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The Aviation Consumer

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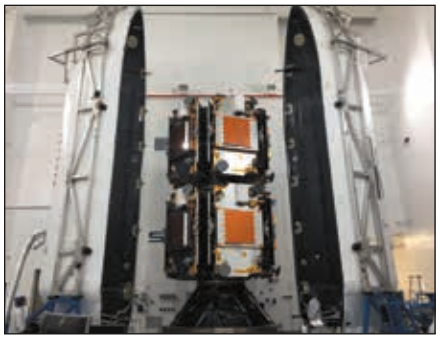
SPACEX LAUNCHES: A CRITICAL BOOST FOR IRIDIUM

The launch of SpaceX's updated Falcon 9 rocket in January was the first of seven missions that are critical for the future of Iridium's aging satellite communications network and its 800,000-plus customers. Recall that a fuel explosion led to the expensive loss of a Falcon 9 vehicle and its Amos-6 satellite payload on the Cape Canaveral, Florida, launch pad in September 2016. But the recent Iridium mission had a much better outcome and the company is banking on at least seven more successful launches as it moves forward with its $3 billion Iridium-NEXT global satellite constellation, which will replace the current 66 satellites.



If you are waiting for better cabin datacomm capabilities as I am, the Iridium/SpaceX effort is one to watch. As I've learned from various inflight evaluations of portable and permanently mounted datacomm hardware, the options suitable for smaller aircraft cabins have been mediocre, at best, while data and hardware costs might be out of reach for typical missions. Shouldn't we have better technology by now? A closer look at the current Iridium network reveals why we don't. While it's the only mobile satellite communications company offering full global voice and data service, Iridium's existing Block 1 circuit-based infrastructure of low-earth orbit satellites was deployed in 1998 (and designed nearly a decade earlier) using technology originally intended to support paging and voice calls. During the Block 1 inception, IP-based (internet protocol) technology hadn't really evolved and users certainly weren't hooked on data-gobbling smartphones. But Iridium's IP-based NEXT infrastructure will consist of 66 operational satellites and 15 in-orbit and ground spares designed for the expected one million global subscribers who will demand faster data speeds.

Iridium's Brian Pemberton told me the data-centric Iridium-NEXT infrastructure has the flexibility to adapt to current and future datacomm devices at more attractive pricing. Specifically, this will require a boost in network performance that's notably lacking in the current system. From a hardware standpoint, this means a cheaper antenna with higher gain that's more suitable for smaller aircraft—something that Honeywell has achieved with its Inmarsat-based AeroWave cabin voice and internet system. But subscribers need better data speeds and cheaper costs. Pemberton described sizable performance gains—from roughly 2.4 Kbps to nearly 200 Kbps—once the Iridium-NEXT system is fully deployed. This might not be fast enough for nav database downloads, but could offer performance that's acceptable for reliable web browsing, texting and emailing larger files. Iridium is planning specific services for customers who want to use smartphones and tablet computers in small aircraft cabins, in addition to facilitating new interfaces that can run on panel MFDs. If you're thinking browser capability on the instrument panel, you're right. Why not? It exists to some degree in the automotive world.

I asked Garmin what functions it might offer for the Iridium-NEXT network but it told me it wasn't in a place to discuss it yet. The company already sells Iridium-based cabin datacomm hardware. The existing $10,000 Garmin GSR56 is a 2.4 Kbps transceiver with position tracking, two-way talk and SMS texting capability and it works with the GTN, G1000 and Flight Stream wireless network. I've used it for texting in a G1000 Perspective-equipped Cirrus where it worked reasonably well. Garmin also recently acquired DeLorme and the company's Iridium-based inReach/Explorer series portable satellite communicators. I'm currently evaluating the new Garmin inReach SE+ and will have a full report in an upcoming issue of *Aviation Consumer.*

As for SpaceX, its Falcon 9 vehicle is customized to accommodate 10 Iridium satellites per launch. The next launch with an Iridium payload is planned for this coming April, with the rest following in 60-day intervals. —*Larry Anglisano*

MORE ON LANDING GEAR

I enjoyed reading the article on landing gear checks in the February 2017 issue of *Aviation Consumer.*

A critical (but simple) ground check you did not mention is when examining the through-bolts holding the nosewheel scissors to the airplane, put a wrench on the bolt head and turn it. If the bolt is straight then the scissors will not move, but if it's bent you will see the scissors move up and down as the bolt rotates.

According to my IA, if you catch this early it's pretty easy for a tech to remove and replace the bolt, but if it's too far bent, as he saw on a Cessna 182 he'd recently worked on, he has to remove the nosegear assembly and get the bolt out using a press. I was lucky because he was able to replace the bolt on my Cardinal RG without having to take anything apart.

Thanks to Keith Peterson of the Cardinal Flyers Organization for teaching me this simple and money-saving examination.

Mark Klebanoff
Worthington, Ohio

You guys offered a great service with your recent landing gear inspection and upkeep article. Unfortunately, I wasn't specific enough when I was doing a prepurchase inspection on my Cessna 210.

While I was lucky enough to not experience a landing gear failure, a closer inspection would have saved me thousands of dollars in repairs during the first 50 hours of ownership. I ended up replacing numerous major components, including the power pack and critical parts associated with the downlock system. Moral of the story: Use a mechanic who knows the system inside out.

Ray Morsani
Greenville, South Carolina

PORTABLE OXYGEN REVIEW

I loved the review of the various portable oxygen systems in the January 2017 issue of *Aviation Consumer* and I'm preparing to assemble a kit. I have two questions: Can a cannula from one vendor be used with a regulator from another? Are the parts interchangeable between brands?

Second, are the portable oxygen concentrators feasible for use in our aircraft instead of bottled oxygen, say at altitudes up to 16,000 feet? Keep up your good work.

Don Norris
via email

To our knowledge, you can use a cannula from one vendor with a regulator from another. The positive crosscheck on any installation is monitoring your blood oxygenation level with a high-quality pulse oximeter.

We have not done any testing of portable oxygen concentrators in aircraft. Several years ago we looked at one that was designed for aircraft, but we declined to put it in an airplane and test it due to some technical issues the mechanic who was going to do the installation pointed out to us. Most portable units require a 110-volt power supply and you'll need to consider the amperage draw before installing it. If anyone has experience in this area, we want to know about it.

ELECTRONIC CHART UPDATES

Does Garmin explain why it only provides the FliteCharts update two days before activation? This is often quite inconvenient. Other vendors of chart information (including ForeFlight) are able to provide updates a week in advance of the update's activation.

David Schmitt
via email

Garmin explains: Garmin provides FliteChart data as soon as we can guarantee it will be available, which is about two days prior to its effective date. The FAA provides Garmin the chart data several days prior to the new charts becoming effective. From there, our cartographers verify and check the data and assemble it for dissemination across multiple avionics platforms and portable devices—a process that takes multiple days. Luckily, all other databases available on flyGarmin.com are available seven days before they are effective, including the navigation database, which makes the navigator legal for IFR flight.

TALKING CHECKLISTS

I recently read the article you ran in the August 2016 *Aviation Consumer* on aircraft checklist apps. You draw sensible conclusions about the value of voice operation.

You might find that the VoxChecklist app (www.voxchecklist.com) comes close to what you are looking for. There is a free trial available, but at the present time it is only compatible with Android devices.

It did occur to me that once airborne, shouldn't the pilot have committed all inflight procedures to memory and rehearsed them until they are second nature?

Phillip Standing
via email

Using memorization may work for some, but we think it's asking for trouble in more complex aircraft.

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AIRCRAFT TECHNOLOGY

Daher's TBM 930: Max Upset Protection

Daher is determined to reduce loss-of-control accidents and the new G3000/GFC 700 combination is the most aggressive ESP yet.

by Paul Bertorelli

However skilled (or not) general aviation pilots are, they have proven consistently good at one thing: losing control of airplanes and digging smoking craters in the verdant earth. The reasons aren't necessarily understood but the solution is becoming increasingly laser focused on providing autopilots that won't let you crash, but will nudge and prod and do everything short of seizing control of the aircraft. Except now, they're even doing that.

The latest comes from Daher in the company's new TBM 930 cabin-class speed merchant. The TBM 930 is essentially the same airplane as the 900, but it has Garmin's new G3000 EFIS/GFC 700 autopilot suite in place of the G1000 previously offered.

So-called envelope protection—the capability of the autopilot to sense and correct an upset or impending excursion outside the airplane's performance envelope—has been a work in progress since it first appeared in 2008 in the Cirrus Perspective system, a branded G1000 variant for Cirrus. The latest envelope protection systems don't require the pilot to push a LVL button, but instead passively monitor the flight from wheels up to wheels down, intervening aggressively if the pilot is about to screw up.

So pervasive is this technology becoming that some light sport aircraft have it, too, trickled down by Garmin into the G3X Touch. And where it trickled down from, conceptually at least, was the G1000 and GFC 700 autopilot. The G3000 in the 930 raises autopilot nannyism to a new level of sophistication and even higher than that used in the Piper M600 we covered in the September 2016 issue.

DAHER'S THINKING

High-performance single-engine turboprops seem to sort into three market segments: working airplanes, personal transport and for-hire people transportation. Cessna's Caravan locks down the cargo and working airplane side while the Pilatus PC-12 is a popular corporate and charter/cargo hauler. The TBM—the fastest of the herd by far—is a favorite among owners who fly themselves to distant destinations, usually without benefit of a professional pilot. We've noticed that the airplane has a bit of a cult following and a community of owners who know each other. Piper's Meridian and now M600 compete in the owner-flown segment, but Daher believes the TBM exists in its own strata.

Daher has stoked owner loyalty through a succession of models beginning with the TBM 700 in 1991, the 850 in 2006, the 900 in 2014 and now the 930. The 850 got a 150-HP boost over the 700 with the Pratt & Whitney PT6A-66D and when the

What makes a 930 a 930 is the Garmin G3000 suite, left. It features larger screens and touchscreen controllers above the center pedestal, inset. The GFC 700 autopilot and smart servos execute ESP features.

900 followed, it retained that engine. But with aerodynamic cleanups, Daher (then marketing as Socata) squeezed more speed out of the airframe. With engine changes and redesigns, the TBM line has become ever faster and higher flying. The 700 series cruised at 280 knots and the 850 upped that to 315 knots. When the 850 was reworked into the 900, the cruise speed bumped up a bit more to as much as 330 knots.

The TBM is fast enough that Daher views its competition as light owner-flown jets such as the Cessna Mustang and not other turboprops. The TBM enjoys the advantage of being able to operate into and out of shorter, less improved fields than typical light jets need and Daher says this seals a lot of sales for the company.

But with this performance comes a penalty and it's not just money. Because of its speed and power, the TBM has proven to be a handful for pilots who are not necessarily stepping down from jets or twins, but up from high-performance piston singles. They thus find themselves flying in the high flight levels at speeds 100 knots or greater than what they may be accustomed to. As a result, as described in the sidebar, the TBM has had its share of accidents, many of which are attributed to loss of control biased toward the low-speed end of the envelope.

Heretofore, this has been addressed with specific training, both from the factory and under insurance company mandates. It's not uncommon for underwriters to require new owners to fly with a TBM-qualified copilot for a certain number of hours. But as other manufacturers have discovered, especially Cirrus, training goes only so far in reducing loss-of-control accidents.

NEW AVIONICS

Airframe wise, the TBM 930 variant is identical to the 900 save for the new Garmin G3000 EFIS suite and an upgraded interior. The G3000 was first announced—wait for it—almost eight years ago. But it is only now beginning to gain traction in the turboprop and jet market, with installations in the Embraer Phenom 100, the emerging Denali turboprop from Cessna, the Piper M600 and Eclipse E550. We covered the G3000 in the September 2016 issue of *Aviation Consumer* as part of our Piper M600 coverage.

