improve redundancy by stepping up from a single to a twin certainly will achieve it with a Skymaster. But in the bargain of gaining redundancy, pilots can be forced to accept a platform with more cabin noise, a set of operating peculiarities all its own and tightly packaged systems presenting more of a challenge to maintenance personnel than if each engine resided on its own wing. All of this might argue in favor of a single-engine airplane or even a conventional twin. Then again, if you fly over the Great Lakes at night, maybe not.

MODEL HISTORY

The 337 Skymaster's front/rear engine layout and high wing started out as the fixed-gear Model 336 in 1964, powered by Continental IO-360-A engines of 195 HP apiece. Widely acknowledged as a slug, Cessna sold only 195 336s in one year of production; around 80 remain on the FAA's registry today. In 1965, the company folded the gear and upgraded powerplants to a pair of Continental IO-360-Cs pumping out 210 HP, resulting in the 337 Skymaster. Cessna sold 239 copies that year. (Not really learning from its 336 experience, Cessna flew a cantilever-winged, lower-powered version, the 327, in late 1967, but it proved too slow and the project was dropped the next year.)

To make the original 336 a retractable, Cessna borrowed the

Terry Allen shared an image of his Skymaster's clamshell cabin door, top. On post-1964 Skymaster models, the landing gear retracts like most Cessna singles, kind of flapping around as it gets sucked into the wheel wells, bottom image.

complex and occasionally troublesome hydraulic landing gear system from the 210. In 1973, it was upgraded to a simpler and more reliable electrohydraulic system. While less complex and easier to maintain, the system still isn't as robust as, say, a Baron's or Seneca's.

Early models also came with multiple fuel tanks, a system that proved problematic in the field. It was replaced in 1973 by a superior, less complicated system. A turbo version—the T-337B, powered by 210-HP TSIO-360-A or -B engines from Continental—appeared in 1967, but was dropped in 1972 with the addition to the Skymaster line of the almost-revolutionary pressurized 337 version, the T-337G-P, powered by TSIO-360-C engines up-rated to 225 HP.

The turbo reappeared in 1978, with TSIO-360-H powerplants, but Skymaster sales had begun slipping by then. Cessna pulled the plug following the 1980 model year, after a total production run of 2058, plus 332 pressurized versions. In addition, Cessna built slightly more than 500 Skymasters for the U.S. Air Force. These saw extensive action in Vietnam as the O-2A. This version boasts structural beefups, hard points and extra windows. These airplanes frequently appear on the used market and may well be the least expensive warbirds available. Additionally, some civilian models were converted to an O-2B configuration for the military to use in psychological warfare.

Major tweaks in the airplane's history were few, but there were many designation changes. Beginning in 1970, some inspection panels were added—making maintenance easier—and the airframe was lightened a bit, increasing useful load. The interior arrangement also changed through the years, with various combinations of seat mounting.

As is common with any aircraft, the non-pressurized 337's gross weight crept up during its years in production. Early models started at around 4200 pounds; late ones weighed 4630 pounds, with max landing weight limited to 4400 pounds. Meanwhile, the P-337, with its 30 extra horsepower, had a takeoff weight of 4700 pounds and max landing weight of 4465 pounds.

Piston-twin prices are still a bit soft, and the 337 is no exception. On the upside, most of the depreciation has been squeezed out of these airframes. The downside? Cessna 337s can't be counted on to increase much in value. But a Skymaster is a lot of airplane for the money. Besides current fuel prices and future uncertainties, other factors depressing prices are that the 337 has a reputation for being a maintenance hog—one that's not entirely deserved—and they aren't all that fast as like-powered twins go.

Buyers should be aware, however, that buying a cheap twin is not the same as operating a twin cheaply. A hangar queen will eat through a bunch of money if it needs remedial work and, in any case, you'll need to find a shop familiar with the breed to do the prebuy and maintain the airplane going forward. The Skymaster doesn't perform much better than a Cessna 210, and it has two of everything to maintain and replace, driving up ownership costs.