Daher's execution of the G3000 differs by degree from Piper's, especially in how the envelope protection is applied, according to Daher's Nic Chabbert. Daher views the G3000's envelope protection—which is formally called Electronic Stability and Protection—as having three parts: the basic ESP itself and two active subroutines, one to guard against under speed (USP) and a second emergency descent capability (EDM) to bail a pilot out of a hypoxic, non-responsive event. While these are separate capabilities, they have some overlap so it makes as much sense to think of ESP as an umbrella system. Further, it has some visual alerting on the displays that tie directly into what ESP is doing.

Chabbert demonstrated the system for me on a flight from Daher's new U.S. facility in Pompano Beach, Florida. Unless the ESP has been purposefully deactivated, its default setting is always on. In normal flight, it may be most noticeable through roll alerting. While being hand flown, if the airplane is held in a 60-degree or greater bank, the autopilot servos will exert ever more counter-control force as the bank is increased. Ten seconds into the struggle, the ESP will turn on the autopilot and right the airplane.

From the pilot's seat, the push back ramps up smoothly and presents as increasingly stiff control forces that are difficult to defeat. Once back inside the bank parameters, the servos return to neutral.

The ESP's pitch parameters are similarly configured. If the pilot manually forces 22 degrees or greater pitch up or 17 degrees down, the servos will come alive and push back, activating the autopilot if the pilot doesn't get the message.

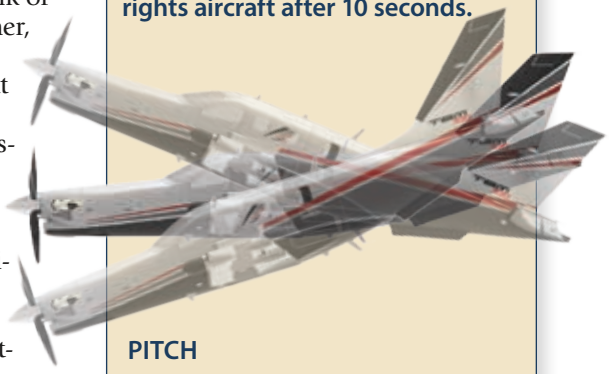
The system also has an always-active feature called USP or under speed protection. USP is configuration sensitive and works around the stall speeds for various aircraft configurations. It represents a layered approach to stall protection and under speed warning. As the airplane slows, the pilot first hears an aural warning: AIRSPEED, AIRSPEED. If the speed continues to decay, an aural stall warning (STALL, STALL) is heard followed by a vigorous stick shaker. Although it felt like a stick pusher to me, Chabbert says it's a shaker only. You'd have to be asleep or drugged to miss it. The G3000 also has two visual aids for low-speed control and recovery. One is a constantly visible angle-of-attack indicator in an analog format, with a red line for the stall AoA. It's located right under the G3000's airspeed tape. This indicator is one of the best I've seen and

ESP AT A GLANCE

BANK

60° Always-on ESP activates when bank angle exceeds this value.

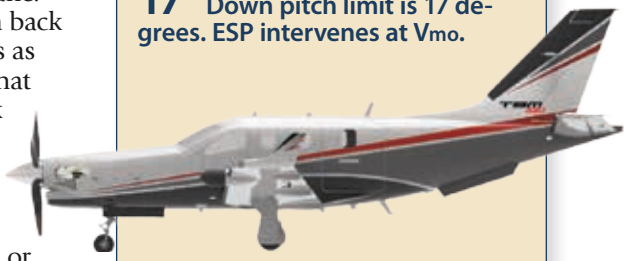
10 SEC If pilot forces beyond bank limit, autopilot engages and rights aircraft after 10 seconds.



PITCH

22° Irrespective of speed, servos push back when up pitch reaches 22. System issues warnings.

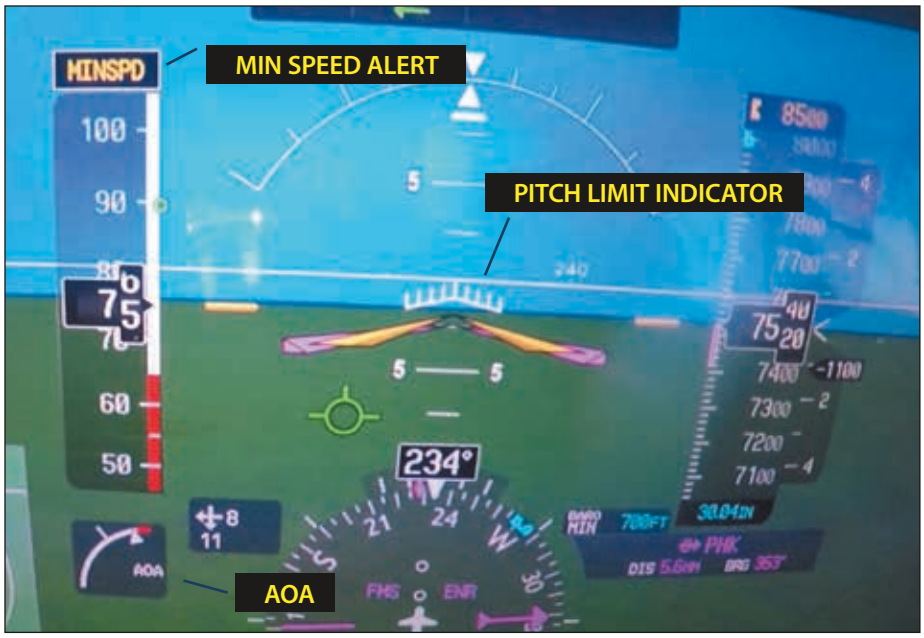
17° Down pitch limit is 17 degrees. ESP intervenes at V_{mo}.



STALL PROTECTION

95 KTS ESP and autopilot intervene to maintain 95 knots in clean configuration.

75 KTS System will maintain 75-knot minimum in landing configuration to avoid an approach stall.



You'd have to be asleep or dead to miss the ESP's speed and stall warnings, left. The AoA is constantly in view and the pitch limit indicator warns of an abnormal pitch event.

is easier to interpret than tape- or chevron-type indications.

It also has what Daher calls a pitch limit indicator. It looks like a small bent fence or pitchfork that floats in the attitude indicator area of the PFD. It's there to notify the pilot that he's flirting with edge-of-the-envelope pitch and needs to correct immediately. If the pilot persists in an attempt to stall the airplane, the USP will activate the autopilot and assume control of the aircraft. It will then fly the airplane at 75 knots if it's in the landing configuration or 95 knots if it's clean. Since the 930 doesn't have autothrottles, the system has no ability to add power and will hold the target speed until ground impact. Presumably, the pilot would get back into the loop and resume control.

OTHER PROTECTIONS

At the opposite end of the speed spectrum, the TBM system keeps the airplane from exceeding Vmo (266 knots indicated), again with aural warnings and by autopilot intervention if the pilot isn't shaping up. This relates to another protection built into the TBM 930's system: hypoxia alerting and intervention. Daher is sensitive to this because of a high-profile accident in which a TBM 900 was lost in what is believed to be a hypoxia-induced incapacitation, possibly due to loss of cabin pressure. (See the sidebar for details.)

The TBM 930 has a new, upgraded interior and sports a large cabin-entry door, top, and an optional pilot-entry door, left.

At its ceiling of FL310, the TBM can maintain a sub-10,000 foot cabin. If the system senses the cabin is above that, it issues a chimed and visual CABIN ALT alert. It will also issue an aural USE OXYGEN MASK message.

If the pilot doesn't respond, the emergency descent module kicks in three seconds later and executes a 90-degree left turn and begins a maximum-rate descent to 15,000 feet and breathable air.

The point of the turn, Chabbert said, is to alert air traffic control to a potential problem, but also to clear the airplane from a potentially congested airway. Of course, depending on the airspace, that turn could also confront a controller with IFR separation challenges, but ATC would be unlikely to miss the deviation.

Chabbert said the autopilot will descend at the 266-knot indicated Vmo, but no faster. Depending on the power setting, this will yield descent rates of 6000 to 9000 feet a minute, putting the airplane back into a breathable atmosphere in under four minutes. Once at that altitude, the airplane will level off while the pilot—one hopes—comes to his senses.

BUSY DISPLAY

I noticed when reviewing the video footage shot for this article that at times, the PFD display on the G3000 is busy, urgent and noisy. During routine flight, it's no different than any other PFD, although the displays are larger than those found in most GA aircraft. When the ESP is active, there are chimes, aural warnings, plus symbology the pilot will need to understand and deal with. Training facilities have already added this to their 930 programs. On the other hand, if it all proves overwhelming, not to worry; the airplane will

intervene and save itself or at least give the pilot time to regroup and get back ahead of the situation. This is important in an airplane that can easily climb at 2000 FPM and cruise at more than five miles a minute.

Anyone with stick time behind Garmin GTN series navigators should adapt readily to the G3000. The two touchscreen pads at the top of the pedestal come readily to hand and the basic design is similar to the GTN displays. However, they have deeper functionality tailored to the TBM 930's features and engine oversight.

But not all buyers are impressed with them. Daher's Michel Adam de Villiers said that about a quarter of TBM buyers have stuck with the G1000. The G1000—including the new NXi version soon to be available—can be fitted with the same envelope protection features offered with the G3000. "Some pilots are just more comfortable with the G1000 and they like to stick with it," de Villiers said.

In order to be effective as a safety system, Daher will need good penetration of ESP into the TBM fleet and traditionally, this has taken time as new airplanes are added to the population. As of late fall, Daher had 54 ESP-equipped airplanes in the fleet and with 850 and 900 models capable of receiving the G1000 upgrade, the company was expecting to have as many as 100 equipped aircraft in the field within a year. There are a little more than 800 TBMs flying worldwide and de Villiers says more than half of those aircraft can be upgraded at a cost of about $47,000. Considering the value of the airplanes, that's not an expensive upgrade.

Although the TBM has had its share of loss-of-control fatal accidents, the Glazer accident in 2014 clearly shook the company, given that Glazer was an experienced TBM pilot and head of the owner group at the time. He was flying the first 900 delivered.

"Loss of control is a problem across the board in general aviation," says Chabbert, "and the TBM is no stranger to them, unfortunately. This system is definitely going to save lives."

In my view, if that doesn't prove to be true, it won't be for lack of trying on Daher's part.

YouTube **See a video review of the TBM 930 at http://tinyurl.com/j95ht2a**

LOSS OF CONTROL OFTEN MEANS STALL SPIN

Our review of TBM accidents revealed that about 35 percent of them have proven fatal and of those, 10 appear to be what we consider classic loss-of-control accidents.

We found a total of 37 TBM accidents in the NTSB records, with 13 of them being fatal. However, these may be incomplete because not all accidents outside the U.S. are necessarily tracked by the agency.

We don't have reliable hours-flown data so it's not possible to compare accident rates among the turboprops or even against high-performance piston aircraft such as the Cirrus line.

To get a rough hack on accident incidence, we looked at accidents measured against total registered aircraft. With just more than 800 aircraft on the registry worldwide, we found 13 fatal accidents for a rate per 1000 registrations of 16.25. By comparison, the Pilatus PC-12 has 1400 airframes flying with 16 fatals that we could find. That calculates to 11.4/1000 registrations.

The Piper PA-46 Meridian line has about 470 airframes and 15 fatal accidents worldwide. Thirteen of those were in the U.S., although we couldn't find details on all of them in the NTSB records. That yields a rate of 32/1000 registrations, the highest of the three. A disclaimer: Because we don't have good hours exposure data, we're not claiming that this comparison is anything other than a rough comparable look at the data.