PERFORMANCE, HANDLING

Skymasters aren't speed demons, although the turbocharged models do respectably well for pilots willing

We shot this retired O-2A Skymaster, top, at AirVenture Oshkosh last year. The O-2A worked well as an observation aircraft, replacing the O-1 Bird Dog in the mid 1960s as an observation aircraft. The one in the lower image is a refurbished pressurized P337H. These are premium priced.

to take them into the teens. Owners of normally aspirated models can plan on between 155 and 165 knots true, depending on altitude and how much fuel they want to burn. The turbocharged and pressurized models will push 190 to 200 knots at 20,000 feet, their maximum certified altitude. At middle altitudes, 170 to 180 knots is typical for the turbo models, which isn't all that bad.

Since Skymasters have relatively small displacement six-cylinder engines, fuel burn tends to be reasonable, ranging from 15 GPH to 22 GPH total, with 19 to 20 GPH typical for a 150- to 160-knot cruise. For comparison, a Twin Comanche will do about the same speed on 100 fewer horsepower and a lot less gas. Efficiency isn't a Skymaster hallmark, except when compared to larger, faster twins.

All-engine rate of climb ranges from a modest 1300 FPM in the old 336 to a lethargic 940 FPM with the last 337H models. We're unaware of any other twin-engine airplane with a book rate of climb below 1000 FPM; even the old 150-HP Apache had a book climb of 1250 FPM with both engines running. On the other hand, lose an engine in a 210 and there's no rate of climb, only a rate of descent. In a 337, you should at least be able to eke out 200-300 FPM.

Like many Cessnas, runway performance is good. Landing-configuration stall speeds range from 55 to 62 knots, depending on the gross weight of the particular model—about 10 knots below conventional twins like the 310.

As a result, a Skymaster will get off the ground in less than 1000 feet at gross weight—a feat very few other twins can manage. Barrier performance is not quite as good, however; the leisurely climb rate brings the Skymaster's 50-foot takeoff figures down to the middle of the light-twin pack.

The single-engine climb rates of all the light twins tend to be very similar—200 to 300 FPM—because engine-out climb rate is a certification point around which the airplane is designed. The FAA requires a certain minimum climb, figured by a formula relating to stall speed, and the manufacturers typically bump up the gross weight to the point at which the airplane just barely meets the FAA minimum. Any excess engine-out climb capability is, in effect, wasted payload. And payload numbers sell airplanes.

What's surprising is the difference between the front and rear engines. Climb on the front engine only is about 50 FPM less than on the rear, but not necessarily for all versions of the Skymaster. Reader Robert Prader told us his research reveals that later models have better front-engine performance. "It is true that front and rear engine single-engine climb rates are significantly different for all pre-1973 Skymaster models; however, the front and rear single-engine climb rates are not significantly different for the pressurized models and the 1978 and later turbo models," he said. "If you consult the POH for any pressurized model, you will find that a single-engine climb rate of 375 FPM is listed for a standard day at sea level at gross weight, with no mention of which engine is out. If you consult the POH for the 1980 non-pressurized turbo model, you will find it specifies a climb rate of 335 FPM for the same conditions, again with no mention of which engine is out."

While leaving the gear down produces a climb penalty of a bit over 100 FPM, raising it carries a temporary 240 FPM hit. (Praeder

told us this is about average for most twins and probably for single-engine retracts as well.) This is because Cessna's complicated gear door arrangement adds drag while the gear is in transit. In an after-takeoff engine-out situation, it may be better to leave the gear down, just as it is recommended in some singles to leave it down until obstacles are cleared.

In normal flight, the Skymaster has typical Cessna handling: heavy in pitch, reasonably responsive ailerons. (The P-model has especially light ailerons.) Pilots praise its IFR stability.