In this comparison, the TBM finishes in the middle of the pack and we suspect that it, and the Meridian's apparent higher rate, are due at least in part to being flown by owner-pilots rather than professional pilots. Additionally, the PC-12 is often used in Part 135 operations, where a higher standard of care exerts downward pressure on accident trends.

Looking over the TBM accident data, we were surprised to find that despite the model's blistering speed, its loss-of-control pattern is strongly biased toward the slow end of the envelope: stalls and spins. There were no high-speed break-ups or upsets of the sort you might expect from an airplane flying high and fast.

But one of the most spectacular accidents might have been due to high altitude. On September 5, 2014, owner Larry Glazer, then president of the TBM Owners Association, took off from Rochester, New York, for Naples, Florida. Enroute, he became unresponsive to ATC, eventually being intercepted by a pair of Air Force fighters. The aircraft continued southbound, finally crashing off Jamaica. The NTSB has not issued a final report yet, but hypoxia due to loss of cabin pressure is suspected.

That accident appears to be a one-off, but the more common fatal scenario is a stall on approach or in the pattern. We found seven of these in various phases of flight, including one on a go-around. Could these have been prevented by Daher's new ESP system?

Nothing is certain, but we're hard pressed to see why ESP stall protection wouldn't have saved these aircraft, by either warning the pilots or assuming direct control of the airplane until the pilot could recover to normal flight. And that is, after all, the point of this technology.

Photo: Bureau of Aircraft Accidents Archives

AIRCRAFT OWNERSHIP

Antiques and Classics: Owning and Operating

Always wanted to own an antique, classic or warbird? It may not be as expensive or difficult as you have thought. Here are things to consider when buying.

by Rick Durden

Admit it. Despite your protestations to the contrary, you've lusted in your heart for an old airplane. It may be a classic such as a postwar Piper J-3 Cub—we'll use EAA's "classic" definition of aircraft built from September 1, 1945, through the end of 1955—an antique such as a Beech 18 or one of the many Wacos, or—yes, you know you want it—a warbird.

Believe it or not, ownership of a classic, antique or warbird (CAW) isn't as esoteric or unreachable as you may think. While keeping a warbird powered by a twin-row radial or one of the hot-water 12s—an Allison or Merlin—fed and watered requires having and being willing to spend cubic money, Aeronca, Piper and Stinson built honest to goodness warbirds in World War II. Chances are, if you can afford at least one part of a joint ownership of a Cessna 150 and you're willing to get your hands dirty caring for it and pay attention to the specialized needs of older airplanes, making your dream come true may not be as difficult as you'd imagined.

We'll talk about the general things to consider before you get into ownership of classics, antiques and warbirds and then take a more specific look at some examples. Because of space, we'll limit our warbird discussion to the smaller ones for now.

NO DAMAGE HISTORY? HA!

The very first thing to stick in your mental computer before you look at buying a CAW machine is that any seller's claim that the airplane has no damage history (NDH) is an outright lie or, to be politically correct, alternative fact. Here's why: First, the airplanes are old—so the risk factor of some sort of scrape is near unity. Second, most are tailwheel airplanes and they start out with a risk of a runway loss of control event three times that of nosewheel airplanes.

Things may start to get interesting about now. The Beech 18 is one of the sweetest flying airplanes ever built; however, when the wheels are touching the ground, they have ways of keeping their pilots humble.

Third, most of these airplanes, including warbirds, were flown by very low-time pilots at one time or another, and low-time pilots tear up airplanes.

Go into any purchase knowing in your head and heart that the airplane *has* been damaged at some time. Your job is to determine whether the repairs were done correctly and the airplane is in good shape.

Education is paramount. Virtually all of the older airplanes that were made in any quantity now have type clubs. Before buying something in the CAW categories, join the appropriate type club and get every bit of information on the airplane possible.

One of the dirty secrets about owning specialized older airplanes is that there are plenty of people out there who are willing—no, are eager—to take money from those new to the old airplane world. As Stan Musick, owner of several—not all at once—warbirds, antiques and classics and former chief check airman for fighters for the CAF told us: "Don't be a tuna. The tuna is the fresh meat that feeds all the other

fish in the sea." His rule of thumb: "Be very careful about taking advice from a seller." We agree and recommend that you never use a mechanic who is suggested by the seller for a prebuy.

When you are looking at an airplane, the issue will be how far it is in money and time from the end condition you want for the reason you are buying it. It is almost invariably cheaper to buy an airplane in the condition you want it to be in than to buy a cheaper one that needs work and do the work (or have it done) to get it up to the condition you desire. Plus, you will *not* be able to recover the money you spent restoring/refurbishing the airplane when you sell it.

DETAILS

Pay attention to the brakes installed on the airplane. Expander tube and drum brakes are not necessarily bad, but they can heat up and fade when you need them most. They require TLC and parts may be hard to find or nonexistent.

Our observation is that most airplanes in the CAW world have been modified with more modern disk brakes; nevertheless, make certain you fully understand the system installed and its condition.

A healthy proportion of CAW airplanes have heel brakes. Depending on your point of view, they are either one-square-inch torture devices installed below the rudder pedals, cool and efficient brake controls or a smart idea to keep pilots from using the brakes during landing rollout. Heel brake operation is a learned art.

Take your time and learn the airplane's systems—before you buy if possible. Bluntly, the human factors design for virtually every one of the CAW airplanes stinks. Instruments appear to have been installed at random. Systems—especially fuel—often are not intuitive. Controls and switches are often poorly labeled and are frequently weirdly juxtaposed. For example, the carb heat and cabin heat knobs on a J-3 are identical, move identically and are only two inches apart. A Piper Apache's throttles, prop controls and mixture controls are identical in size and shape and located in a group of six.

The late Jeff Ethell, author of *The Illustrated Classic Warbirds Buyer's*

TAILWHEEL TRAUMA: AVOIDING IT

It looks so innocent.

The upper photo shows one of those not-really-so-innocent airplane ground steering devices. The lower shows what comes of not treating an airplane equipped with such a device appropriately.

The chances are that if you buy a classic, antique or warbird, your airplane will have a tailwheel. Unless you logged time as PIC in a tailwheel airplane prior to April 15, 1991, you'll need a tailwheel endorsement before you can fly your airplane as PIC.

That's a good thing, because installing the wheel that steers the airplane on the ground in a position aft of the center of gravity of the airplane makes the airplane much more difficult to control on the ground than when the steering wheel is forward of the center of gravity. That's because once the airplane starts to turn, even a little bit, it will keep turning at an increasing rate until something is done to stop the turn. That fact has to be ingrained into the pilot's unconsciousness. Along with it should be the fact that tailwheel airplanes have three times the rate of runway loss of control accidents of nosewheel airplanes.

The good news is that most classics, antiques and warbirds equipped with tailwheels have flight controls that are effective enough to allow a competent tailwheel pilot to control the airplane on takeoff and landing even in some very ugly crosswinds.

There are , however, antiques that were designed for the days when aerodromes were wide open fields and the airplanes landed and took off into the wind. Those airplanes may not have flight controls that are adequate to handle a crosswind of more than a gentle breeze. It wasn't until the early 1930s that aeronautical engineers sorted out stability and control—and it took a few years after that for the knowledge to trickle down to the smaller manufacturers. Be cautious of older airplanes.

We recommend that if you are going to buy a tailwheel airplane that you spend the money to get a checkout in the type from an experienced instructor. Also, have a knowledgeable mechanic make certain the landing gear is properly aligned—that's very important.

Our thumbnail set of guidelines for tailwheel flying is as follows:

- You must start *and stop* each turn on the ground.
- Be fully alert and focused *anytime* the airplane is on the ground.
- Make a decision as to where you want the airplane to go at all times.
- Be willing to put the controls to the stops.
- When in doubt on landing, make it full stall/three-point.
- Do not fly faster than the recommended approach speed.
- Land as nearly into the wind as possible.
- If you don't like the landing, go around. Go around early and often.

Before you fly tailwheel, we recommend reading the articles on tailwheel ops in our sister publication *www.avweb.com* (it's free) and the books *The Compleat Taildragger Pilot* and Vol 1 of *The Thinking Pilot's Flight Manual*. Full disclosure, I wrote that one.

Editor Rick Durden props a J-3 Cub on skis, something that must be done with respect for the destructive power of the prop, top. Paul Berge on a grass field with his Champ and a friend; it doesn't get any better, middle. The Boeing Stearman Kaydet boasts an incredibly strong airframe but narrow gear, bottom.

Guide, considered by many to be the definitive book on warbird ownership, was killed in a P-38 due, in our opinion, to the complex and unusual fuel system in that specific airplane.

Systems matter—the Aeronca Chief can have an extra fuel tank that requires appropriate positioning of valves to avoid dumping its fuel on the ramp; the Beech 17 Staggerwing, as with many of its peers, has a multitude of tanks and a gauging system that requires the pilot to not only select the tank from which fuel is being burned but also the one whose quantity is being viewed.

In many CAW airplanes, visibility from the pilot's position stinks. For those tandem airplanes soloed from the rear seat, visibility forward on landing may be nonexistent.

That requires training, alertness and the ability to use peripheral vision on landing to keep the airplane straight.

It also can require slipping down final to see ahead as one of our airshow pilot friends learned when landing a biplane that was soloed from the rear seat—a truck pulled out onto the runway when she was on short final and she didn't see it until it removed the left wings from the airplane shortly after she touched down.

In the hit parade of ugly surprises after aircraft purchase, corrosion is right up at the top. Derrick DeRuiter, proprietor of Northwoods Aviation in Cadillac, Michigan, an owner and operator of a J-3 Cub for decades and regularly hired to do prebuys on antiques and classics, told us that he frequently sees engine corrosion on the small, opposed engines on Cubs, Champs, Luscombes and Cessna 140s. "Often the seller has only been flying the airplane 20-30 hours a year, so the cylinders and bottom end are corroding from lack of use. The buyer doesn't do a borescope inspection on the prebuy and starts flying his new toy like mad. Lots of metal shows up in the oil analysis—it's corrosion, and it may mean serious engine work."

Our recommendation: Buy an airplane that was flown regularly and be prepared to not only borescope the engine on the prebuy, but—on small Continentals—also pull a cylinder to look at the bottom end.

Paul Berge, aviation writer and owner of an Aeronca Champ for three decades and change, told us that fabric can be a deal-killer for CAW airplanes even though "Ceconite will last until the next atomic bomb is dropped." A prebuy should include a careful test of fabric condition. Derek DeRuiter told us that he regularly sees 25- to 30-year-old Ceconite in great condition on airplanes that have been hangared. Not so much for machines tied down outside. He recently priced a full recover and paint for a customer's Super Cub at a dedicated fabric and paint shop—$35,000.

Several of the owners we interviewed warned us about buying engines that are no longer supported or are now only found on a limited number of airplanes. We were told that it's getting tough to find parts for the smallest Continentals (crankshafts are especially in short supply) and that maintaining a Kinner radial engine can be a major exercise as every 10 hours the rocker caps have to be removed and rocker arms greased.

We were also warned that potential buyers should be wary of getting into a one-of-a-kind airplane. Many got that way for a reason—often exceptionally poor handling qualities. In addition, parts availability will probably be nonexistent so the owner will have to be able to make needed parts and know the FARs on owner-supplied parts intimately.

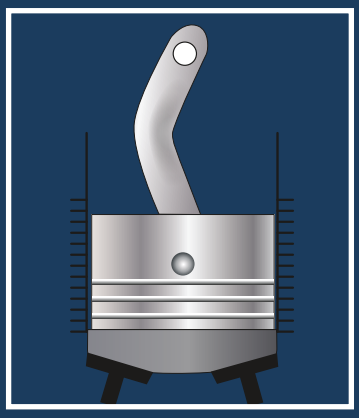
PREVENTING HYDRAULIC LOCK: SERIOUS RISK FOR RADIALS

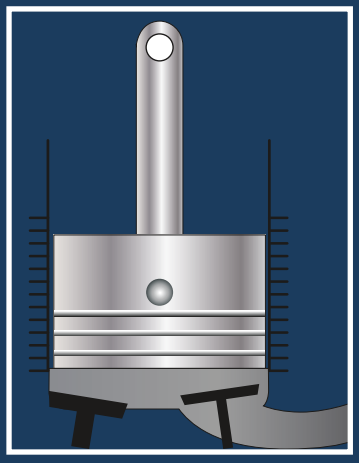
If you are considering owning and operating an airplane with a radial engine, it's essential that you understand hydraulic lock, how to detect it and how to fix it. To put it bluntly—dealing with it the wrong way *will* result in a bent connecting rod, expensive damage to the engine and probably catastrophic failure.

Paying attention now?

Hydraulic lock affects radial engines on both tailwheel and nosewheel airplanes because some of the cylinders point downward and the engines use a lot of oil for lubrication—gallons rather than quarts. After shutdown some of that oil often finds its way to the combustion chambers of the cylinders that are pointed downward.

Oil in a combustion chamber is a big deal. When the piston comes up (down when the cylinder is upside down) to top dead center (TDC) in the compression stroke—just before the spark plugs fire and the power stroke occurs—the space available in the combustion chamber reaches its smallest dimension and the valves are closed. If there is more liquid in that cylinder than there is space available when the piston gets to TDC there is a serious problem. Something has to give. That something is most likely going to be the connecting rod. The upper image at right shows the piston stopped by oil and the valves closed—the connecting rod has bent.





A hydraulic lock is simply too much liquid in the combustion chamber. It leads to a bent connecting rod. Once the connecting rod is bent the engine is going to fail. It may run for a few months or it may quit within minutes.

So, why do you see pilots pulling the propeller through on a radial engine before startup? Two potential reasons: The pilot knows precisely what he or she is doing and is s-l-o-w-l-y pulling the prop through to feel for any sudden rise in resistance that is not the normal buildup of compression. The other reason is that the pilot has seen folks do it and figures he might as well do it, too.

Pulling the prop through will cause damage to a connecting rod if there is a hydraulic lock because of the mechanical advantage available to the person handling the prop. The prop blade is a long lever. It allows amazing force to be applied within the cylinder. For example, on a Pratt & Whitney R-1340 radial (used on the North American T-6/SNJ/Harvard), not only will just 3/4 of a pint of oil create a hydraulic lock, but 50 pounds of force on the propeller, at the tip, will generate 900 pounds of force in the cylinder at 90 degrees before TDC. As the piston approaches TDC, the force generated increases exponentially. At just 10 degrees before TDC, the force is 11,000 pounds. In the last 10 degrees of travel, the force approaches infinity.

You can detect lock is by pulling the propeller through slowly and feeling for it. There is only one sure and certain way to get rid of hydraulic lock: Drain the bottom cylinders. Pull one spark plug out of each cylinder and pull the prop through several full rotations. Then, with the magnetos off, use the starter to turn the engine through several more rotations. Start the engine with those plugs out and run the engine to about 1200 RPM and then shut it down. Clean up the mess, put the spark plugs back in and go fly.

You absolutely *cannot* get rid of hydraulic lock by pulling the propeller through by hand.

You also cannot be certain of getting rid of hydraulic lock by pulling the prop through backward. If the prop is moved backward that cylinder will next experience an intake stroke. The intake valve opens. The oil will flow into the intake manifold—as shown by the lower image at left. You have just created a time bomb.

On startup, the oil that you drained into the intake manifold is going to go back into the combustion chamber. It is also going to go in with gasoline. That is a liquid. There is a very good chance that there will be sufficient quantity to create a hydraulic lock. You are engaged in the aviation game of chance: "Will it lock this time?" Some people are lucky and get away with pulling the prop backward several times. Some get a lock the first time they try the procedure.

Yes, there are one heck of a lot of people who subscribe to the pulling the propeller backward theory of getting rid of hydraulic lock. However, if you read the Wright engine technical manuals, most military engine technical manuals and even the manual the British put together for flying their version of the Flying Fortress, you will see that the procedure is prohibited.

Bottom line: If you detect a hydraulic lock on a radial engine the only certain way to cure it is to remove the lower cylinder spark plugs and let the oil drain out. Pulling the prop through forward will result in a bent connecting rod, expensive damage to the engine and probably a catastrophic failure. Pulling the prop backward is engaging in Russian roulette.

Now you know.

A freshly overhauled Franklin engine being hung on Chris Collum's Stinson 108 at Airworx Aviation in Brewton, Alabama.

While not around in large numbers, we nevertheless like the Franklin engine. It's found mostly on Stinsons. Stinson 108-3 owner Karl Vogelheim told us Franklins perform well if run properly and that they must be maintained by a mechanic who knows the engine. While the Franklin Type Certificate is owned by a Polish company, there are two sources for parts in the U.S.—http://franklinparts.com and www.franklinaerospace.us.

A healthy proportion of CAW airplanes don't have starters. That means the owner will be doing a lot of hand propping to fire up the machine.

In our opinion, hand propping requires training and extreme care. It also means coming up with a technique and equipment for safely starting the airplanes on the days when the pilot has to do it alone. Oh, and make certain the engine on the airplane you're buying has an impulse coupler. Trying to prop start one that doesn't can come so close to being impossible that you'll swear it is.

Owners and the insurance brokers we spoke with told us that they had no trouble getting insurance for their CAW airplanes. However, there were often checkout and experience requirements and it was hard to find coverage that didn't have $100,000 per-person sublimits. We have covered the shortcomings of sublimit policies at some length in *Aviation Consumer*. It means that no matter what the overall limit of your policy—even in the millions of dollars—there is only $100,000 available per person who is injured in an accident. We think that's peanuts and puts the assets of aircraft owners at risk. If at all possible, we recommend carrying a "smooth" policy—one with no sublimits—or consider not carrying passengers.

We'll wrap up with some brief comments on some of the most popular of the CAW airplanes.

CUB/CHAMP

We'll never resolve the battle as to which is more popular and we like both a lot, but we note that a Champ is often half the price of a Cub. On both of them watch for corrosion in the lower longerons and tail cluster. Some people leave the area around the tailwheel attach point uncovered to allow water to drain. The airplanes are often misrigged—use the manuals and measure things to get it right. Watch empty weights on both; rebuilders often slather on dope and add extras that kill useful load. Both are LSAs.

BOEING STEARMAN

Built in large quantities for the Army Air Force and Navy, the Boeing's (Lloyd Stearman had long ago sold his company to Boeing) airframe is tough as can be. As with most other WWII airframes, it was built to be worked on by kids just off the farm, so it's easy to maintain. Multiple Boeing Stearmans owner Bob Matthews told us to watch for corrosion on lower longerons.

The brakes are a weak point—we've seen too many of the airplanes badly damaged due to brakes either locking up or failing. Funky brakes combined with a high center of gravity and narrow landing gear can make for some wild rides on crosswind landings.

BEECH 18

The "double-breasted T-6" had an extended production run and its gross weight and useful load increased by nearly 50 percent, so check the paperwork on a prospect carefully. Owners who also owned Bonanzas told us that because the 18 is so easy to work on, the maintenance costs for the airplanes were nearly identical with $6000 to $8000 annuals.

Fuel cost is another matter. Lean of peak we've seen burns as low as 36 GPH, but figure on 48 GPH if ROP and seeing a cruise speed of 175 knots. It has classic Beechcraft handling in flight, but is one of the more difficult tailwheel airplanes to handle on rollout. While the nosewheel conversion makes the airplane more friendly on takeoff and landing, it is more difficult to taxi in crosswinds. A tailwheel 18 sits taller than a nosewheel version—hangar door height may dictate your purchase decision.

The Pratt & Whitney R-985 engines are considered bulletproof. Overhauls run in the $40,000 range. Owners and 18 restorers Lorraine and Ken Morris told us that the big maintenance items are a 1500-hour spar X-ray AD that runs as much as $5000 and a five-year inspection AD on two-bladed Hamilton Standard props—it costs $3000 if they pass.

With the ability to carry as much as 1300 pounds in the cabin with full fuel, owners told us they considered the Beech 18 the ultimate family airplane.

CONCLUSION

We'll go into ownership of the larger warbirds at a later date. In our opinion, if you're willing to get your hands dirty, do your homework on systems, care and operation and don't get hooked on something very rare, CAW ownership can provide a lot of enjoyment without breaking the bank.

Insurance For Seniors: Loyalty, Currency Matter

When insuring older pilots, underwriters favor active ones who are long-term customers. For now, the FAA's BasicMed may not be a factor.

by Jon Doolittle

CHECKLIST

- ⊕ Underwriters may not have a problem with age if you fly and train often.
- ⊕ Even better if you fly a more basic aircraft with lower liability limits.
- ~ Insurers may not agree that 70-plus is a good age to start flying jets.

When we last looked at insurance for older pilots, the insurance market was in the midst of a soft market cycle, or at least we thought it was. Almost four years later, there are even more insurers than there were then.

As the GA fleet in the U.S. continues to gradually shrink, there are more insurance dollars chasing fewer airplanes. As a result, rates and underwriting guidelines are even softer now than they were then.

Still, there are specific things aviation underwriters look at when considering a policy for aging pilots. Here's how you might convince them that you're good to go.

ARE YOU A GOOD FIT?

Now, as then, the primary factor that aviation underwriters look at when offering a policy is the fit between the pilot and aircraft. How well is this pilot equipped to fly this type of aircraft, given his or her experience and training?

If the pilot is making a transition and is not particularly well equipped, what sort of training can make him or her proficient and safe, and how can it be provided? What steps can be taken to measure its positive effects? The age thing isn't easy to quantify.

When looking at older pilots, underwriters are at a little bit of a loss. There is very little literature or research that is aimed directly at older general aviation pilots. What research has been done in this area is aimed primarily at air carrier pilots who by law max out at 65, and tells us little about the septuagenarians and even octogenarians who are becoming more common in general aviation. The available evidence is confusing and even contradictory. Many of the studies that are based on accident analysis include only NTSB-reportable occurrences, which are only a fraction of all aircraft insurance claims. And how do we tell whether a gear-up landing is just an "oops" or is caused by age-related factors?

Some of the research concludes that older, more experienced pilots perform certain tasks better than younger pilots with less experience. How much more experience? Perform how much better? Which tasks? It's hard to put a number on it. And putting numbers on things is what underwriters are paid to do, so most of them are left with whatever overall accident statistics are available and the experience their own company has with pilots of different types of airplanes and of varying ages. And since pilots age very differently—and the underwriter rarely gets to meet them—how can he make any kind of accurate judgment about who to offer insurance to, and how much to charge for it?

Partly because of all of this vagueness, the topic of insurance and older pilots continues to be a very sensitive one. As in our prior surveys of older pilots and insurance, we spoke with aviation underwriters and brokers to learn more about the subject. Once again, nobody wanted to speak for attribution, but we did get plenty of feedback.

For an underwriter sitting at a desk in Atlanta, Los Angeles or New York, it is difficult to evaluate an aging pilot. As one insurer put it,

Insurers know that humans age at different rates. The 70-year-old athletic pilot below might have to prove through additional training that he can fly his speedy Columbia as well as he can run.

WILL BASICMED MATTER?