The noteworthy aspect of the Skymaster's handling—indeed, the whole reason for the airplane's existence—shows up when an engine fails. Instead of the normal yaw-roll-stall-spin scenario too often following engine failure in "conventional" twins, the Skymaster continues to fly straight ahead. An unprepared or rusty pilot can take his time and concentrate on the task of identifying and feathering the prop on the failed engine, without worrying about losing control.

PAYLOAD, RANGE

A Cessna press release from the 1970s describes the Skymaster as "a full six-place airplane with nearly a ton of useful load."

Good luck with that. At best, the two rear seats can accommodate youngsters. And that press release conveniently forgot when the fifth and sixth seats are installed, there's no baggage space, nor is there a baggage door. Consider the Skymaster a roomy four-placer.

Real-world useful loads run around 1500 pounds—not bad at all, and several hundred pounds more than a Twin Comanche. Standard fuel is 93 gallons, which should leave more than 900 pounds available for payload; plenty for four passengers and their bags. Standard fuel is just adequate, however—unless you throttle back—providing a bit more than three hours with IFR reserves at fast cruise.

Pre-1973 airplanes with long-range tanks had a four-tank fuel system; later ones came with a two-tank system. The long-range tanks—150 gallons in 1975 to 1980 models, 131 gallons in earlier models—solve endurance limitations nicely, at the expense of payload, of course. One owner told us that with long-range tanks full, he has seven-plus hours at 150 knots with 650 pounds of payload (three people and bags). Not a bad compromise.

Oddly, the P-337 is allowed only five people; it was certified under different rules requiring an emergency exit in a six-seat airplane. Rather than put in the exit, Cessna simply limited the seating to five. Early P models had a middle seat hinged up and to the side to get at the back row, but these seats didn't slide fore and aft. Access to the rear seats in other Skymasters requires an awkward scramble over the center row.

The Skymaster's visibility is excellent—about as good as it gets in any light airplane, single or twin. The view down is unlimited, of course, and the wing's leading edge is back far enough that it doesn't block upward vision, either, as with most Cessna singles. Good visibility is not only a safety feature; it adds to the feeling of roominess in the cockpit.

The Skymaster is also quite noisy, since the passengers are sandwiched between the engines. Also, sympathetic vibration can be a problem, particularly without prop synchronizers. Conventional twins are quieter by far.

MAINTENANCE, MODS

The Skymaster was the most complex aircraft ever engineered and manufactured by Cessna's Pawnee Division, which otherwise built only Cessna singles. Evidence suggests the division simply wasn't up to the task, particularly in the 1975-1980 period when production was growing rapidly and Cessna was plagued by an epidemic of design, engineering and production problems.

For example, the pressurized Skymaster was initially such a disaster that the first year's production was recalled to the factory for complete remanufacture and modification. Distinct from other twins, Cessna had to pack everything into the fuselage, not having the luxury of sticking systems out in the wings or into the nose. As a result, access is difficult and it is those systems where most maintenance problems will be found.

The basic airframe is stout, with a rugged strut-braced wing. There are remarkably few ADs on the airplane. And remember that the military version of the Skymaster did plenty of rough duty in Vietnam, often flying home with bullet holes or worse.

Still, a potential Skymaster nightmare is runaway maintenance costs, particularly in the turbo and pressurized models, so the prudent purchaser will closely examine logbooks and service records of any aircraft under consideration.

The Riley Rocket was a popular Skymaster mod and included upgrades to 310-HP TSIO-520 engines, intercoolers, three-blade props and air conditioning. Rockets come on the market now and again, at a premium price over stock models.

Ohio-based Aircraft Sales' Pristine Airplanes modification (www.pristineairplanes.com) offers the Rocket II full refurb for the Skymaster, while adding intercoolers to P337 models, plus new avionics, paint and interior on all models. Including the aircraft, a fully refurbed Rocket II could top $600,000, but like all of the other refurbished aircraft the company pumps out the end result is a like-new aircraft, following almost six months of intense rework.

Other 337 mods include vortex generators from Micro Aerodynamics (www.microaero.com) and intercoolers from American Aviation (www.americanaviationinc.com). Both Horton (www.hortonstackdoor.com/stolcraft_description.htm) and Sierra Industries (www.sijet.com) apparently still offer STOL kits and other aerodynamic mods. A wing spoiler kit is available from PowerPac Spoilers (www.powerpacspoilers.com).

Aviation Enterprises (www.cessnaskymaster.com) offers a wide range of major modifications for Skymasters, ranging from air conditioning, airstair doors, extended wingtips, IO-550 engine conversions—for one or both engines—long-range fuel and MT propellers. The company also can provide various parts, including cargo pods. Similarly, RT Aerospace (www.rtaerospace.com) offers several items of interest to the Skymaster owner, including a convertible rear seat for the baggage area.

CESSNA 337 MISHAPS: PILOTS

Our review of the 100 most recent accidents involving airplanes in the Cessna 337 series produced results that were good, bad and, frankly, just plain strange.

We'll start with the good news: There were only two runway loss of control (LOC) accidents involving 337s—a very low rate and, in our opinion, powerful evidence of good ground-handling characteristics of the marque.

On the bad news side, we were surprised by the number of fuel-related accidents—15. That is nearly twice the rate we've observed for the tip-tank Cessna twins—300- and 400-series—which have a reputation for being endowed with a complex fuel system.

The fuel-related accidents were split almost evenly between pilots who mismanaged the fuel aboard—running a tank or tanks dry and not causing fuel to flow from a tank containing it to the engine(s)—and simply not putting enough fuel in the airplane for the intended flight. However, where things started to turn strange to us was that so many pilots simply didn't bother to check to see if they had any fuel in the airplane at all (or were too cheap to buy any) and had the engines quit right after takeoff. One put fuel in only one wing and others only in the aux tanks and then selected the nearly empty tanks.

In proving that the late gonzo journalist Hunter Thompson was right when he said, "When the going gets weird, the weird turn pro," one pilot decided to ferry his 337 for maintenance after the interior had been stripped out—including the fuel selector handles. You got it, he ran tanks dry and couldn't turn the valves to change tanks.

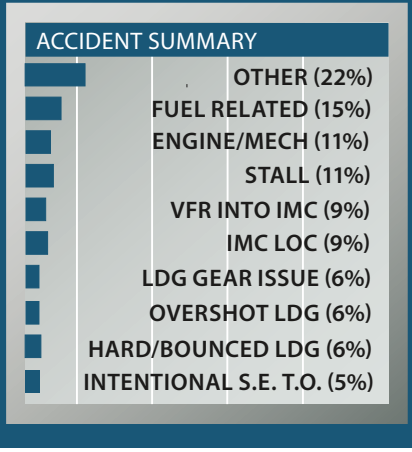
We've flown Skymasters off and on for nearly 40 years, have done single-engine work and observed that they go straight ahead following an engine stoppage and will hold altitude and usually climb if the POH procedures for engine failure are followed. That was confirmed by a pilot who was scud running beneath an overcast, in flat light off the coast of Alaska on a winter day. He hit a pressure ridge in the ice, wrapping the front prop around the cowling and stopping its rotation. He was able to continue to his destination.

Six pilots lost an engine after takeoff and did nothing to clean up the airplane. Not surprisingly, they were unable to climb. Nearly all of them then stalled the airplane and lost control. A pilot who lost an engine in cruise and landed in a field after not feathering the prop was unable to describe the engine failure procedure for the airplane.

At least five pilots unsuccessfully tried a single-engine takeoff—some after arguing with other pilots who tried to talk them out of it and one with passengers. One of the airplanes had not had an annual in 10 years.

There were five fatal accidents and one non-fatal in which the pilots had incapacitated themselves with drugs or alcohol.

The rate of what we consider stupid pilot tricks was so high in the 337 we can't help but wonder about why an airplane designed to be safe may attract more than its fair share of pilots who don't seem to give a fig about safe operations. On that note we'll close with the 337 pilot who was practicing his IFR skills at night, without a safety pilot, and flew into the side of a mountain.