Insurance company representatives did have varying opinions of the FAA's new alternate path to Third Class medical certification, or BasicMed.

While the industry is still looking at the changes that BasicMed will bring about, the majority of insurers that we asked about it said that it would not cause any radical change in their policy issuance. In some cases, this is because their company has never required a medical. Two companies said their policies required current medicals "if required." In the case of pilots who successfully negotiated the steps to meet BasicMed minimums (per AC 68-1), they would not be required to hold an FAA third class medical certificate.

Underwriters who are requiring annual medical certificates from their older customers mostly said they would continue to require either a Third Class medical with an AME or BasicMed with a state-licensed physician annually.

There are questions about BasicMed that will only be answered in time. Will non-AME physicians be reluctant to sign the medical exam checklist? We also wonder if pilots will return to the AME they have worked with for years to go through the BasicMed process. The devil you know may be better than the one you don't.

BasicMed might not open the floodgates to hordes of the halt, the leprous and the blind, nor will it have a short-term impact on insurance. See the results of our survey on page 23.

"How do you know if you are writing the 60-year-old 80-year-old, or the 80-year-old 60-year-old?" A little birthdate subtraction would eliminate one of the options, but we take his point: People age at different rates. Some lag behind their chronological age, and some are way ahead of it.

Since underwriters don't get to fly with each of these pilots and see how they perform firsthand, what clues do they have to help them make decisions? There turns out to be more clues than you might think.

AGE EQUALS JUDGMENT?

That may be true, but is it cancelled out with declining situational awareness and reaction time? The really low-hanging fruit is accident history. Almost every company did tell us that they experienced a slightly higher accident rate among their senior pilot customers. As a result, a 75-year-old pilot with two gear-up landings in the last three years, or who ran one tank dry and made an off-field landing with 40 gallons in the other side, is probably not a good bet.

Another easy one is a pilot's total flight time. Most of the research points to slower declines in areas of learning that took place earlier in life, and areas that have been practiced countless times over the years. You want to insure the 20,000-hour 70-year-old pilot more than the 500-hour 70-year-old pilot. And in fact, some of the science shows what most of us know: that you are probably better off insuring the older pilot with more experience. The more experienced pilot uses his superior judgment in order to avoid having to demonstrate his superior flying skills.

Two areas of human thinking that researchers say suffer the most and the soonest from aging are working memory and reaction time. Working memory is defined in different ways, but we use it here to mean the part of transient memory used to temporarily store and manipulate information, like reading back an approach clearance.

Another clue that underwriters look at is how much time a pilot has in the same type of airplane in which he or she is looking to be insured.

Some aging pilots can easily tackle the challenge of a different airplane with lots of new features and complex systems, but many cannot. One underwriter said that while his company insures many older pilots, they tend to avoid older pilots who were making transitions, especially large transitions. The required learning of new systems may be a challenge and insurers know it.

A victim of aging is our ability to learn new things. As with all things that change as we age, that ability varies greatly from person to person. We can deal quite proficiently with what we know and what we are used to, but new/different often throws us as we age. "We're not really interested in an older pilot who is jumping into, say, his first turbine. If he has been flying the same type or something quite similar, we probably won't have an issue," one insurer told us.

Recent and focused training counts for something. As one underwriter put it, "If a pilot just got back from an IFR refresher in a simulator and did OK, he probably is still OK himself. The folks who are still training without us forcing them to are the ones that I want."

Underwriters also look at what kind of airplane their older customer is flying and the amount of liability coverage he carries. Bear in mind that the insurer has in effect promised to pay for the airplane, and the limit of liability, if things go really badly. Underwriters treat this as very real money. So the older pilot in a Cessna 182 insured for $60,000 who carries $1 million of liability coverage limited to $100,000 per passenger causes an underwriter much less concern that the older pilot flying a TBM850, as one example, worth $3 million and toting liability limits of $5 million.

And the one thing that every single insurer mentioned when reviewing his aging clients and client candidates was how much flying the pilot was doing each year.

"Depends a little on the airplane, but we're looking hard at currency. The pilot who is flying 100 hours a year, getting periodic training and proficiency checks, plus maybe doing a WINGS phase is a pretty good bet." We heard similar sentiments from almost every underwriter we spoke with. They are looking for currency.

SO HOW OLD IS OLD?

There seems to be a variety of opinions among underwriters about just what "old" is. Most told us that they really started to pay attention when pilots reach 70, which is unchanged

from our last look at this market.

"At 70, a lot of people begin to have noticeable changes in all the faculties that we need to be pilots," was the way one underwriting manager put it. Another said, "Somewhere around 70 is where we look at what kind of airplane he or she is flying and what kind of liability limits we are providing."

One of the old standbys that underwriters have relied upon in the past to give them some reassurance about the physical fitness of their clients is to require additional FAA medical exams. This is one more piece of evidence that they can put in the files. The annual FAA medical including EKG has been a favorite for years. In some cases, underwriters will accept a doctor's letter following a regular annual exam.

Unfortunately, mere issuance of a medical certificate does not provide the underwriter with much information about either gradual deterioration of the pilot's skills, nor does it provide much ability to predict sudden medical incapacitation. See the sidebar on page 14 about how underwriters are reacting to the FAA's BasicMed certification reform. Under BasicMed, pilots (regardless of age) are eligible if they have a driver's license and if they have held a valid FAA medical certificate that expired within the past 10 years. This also includes a special issuance medical, provided it has not been suspended, revoked or withdrawn.

DON'T JUMP INSURERS

So if we are approaching those golden years and we want to be assured of buying aircraft insurance for a reasonable price with good limits from a reputable insurer, what steps can we take? Plenty, actually.

The golden years may be a good time to finally get a seaplane rating (that's the view from a J3 Cub on floats, top), but perhaps not the time for a new turbine step-up, bottom.

If you are flying a simple single-engine airplane and you are comfortable with $1 million of liability limited to $100,000 for each passenger, you probably will never have a problem getting insurance. But if you fly a larger more complex airplane and you need higher limits of liability, there are three things that you can do to help make this possible.

First, train every year—at the least. Train in your airplane, train in other types of airplanes. If you fly instruments, get an IPC each year, whether you need it or not. Consider making a flight review part of your annual regimen. Train in areas that are outside your usual flying envelope. Get a seaplane rating, take upset training, get a tailwheel signoff and complete an FAA WINGS phase.

Align yourself early with an insurer who is comfortable with what you are flying, and who is willing to provide the limits that you need. Insurers really do treat their long-term customers better than those who always buy the cheapest offering and constantly are changing insurers. The longer that you have been with a company, the longer they are likely to stay with you. Companies sometimes change their appetites over time, but staying with one will give you the best chance. Age 65 and up is not a great time for jumping from one insurer to another. But if you stay with the same company from 65, you arrive at 70 as an established customer.

Finally, the most important thing that you can do for your ability to fly is to exercise it frequently. Nothing says that you are still up to it like 100 hours in the last year, or better yet—150 hours. And if you feel like you have lost a step or two and are asking controllers more and more frequently to repeat something that you heard but couldn't quite hold onto, consider stepping back to a simpler and slower airplane. If you are thinking slower, just go slower.

Contributor Jon Doolittle is the principal of Sutton James Aircraft Insurance in Hartford, Connecticut.

INSURANCE TIPS FOR AGING PILOTS

- ✔ Fly often. Underwriters know that rust means more risk.
- ✔ Be realistic when it comes to upgrading to advanced aircraft.
- ✔ Don't jump from insurer to insurer. Loyalty counts.
- ✔ Take an aggressive approach to training.
- ✔ Complete an IPC even if you don't need it for your missions.
- ✔ Consider a simpler aircraft with lower liability limits.
- ✔ Old age and multiple wrecks isn't a favorable combination.

Fuel Gauge Upkeep: Parts Supply Is Good

But maintaining the accuracy of aging analog fuel gauges is labor intensive. McFarlane is a good choice for parts, while CIES may work for retrofit.

by Jim Cavanagh

Ignorance is bliss, but there's a dark feeling when a pilot realizes there is far less fuel on board than the fuel gauges indicate. Get lucky like I once did and you'll recognize the inaccuracies inherent with aging analog fuel quantity gauges when you're on the ground.

The next step is chasing the problem, which means removing the instrument for testing and rebuilding and recalibrating the fuel measuring sensors in the tanks. There are some worthy repair attempts, but compare the all-in troubleshooting, overhaul and gauge replacement costs to a new digital system. The system you're throwing money at may be as old as the aircraft.

FUEL GAUGES 101

First, let's get the regs out of the way. There is the perception that an aircraft fuel gauge only needs to be accurate when the tank is empty and that's partially true. It's all about calibration.

FAR 23.1337 partially says each fuel quantity indicator must be calibrated to read zero during level flight when the quantity of fuel remaining in the tank is equal to a type-specified unusable fuel supply. That could be a sizable amount. Unusable fuel isn't the same as empty, but it might as well be.

Fuel gauges have been in airplanes since before there were electrical systems. The early cork and wire combination was an accurate and dependable measuring device that required little maintenance. That little bend at the end of the wire bobbing up and down was pretty darn accurate, too. Later, the wire ended up in a glass tube with graduated markings for more precise readings.

Perhaps the next simplest was Jim Bede's glass tube fuel gauges found on the two-place Yankee/Grumman models. Mounted low on the side of the fuselage, the gauge showed the level of the fuel in the wing tank by using atmospheric pressure and the leveling dynamics of fluids. Pilots flying with these systems were wise to empty the tanks and add measured amounts of fuel to know exactly how much was in the tank at a given level and mark the tube or wire for future reference. But it soon became more complex.

Eventually, gauges had full, half and empty markings—a design that came from the auto industry—bringing some inherent problems. Fuel sloshing at different attitudes, the side effects of dissimilar metals in the tank and a multiplicity of fuel tanks are examples.

Later legacy systems operate on the principle of capacitance. In general, capacitant sensors are pretty bulletproof because they are basically a couple of tubes insulated from one another using the fuel as a dielectric, while electronics handle the resolution.

The latest technology is magnetoelectric, which uses—you guessed it—magnets installed in the measuring float. This technology requires the replacement of all existing senders and measures the angle from the fixed sensor to the float, while a precise

We're still waiting for direct digital drop-in replacements for OEM analog fuel gauges like the ones in a Cessna 210 shown left. We like the simplicity of Aerospace Logic's FL202G digital smart gauge, shown at the top.

(and critical) aircraft-specific calibration procedure results in fuel quantity measurements accurate to a tenth of a gallon. See the sidebar on page 19 for more on this digital technology.

LEGACY SUPPORT

The aircraft maintenance manual is the go-to for working with a particular system. Most of the earlier legacy systems (a tank sensor hooked up to an electrical gauge) used variable resistance to produce a value of measurement, with components scattered about the airframe. Cessna mounted the gauges in the wing roots of very early models, but eventually went to panel-mounted gauges generally built by Stewart-Warner and Rochester, with some AC Delco units thrown in the mix. These companies have long retired from supporting the systems. Luckily, there is still at least some support for ancient systems.

Popular sources for replacement parts are McFarlane Aviation in Vinland Valley, Kansas, and Air Parts of Lock Haven in Pennsylvania. There's also some repair and exchange support through Keystone Instruments in Pennsylvania and Malkasian Corporation in Arizona.

A typical instrument shop might take in senders and indicators, but many simply send them out for repair or exchange. Before you give the go-ahead to have the system yanked from the aircraft (expect some disassembly and downtime), make sure your shop knows what it is dealing with. It's possible that the sender or the gauge has once been replaced, which can lead to compatibility issued with replacement parts.

Fuel senders and gauges are a matched set and work within specific ranges of resistance. Common to aviation systems are 0 to 90 ohms for 24-volt electrical systems and 33 to 240 ohms for most 14-volt systems. The aircraft's service manual should specify which range is correct. Owners who buy gauges and senders at salvage yards or aviation flea markets might not have done their research.

Rose Mumbauer at Air Parts of Lock Haven said a number of units that come in for repair are simply the wrong ones for the aircraft. Moreover, Cessna complicated matters by switching suppliers as often as four times a year with some of its models. Having the aircraft serial number handy is a must when ordering Cessna senders and gauges.

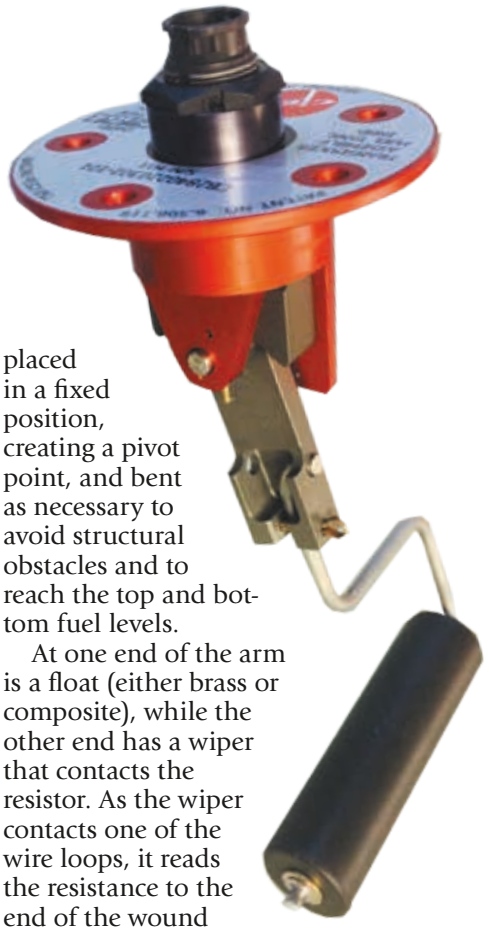
TROUBLESHOOTING TECHNIQUE

Want to tackle the troubleshooting on your own? Testing the old analog components is pretty simple (gaining access might not be) and getting an idea of the fuel sender's accuracy is accomplished with a common multimeter set at the 2000 ohms measurement. You'll get the best results if the senders are out of the tank, although it's possible to get fairly accurate measurements while the senders are installed. Don't be surprised if you'll need to empty the tanks during the process, plus problems could be more extensive than faulty senders.

The troubleshooting chase could reveal wiring problems at the back of the gauge, a faulty gauge and of course problems related to the senders. There's no real magic involved in testing the system. Instead, it's the disassembly that you'll pay for. Should you attempt it on your own, it will help to have an assistant to watch the gauge while you manipulate the sender.

Start at the gauge. Once you've verified a solid power connection to it, if the gauge reads empty or less all of the time, then there is no resistance and probably a ground short. If the gauge reads full or more (infinite on the tester), then there is likely a broken wire or maybe even corrosion. If the needle moves, but does not correspond to how much fuel you think is in the tank, then there is likely an internal problem or perhaps a calibration problem. The sender is more difficult to diagnose.

You'll first have to find it and the access panel that will enable you to work with it. The sender will generally have a round steel plate with an attached grounding lug and a signal lug. For measurements, a wound resistor attached to a long arm is

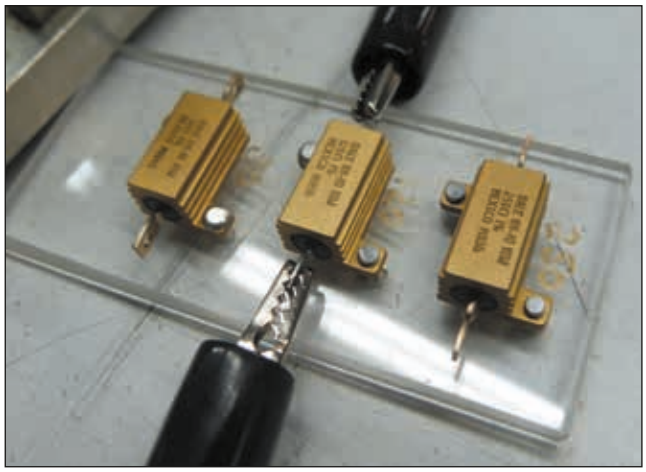


placed in a fixed position, creating a pivot point, and bent as necessary to avoid structural obstacles and to reach the top and bottom fuel levels.

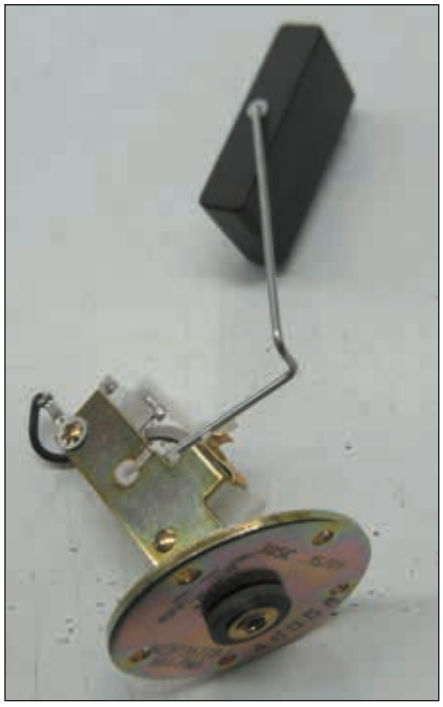
At one end of the arm is a float (either brass or composite), while the other end has a wiper that contacts the resistor. As the wiper contacts one of the wire loops, it reads the resistance to the end of the wound wire. A wound wire creates a specific number of contact/measuring points for the wiper. Some gauges may have nearly 300 reference points for measuring the fuel level. The newer magnetoelectric units have as many as 10,000 measuring points for incredible accuracy.

Keep in mind there is no electricity in the fuel tank—resistance is merely a reading of the length of a specific conductor—which is the wound wire creating the distance from one location to the other.

Digital senders like the CIES shown at the top of the page have tight measuring tolerance compared to resistive senders. Those are some of Mitchell's replacement gauges below.



Resistors with the proper value, top, are integral in matching the senders to the gauge. That's a McFarlane sender with composite measuring float, bottom. It's a replacement for older Stewart-Warner senders.



First, remove the send/gauge lead wire from the center post and touch it to chassis ground. The quantity gauge should read empty and the multimeter should read 0 ohms, as there is no resistance. If it is a 90-ohm system, a full tank would yield 90 ohms of resistance. If you measure 45 ohms, verify that the fuel level is at half. See why doing this with the tanks full is easier? If there is a large discrepancy between the gauge and the meter, you've verified a problem with the sender. Read on for your options.

REPLACEMENT SENDERS

The choices are limited when it comes to replacing senders. One option is sourcing them from the aircraft manufacturer. Worth noting is that Cessna sells them through Yingling Aviation (www.yinglingaviation.com, 316-943-3246) in Wichita, Kansas. Plan on roughly $800 per sender. A word of caution: Yingling's Scott Jantz says the company only sources senders made by Rochester Gauges. This could require gauge replacement for compatibility, which could also mean wiring modifications. The other option is sourcing used senders from a salvage dealers. Wentworth Aircraft (www.wentworthaircraft.com) and White Industries (www.whiteindustries.com) are two well-regarded sources. I spotted an eBay store that's run by Discount Aircraft Parts. It sells a variety of used senders and other fuel system components at attractive prices, although slightly higher than others that charge a core fee. While the company says it tests the components, it won't do any repairs and everything is sold in as-is conditions.

McFarlane Aviation offers new PMA replacements for Stewart-Warner senders for under $400 list, with much lower street prices. Its senders are newer technology with many of the components built to specifications by Stewart-Warner, which no longer supports its legacy units.

From my experience, McFarlane's replacement senders have an edge over new Stewart-Warner senders and can even be calibrated to replace legacy ones. What goes wrong?

As senders age, they accumulate dissimilar metal corrosion and rust due to condensation, wiper wear and residue buildup on the resistor. The wiper can also deteriorate. McFarlane's modern transmitters are ceramic plates printed with resistive ink. These have been tested to millions of cycles with no failure of the printed-on resistor element or the wiper. The potentiometer is faced with conductive bars that when contacted by the wiper provide a resistance proportionate with the wiper location, the location of the wiper controlled by the fuel level and float. Unlike wire-wound designs, the ceramic design might last forever.

During my research, McFarlane's Fred McClenahan gave me a tour of the lab and demonstrated how each sender was checked using a consistent reference voltage and with calibrated resistors suitable for the three most common resistance-type fuel indicating systems. The company provides hundreds of PMA replacement Cessna parts at impressive savings to owners and has a sterling reputation.

As for rebuilding existing senders, Air Parts of Lock Haven (established in 1987) is perhaps the most popular. Its sender rebuild prices start at $166.50, plus parts, which makes for a reasonable alternative to the shotgun approach. The company's gauge overhaul service starts at $144.50 and it can support all three of the legacy brands, including Stewart-Warner, Rochester and AC Delco. Much of Lock Haven's work involves exchanges, plus it has 12 technicians working on instruments each day. Turnaround is usually less than three weeks. It also has an extensive inventory of senders ready to ship because the company purchases as many cores as it can find. My research revealed that Lock Haven's selling price for senders is

CONTACT...

Air Parts of Lock Haven
800-443-3117
www.airpartsoflockhaven.com

CIES Inc.
541-977-1043
www.ciescorp.com

Keystone Instruments
570-748-7083
www.keystoneinstruments.com

McFarlane Aviation
866-920-2741
www.mcfarlaneaviation.com

Mitchell Aircraft products
815-331-8609
www.mitchellproducts.com

DIGITAL FUEL QUANTITY: NO SIMPLE UPGRADE

If you're considering a primary electronic engine display, the integrated fuel quantity function that's standard on select models—including the JP Instruments EDM930 and Electronics International CGR-30—is a sweet bonus. But don't expect these devices to be the cure-all for existing fuel measuring problems; the displays connect with the existing fuel senders. It's a liberal interface, especially with the JP Instruments EDM900 series primary engine display, which is STC-approved for replacing the existing fuel quantity gauge, plus it works with a variety of existing fuel senders.

If a big screen engine display is more than you can budget (it could require sizable instrument panel modification) you could replace the analog gauges with a digital smart gauge like the one made by Aerospace Logic. The FL202 series display fits in a 2-inch instrument cutout and, aside from the senders, is a one-piece system. STC-approved as a primary fuel quantity gauge, the FL202 has a 65,535-color LCD display and connects with the senders through a DB25 interface connector.

Keep in mind the system doesn't display fuel flow or any engine data. You'll need a fuel flow computer or engine monitor with fuel computer for that. The FL202's primary data—which is fuel quantity—is on an uncluttered display that's intuitive to interpret at a glance. There's also a fuel imbalance warning, which is set during programming. A flashing yellow bar on either tank designation indicates a fuel imbalance condition, which serves as a reminder to switch fuel tanks. There is also a trend-graph function, which provides a scrolling line graph of the total fuel used from each tank since the last power cycle.

Aerospace Logic's STC requires the use of the CIES magnetoresistive digital fuel sensors. As mentioned in the main text, magnetoresistive senders have more precision than old-school senders, plus they work well under extreme temperature fluctuations and are compatible with alternative fuels. We retrofitted a CIES system (with the FL202G control head) in a first-gen Cirrus with poor results, but the inaccuracies had more to do with limitations of the fuel tank design. The system is said to be flawless in other models, and CIES senders are used by OEMs, including Cirrus. Expect an installation that approaches or even exceeds $5000. For that money, it's worth pricing a primary engine data display, while addressing any problems that might exist with the current fuel senders.