Cessnas seem generally blessed with good owner organizations, perhaps because the company abandoned the piston market in 1986 and stayed out of it until 1997. The clubs and groups have proven to be as good as it gets when it comes to support.

Every Cessna owner should join the Cessna Pilots Association (www.cessna.org). The organization offers the usual benefits, including an insurance program, monthly newsletter and fly-ins, and has a wealth of Skymaster-specific information. We found a useful if unofficial Skymaster website for the Cessna Skymaster—SOAP, for the Skymaster Owners And Pilots (www.337skymaster.com).

OWNER FEEDBACK

I'm the owner of my second Cessna 337, a 1977 normally aspirated 337G Skymaster II. The 1976 and newer models incorporate all the design upgrades done throughout the 337 model run, and a particularly nice upgrade, the 150-gallon long-rang tanks. This is an on/off cross-feed fuel system, which means there are no tanks to switch, just front and rear. Four metal tanks in each wing utilize the wing dihedral sloped to drain 100 percent to the inboard wing root tank, with only 1.2 gallons of unusable fuel on each side. There's also heavy-duty landing gear, larger wheels and heavy-duty double-puck Clevelands with semi-metallic brake pads, another real nice option that came standard on 1977 Skymaster II models.

I prefer the "aspros," normally aspirated Continental IO-360 G engines, which will go to TBO and beyond, but their weakness (being a lightweight Continental engine design) is they don't tolerate the heat distress of turbocharging, and particularly the always-on heat distress of turbocharging plus bleed-air pressurization. My engines have 1800 hours (Continental remans) and burn one quart of oil every five hours. Plan on roughly $60,000 for factory reman engines and props, and more for turbocharging.

Indeed, Skymasters swallow 100LL at a pretty good rate. Between 6000 and 8000 feet and engine settings of 2400 RPM and 24 inches of MP, plan on about 22

GPH. As I jokingly tell my friends, my Skymaster will do anything on 150 gallons of fuel that your 182 Skylane can do on 80 gallons, but will get me home if an engine crumps. The fuel burn isn't a concern to me. With today's typical fuel prices, plan on $80 to $120 per-hour fuel costs. Range is a comfortable five to seven hours—farther than many can tolerate in the cabin.

As for maintenance, as an owner/mechanic I can say plan on a lot. As a rule of thumb, budget as much as you would for a last-minute first-class airline ticket for everywhere you go in a 337. I hate to say what's been said plenty of times: There are more buyers who can afford the 337's purchase price that can actually afford to properly maintain it. If a purchaser is financially well-off enough to simply toss the keys to one of the several well-known and well-respected 337 specialty shops to manage and perform routine maintenance, so much the better. Costs would not be a seen as show-stopper to keep such a unique and nice flying airplane in service.

Never forget that you are flying a 45-year-old legacy aircraft, which is the most complicated one ever built at Cessna's Pawnee factory, and that includes the landing gear system. If you are not already a Cessna-knowledgeable A&P yourself, as I am, I would strongly suggest becoming one. Cessna factory technical and parts support is in general really excellent. Certain parts of course are no longer produced, but they're available from vendors on the secondary and salvage markets.

The Cessna OEM fuel gages are functionally useless for planning maximum range, except for timed constant-power cross-country flying when starting with full tanks. Fortunately, Cessna's fuel flow gauges are pretty accurate, and are helpful in that regard.

I suggest sourcing Cessna factory parts, service, wiring and maintenance manuals for the 337, in addition to the Continental engine manuals. I really feel this airplane can't be owner-flown and maintained without them.

I have personal experience with Ron Lillie of Little Enterprises. He's a longtime multiple 337 owner and pilot himself and the proprietor of a 337 specialty maintenance, service and sales organization in Salt Lake City, Utah, from whom I purchased my current 337G. Without hesitation I can recommend Lillie Enterprises as a highly knowledgeable, honest and ethical organization to do business with.

In my first 337B, I lost an engine while preoccupied by Houston Approach at a peak traffic time after a 30-minute flight from Austin, Texas, and forgetting to switch tanks after taking off and flying low and slow in a steep bank taking aerial photos of a construction site. Actually, it was such a non-event, I wasn't immediately sure what had happened, but like in all light twins when something such as this happens, say your ahh shucks, and then try to figure out if the second engine is about to pack for the same reason as the first one. If so, you might have 10 seconds to do exactly the right thing. Head up and locked, true enough, but it might be a very different outcome in a conventional twin.

Inflight visibility outside the cockpit is as good as it gets. Like in a 500-series Aero Commander, you sit ahead of the wing's leading edge. The only better flight visibility might be in a military O-2 model 337 with a full bubble side and overhead windows—the flight visibility is truly amazing. There's also hardly ever the need to stand on a rudder during most conditions.

Cessna 337s generally handle with the familiar control forces of a heavy Cessna—think 210/206, except with lighter elevator forces, large long-span fowler flaps and with elevator trim tab and flaps interlocked to minimize attitude changes in landing configuration. There's plenty enough rudder authority for wing-low slips for altitude control during approach. And it's easy to land on the mains with the elevator authority to maintain a nose-high touchdown and rollout.

As for mods, gear door mods eliminate much of the complexity and maintenance burden of a seemingly endless number of squat switch adjustments and potential malfunctions causing mostly false positive indications of gear not down and locked. Seemingly the whole belly of the plane opens up at gear extension

The Aviation Consumer

Cessna Skymaster

(continued from page 31)

and retraction, so the gear door mod appears to be a pretty worthwhile, well-thought-out one.

When the gear doors open, they look like speedbrakes. They create a flat-plate area on the both the airplane nose and rear door pairs large enough to swallow up several beach balls, so it's easy to understand why the landing gear system creates so much drag that the 337 won't climb at gross weight after an engine failure during the takeoff roll and while the gear is in transit.

Robertson and Horton STOL kits, as well as VGs, are available. Leading-edge cuff and stall fences aren't too expensive to have installed and are generally agreed to aid low-speed controllability at the bottom of the airspeed/stall envelope, with no significant effect on cruise speed. The 337 comes over the fence a wee bit hot, so when flying heavy, any improvement to the low, slow and touchdown flight envelope would seem worthwhile.

As for insurance, driven by all the standard underwriting guidelines, hull valuation is a big factor. The same goes for pilot experience/time-in-type.

Pricing is all over the map and some new owners might find that getting insurance for a Skymaster might be cost prohibitive. Some might not even qualify without lots of additional training—not necessarily a bad thing.

Terry Allen
via email

One of the most worthwhile mods for a Skymaster might be landing gear doors, shown in the photo below.

I am on my second Skymaster; the first I had about five years and this current one well over 10. The present one is a 1967 T337B. The biggest positive features of the Skymaster are, one, that it can carry just about anything I can stuff in it, and two, is that it has two engines. I live on the far north coast of California and there are serious mountains in three directions.

I have limited experience in Cessna 182 models, but the flying qualities seem similar.

I normally cruise in the mid teens and see a total fuel flow of 18 GPH there with 160 knots true airspeed. Insurance has cost me an average $2152 per year based on a hull value of $55,000. Parts and labor have averaged $8644 per year, with a high year around $15,000 and a low year just over $2000.

I have been a member of the Cessna Pilots Association since I got the first Skymaster and have benefited greatly from the organization. I also have been lucky to have a local IA who has plenty of experience with Skymasters.

Steve Bowser
via email

FEEDBACK WANTED

CESSNA 310

It's time again to take a fresh look at the Cessna 310 market in an upcoming Used Aircraft Guide in *Aviation Consumer*. We want to know what it's like to own these twins, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your 310 to appear in the magazine, send us any photographs (**full-size, high-resolution please**) you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments that can be helpful for buyers considering one. Send correspondence by February 10, 2019, to:

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