—Larry Anglisano

in line with what a repair would cost, plus a core charge.

Malkasian Corporation is a small shop in Arizona that advertises a $400 exchange price and $450 to rebuild your unit if there are none in stock. The shop specializes in Stewart-Warner senders (the old ones) and says the components are relatively easy to repair. It also said that Rochester senders might be repairable at least one time because the resistor film wears out. During the rebuild process, Malkasian uses a newer, denser film to help the units last longer. The company suggests saving older senders because they might be worth repairing. "We are running out of the good ones," it said.

Operating since 1961, Keystone Instruments in Lock Haven, Pensylvania, works on virtually all aircraft instruments including Stewart-Warner, Rochester and AC Delco fuel senders, plus some lesser common components, including King-Seeley, Lee (used in Cessnas for a short while) and Liquidometer. Keystone's Gig Bumbarger said wound resistive senders can last forever with the right maintenance. Bumbarger and Fred McClenahan at McFarlane warn that ceramic plate-and-resistive-ink senders made by Stewart-Warner can melt if you accidentally short the poles at the gauge. That's because when the wiper is at its lower end, there's less resistance, which can overheat the resistor. Worth stressing is this problem is the result of a short somewhere else in the system or a maintenance accident and not a design or manufacturing problem. This type of thick-film transmitter has been in use in automotive systems for over 20 years and has a pretty good track record. Keep the power turned off when working around the system wiring.

Keystone overhauls (turnaround is a few days) start at $145, plus parts, while exchanges are $195 to $225.

THE FUTURE LOOKS DIGITAL

The future of aircraft fuel gauges seems focused on magnetic senders with digital outputs like the technology found in CIES senders. They're standard in some OEM applications and the STC list for retrofit is growing.

When it comes to our older aircraft and the ratio of cost to value in modernization, remember that older variable resistance senders were incredibly simple.

I had access to an SAE test report written by a Stewart-Warner engineer that cited test results of the wire-wound resistor. If kept lubricated with fuel (which helps to keep moisture off critical components), the test results proved the senders could last 2,000,000 cycles.

While older senders might be too far gone to salvage, parking the aircraft with the tanks full is a good strategy for preserving good ones.

For mechanical gauges, we like the Mitchell and Sigma Tek options. Like all-in-one digital engine displays, they can be matched to work with existing senders. That might save money.

Cabin USB Power: Guardian Easiest Install

We think USB power receptacles are worthy cabin accessories. Guardian Avionics and True Blue Power have a variety of options that won't fry your devices.

by Larry Anglisano

Since tablets, smartphones and portable ADS-B units are integral to our flying, USB charging devices have become necessary inflight accessories. You could carry along a portable USB power supply, but if you're like us, you might forget to recharge it—if you can remember where you left it.

Both Guardian Avionics and True Blue Power (from Mid-Continent Instruments and Avionics) have the most complete line of panel-mounted USB power supplies engineered specifically for installation in aircraft.

GUARDIAN IFDR POWER

The iFDR Power panel USB devices are available with either a single USB port ($249 for the Power 150) or dual USB ports ($299 Power 250). The devices are available in several versions, depending on where and how you want to mount them. For example, you can remove the existing cigar lighter socket and mount the iFDR Power in its place using the existing socket wiring (a simple power and ground interface) or you can start fresh and cut a round or square hole on the instrument panel. With the remote version, there is flexibility for mounting it in the rear cabin.

Each USB port has 2.1 amps (10 watts each) of output current with 5 volts DC of output voltage. Those specs are significant because some low-cost USB power adapters sourced in automotive and hardware stores might not have the appropriate step-down output voltage. That means you can inadvertently zap your device with 28 (or 14) volts of power. The iFDR Power modules can accept between 9 and 48 volts DC input voltage, but are smart and stable enough to still output 5 volts of power from each port.

The other gotcha with non-aviation USB power supplies is the potential for EMI, or electromagnetic interference. This can induce unwanted noise into the aircraft audio system. The iFDR Power devices have built-in EMI protection, have green LED backlighting for use at night and are designed to not overcharge the device.

Guardian says the installation can be signed off with a logbook entry (no field approval is required) because it has a letter of authorization from the FAA stating the devices meet the design and performance requirements of FAA policy PS-AIR-21.8-1602 for non-required safety enhancing equipment, known as NORSEE. That saves time.

The iFDR Power is also available with a chassis that mounts to the base of Guardian's iFDR tablet

The flush-mounted iFDR Power 250 shown below measures 1.5 by 1.5 by 2.1 inches and weighs 2.6 ounces. The True Blue Power TA102, top of the page, is available with lighted or sealed water-resistant ports.

panel dock mount. Contact Tucson, Arizona-based Guardian Avionics at www.guardianavionics.com.

TRUE BLUE, LONE STAR

The $379 True Blue Power TA102 is a dual-port USB panel-mounted charger that will accept 10 to 32 volts DC input and outputs 2.1 amps per port. It has short circuit and over-current (and over-temp) protection. Sold in both lighted and sealed water-resistant configurations, parent company Mid-Continent Instruments and Avionics says the device might require an FAA field approval if the aircraft doesn't have an existing cigar lighter socket.

We like that the TA102 has wiring input on the bottom of the case to facilitate installation in tight areas—helpful for the rear cabin. The TA202 has wiring input on the rear of the case for panel mounting. Contact www.truebluepowerusa.com.

Lone Star Aviation offers the $750 LS03 iPad charging kit, which includes a remote 28 volt to 5 volt DC stepdown converter, plus a single-port USB socket. The MS-USB plug has an anodized aluminum chassis and is dust-proof. We wish the converter was self-contained and had dual outputs. Contact www.lonestaraviation.com.

STICK IT IN THE SOCKET

Worth mentioning is the long-standing FAA airworthiness directive (AD 79-08-03) that applies to a wide variety of Cessna models with original equipment cigar lighter adapters. It requires adding appropriate circuit protection between the socket and the electrical bus so it doesn't smoke the associated wiring bundle. We've seen many instances where the AD wasn't complied with and where the socket was simply disabled.

If you have a functioning cigar lighter socket and want an alternative to permanently mounted USB ports, we've been using the $30 DualMicro USB rapid charge device sold by MyGoFlight. It works in both 14- and 28-volt systems, has two 2.4-amp USB ports and the company says it was tested to not interfere with onboard radios. This obviously won't do you any good for installation in the rear cabin.

For price and installation flexibility (including the ability to sign it off with a simple logbook entry), we favor the Guardian iFDR Power.

LONG TERM EVALUATION

Garmin D2 Bravo/Ti: Rugged, Good Battery

These pilot watches can work for supplemental nav, but have stark maps. VIRB action cam control and a sports-centric feature set are good utilities.

by Larry Anglisano

On an FBO bulletin board I recently spotted for sale two Garmin Bravo pilot smartwatches. There's more on eBay. This got me thinking that since the D2 could make a good used market buy, it's worth running a long-term field report to chase the original review we ran in the August 2015 issue of *Aviation Consumer*.

I've been wearing the soft-strapped D2 Bravo and the newer all-metal D2 Titanium for flying and sports activities and while it took a while to warm up to a somewhat quirky user interface, they turned out to be good everyday watches that expand the Garmin Pilot app.

MORE THAN PILOT WATCHES

As pilot watches go, Garmin's second-gen D2 Bravo and the latest D2 Titanium may not be as handsome as a Breitling or a racing-inspired Tag Heuer Carrera, but they cost far less ($899 for the Titanium and $599 for the Bravo) and do a whole lot more in and out of the cockpit. Which functions you'll use will depend on what you have for external sensors, whether or not you are a Garmin Pilot app user and whether or not you're into sports and fitness.

For example, both models are compatible with Garmin's speed and cadence sensors for bicycling, the heart rate sensor (the Titanium has its own integral heart rate monitoring), the Tempe wireless temperature sensor for measuring ambient air temperature, plus Garmin's Vector pedal-based cycling power meter. They also work with Garmin's VIRB series action cams.

With its titanium band and a gunmetal bezel, the newer D2 Titanium is a big watch. It measures 2 by 2 by .6 inches.

The D2 Titanium's heart rate sensor, top photo, performed as well as Garmin's chest sensor, but with some lag. Connect IQ software enables you to customize the watch face. That's the Mooney logo on the D2 at the bottom.

These watches serve as basic navigators and have a GPS receiver and internal worldwide aviation database, which only includes airports. I found that navigating directly to an airport is straightforward. Using the upper right bezel button, select the Fly menu and then scroll through the letters to input the airport's identifier. The watch is far from an FMS, but I recognized its basic utility flying a glider when soaring in an unfamiliar area. The direct-to/nearest airport feature could be useful during an electrical failure.

You can view the active route/waypoint guidance on the basic map display (don't expect much—it's stark) or follow course guidance with an onscreen HSI, which I found more useful. You can also mark your own waypoints. The internal GPS/Glonass worked well and locked on quickly, although other users have reported issues.

The watch has an altimeter (and a compass) and you can set vibrating alerts from inside the Pilot app to remind you to level off, switch fuel tanks or other chores.

As a guy who prefers a basic analog watch, I didn't expect much from the LED backlit display, which Garmin calls Chroma, but it was acceptable in bright sun. As for the feature set, there was a learning curve. Since these watches have limited controls, you'll spend some time learning to navigate onscreen menus—something I think might be improved upon with a touchscreen. On the other hand, that could pose more challenges given the small confines of a watch face.

KEEP UP WITH SOFTWARE

If you have an existing D2 Bravo, which was released in June 2015 (or the newer Titanium released in May 2016), and haven't kept up with software updates, you're shortchanging the overall smartwatch interface. Garmin considerably improved the feature set from early software versions.

If you're still on software version 2.30, the jump to 2.40 was a major one. It added flight plan transfer capability from Garmin Pilot (this requires the PilotSync Connect IQ app and Garmin Pilot for Android version 5.3 or iOS version 8.3). It also added current UTC/Zulu time to the TAF display page. Again, the TAF data originates in the Garmin Pilot app.

With the Connect IQ utility, you can download different watch faces, including a logo that represents the brand of aircraft you fly. Cheesy? Yeah.

Changes made from software version 2.50 to 2.60 include support for Apple Media Service. This enables the control of any active music player (Spotify, as one example), including volume adjustments. You can also receive text and email messages when connected to a smartphone—something I found useful. If you use the watch when flying a jet, the update supports speeds up to 990 knots. One thing that bugged me was the watch measuring nautical units (instead of statute miles) for non-flying activity summaries. Version 2.60 fixes that.

DAY TO DAY

The D2 Bravo turned out to be a rugged daily watch for me and I especially like the sports functions when traveling because I don't have to bring along my cycling computer or Forerunner sports watch. The Titanium is even better because of the integrated heart rate monitor, but it's heavy on the wrist. Both models come with interchangeable bands for use during sports. I kept the black plastic sports strap on the Bravo because it's comfortable—and more my style than the brown leather one.

Garmin Pilot app users will likely get the most aviation utility from these watches. On the other hand, I'm a Pilot app user, but just find it easier to focus on the data within the app instead of on the watch, including METARs. I did make good use of the Garmin VIRB action camera interface. Whether on the bicycle, motorcycle or in the airplane, the basic camera controls made it easy to start and stop recording when I couldn't easily get to the camera. Software version 2.7 is required for the newer VIRB Ultra.

In basic watch mode, the Bravo's battery is good. Expect a couple of weeks endurance—and more from the Titanium. Battery life is shortened considerably when using any of the wireless functions.

A couple of nits come to mind. It might not matter much to the average user with only one D2 watch, but I had fits whenever I had to charge these two watches because the charging cradle for the Titanium and Bravo are slightly different.

I'd like to see the wireless interface expand to panel navigators and perhaps other tablet apps. For those not using an app, a better basemap could step the interface up a notch.

BASICMED: MIXED VIEWS FROM PILOTS

The FAA's recently announced BasicMed rule drew cheers from owners and pilots, but there's still confusion about what effect it will have on the industry and worry that non-AME doctors won't sign off on the FAA's new medical checklist.

At press time, the FAA had published a draft of the checklist in AC 68-1 and although BasicMed won't be available until May 1, 2017, the AC serves as a template for pilots to convince non-AME docs to sign the approval. The full rundown on BasicMed can be found on the AOPA (http://tinyurl.com/gq6ta2u) and FAA (http://tinyurl.com/h7xpymv) websites .

In a nutshell, any pilot who has held a valid medical of any kind after July 15, 2006, is eligible for BasicMed, which essentially replaces a Third-Class medical. Under BasicMed, a pilot can fly any aircraft up to 6000 pounds carrying not more than five passengers and operating VFR or IFR at under 18,000 feet. Aircraft operating speeds are limited to 250 knots.

BasicMed requires the pilot to undergo a physical by any state-licensed physician every 48 months. The doc can be an AME, but that's not required. The physician must sign the aforementioned checklist affirming the pilot's fitness to fly. In addition, the pilot must take an online medical education course and consent to allow access to the National Driver Register for drunk driving checks every 24 months. There is no denial involved in BasicMed. If the doctor won't sign the checklist, this isn't reported to the FAA and the pilot can shop doctors until he finds one who will sign.

Current holders of special-issuance medicals will be eligible for BasicMed, However, the legislation that enabled it lists three conditions—mental, cardiac or neurological—that will require a special-issuance medical before the pilot can use BasicMed. It's unclear how this will be handled for pilots who already have specials listing these conditions. Pilots who have specials for conditions not listed in the BasicMed rule should easily qualify. According to a survey conducted by our sister publication, *www.avweb.com*, pilots seem moderately confident they'll be able to find a doctor to sign the checklist. But there's worry that many doctors won't participate because of liability concerns.

"Why would a doctor or medical group expose themselves to this kind of litigation? If one does, I expect it will not be for long," said David Dean. Overall, the AVweb survey revealed that 28 percent of pilots thought it would be easy to find a doctor, 36 percent thought it would be difficult and 14 percent thought it would be impossible. The survey also asked readers how effective they thought BasicMed would be in stimulating aviation activity.

The responses were generally positive but lukewarm. Fifteen percent said it would be very effective, while 23 percent thought it wouldn't do anything at all. More than half said it would help, but they weren't expecting miracles. "Eliminating the Third Class pales in comparison to the cost of flying," wrote one commenter.

For many years, we assumed that the elimination of the Third-Class requirement would kill the light sport industry, but boost the sales of certified aircraft and aviation activity in general. And if it wouldn't stimulate sales, it would at least keep older pilots owning airplanes longer than they otherwise might have.

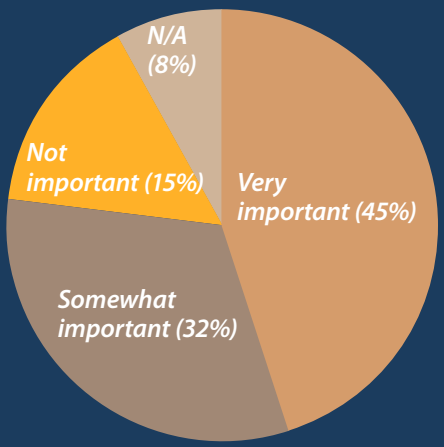
The survey didn't suggest there's a huge groundswell for this idea because not many pilots who responded to the survey have bailed out of certified airplanes and gotten into LSAs to stay in the game.

This squares with what light sport manufacturers have been telling us. Whatever bailouts there were petered out five years ago. Now, would-be LSA buyers are either stepping down from more capable airplanes even if they can maintain a Third Class or they're just interested in LSAs for fun flying, irrespective of medical considerations. One manufacturer told us some LSA buyers simply don't see the value of expensive, fuel-guzzling aircraft for recreational flying.

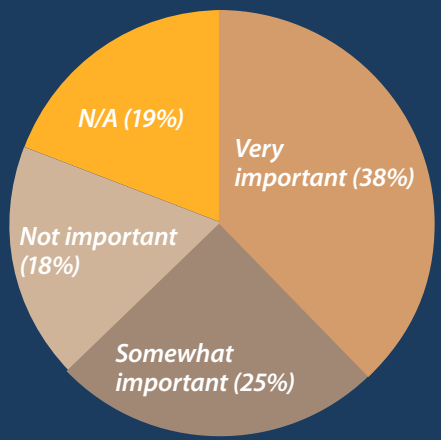
Many readers expressed disappointment that EAA and AOPA weren't able to lobby effectively for a bill that would have hewed to the original idea of a driver's license medical certification similar to the light sport requirement.

"The BasicMed is such a compromise, I do not think it will help me as much as it could have had AOPA and EAA done more to stay closer to the original plan. My doctor filling out a form is very governmental and unnecessary. I believe I will still mostly do what I have been doing under my AME-assisted special issuance…just will not have to send it in to the FAA," wrote one commenter.

How important is the Third-Class medical exemption to your personal flying?



How important is the Third-Class exemption to your aircraft ownership plans?



Cessna 340

If you can keep up with the maintenance, a 340 serves a broad mission. Comfort and performance are high points.

The typical cabin-class piston twin buyer is generally moving up from a high-performance single, or perhaps even stepping down from a jet or turboprop. With a need to go places comfortably and efficiently, these buyers recognize that a serious business airplane needs a decent cabin, credible speed and the ability to hack it when there's ice or other rotten flying conditions in the forecast. Pressurization is nice since passengers don't want to spend several hours with a plastic hose stuck up the nose.

Although not without its shortcomings—most notably certain loading limitations and an overly complex fuel system—the Cessna 340 fills that mission. Owners report that a 340 is flexible and capable enough to serve double duty for business and personal missions. It won't be cheap to operate or maintain, but it pays back with decent cabin comfort and performance.

MODEL HISTORY

The 340 owes its existence to the boom days of general aviation during the late 1960s and early 1970s when the twin market was stratified and still developing. At the entry level, you had Twin Comanches, Apaches, Aztecs, Barons and the Cessna 310. At the upper end, the ritzy cabin-class Cessna 421, Beech Duke and Piper Navajo met the needs of well-heeled owners who could afford megabucks for an airplane.

The 340 arrived in 1972 as a lower-cost alternative to the Cessna 414, which had arrived in 1970.

The Cessna 340 is not a failure-prone airplane, but there's a lot of it, so failures are inevitable.

Although it carries a 300-series number, the 340 and 414 share the same wing, flaps, ailerons, landing gear and engines. The 340 has an airstair door, thus you don't need a ladder to get into it, as some have jokingly complained about the long-legged Cessna 310. The 340 carries less than the 414, but it's faster on the same fuel burn.

From 1972 through 1975 the engines were Continental TSIO-520Ks, which produce 285 HP at 33 inches manifold pressure from sea level to 16,000 feet. However, most of the K engines in early 340s have been converted to Js or Ns.

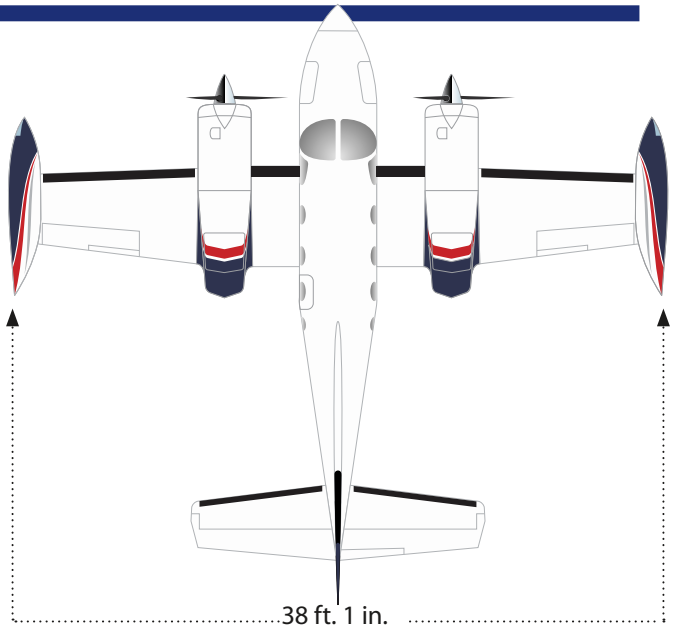
The TSIO-520J engine, used on early 414s, produces 310 HP at 36 inches manifold pressure. The N engine, installed on later 414s and 340As, produces 310 HP at 38 inches.

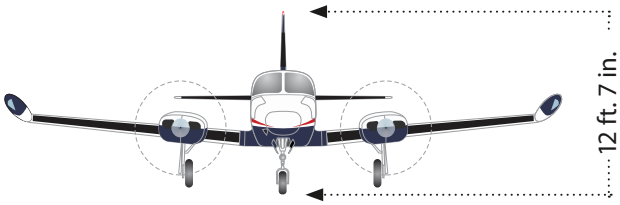
The major difference between the K engine and the J and N variants is that the latter are equipped with intercoolers, which wash the heat out of the induction air as it flows to the cylinders. This yields better power and efficiency without stressing the jugs, something that can be good for longevity, but only if you know how to properly set the power.

The N engines produce their rated 310 HP up to 20,000 feet and provide higher cruise speeds

It's not uncommon to see a 340 like the A model shown in the lead photo parked at a maintenance hangar. Bring it to a shop that's well-versed in wrenching it.

CESSNA 340





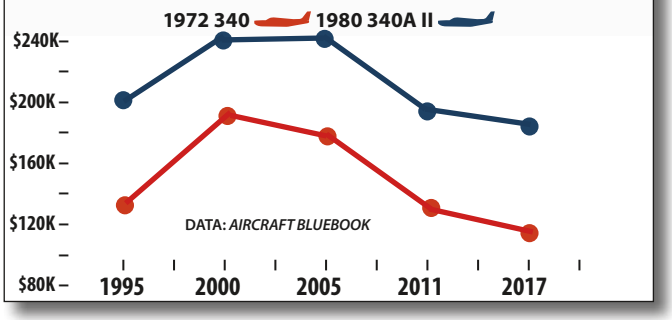
drawings courtesy
www.schemedesigners.com

SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1972-73 CESSNA 340	CONT. 310-HP TSIO-520-N	1400	$40,000	102/203	2200 LBS	210 KTS	±$107,000
1974-75 CESSNA 340 II	CONT. 310-HP TSIO-520-N	1400	$40,000	102/203	1800 LBS	229 KTS	±$117,000
1976-78 CESSNA 340A II	CONT. 310-HP TSIO-520-N	1400	$40,000	102/203	1800 LBS	229 KTS	±$140,000
1979-80 CESSNA 340A II	CONT. 310-HP TSIO-520-NB	1600	$40,000	102/203	1800 LBS	229 KTS	±$180,000
1981-82 CESSNA 340A II	CONT. 310-HP TSIO-520-NB	1600	$40,000	102/203	1800 LBS	229 KTS	±$195,000
1983-84 CESSNA 340A II*	CONT. 310-HP TSIO-520-NB	1600	$40,000	102/203	1800 LBS	229 KTS	±$215,000

*NONE DELIVERED IN 1983

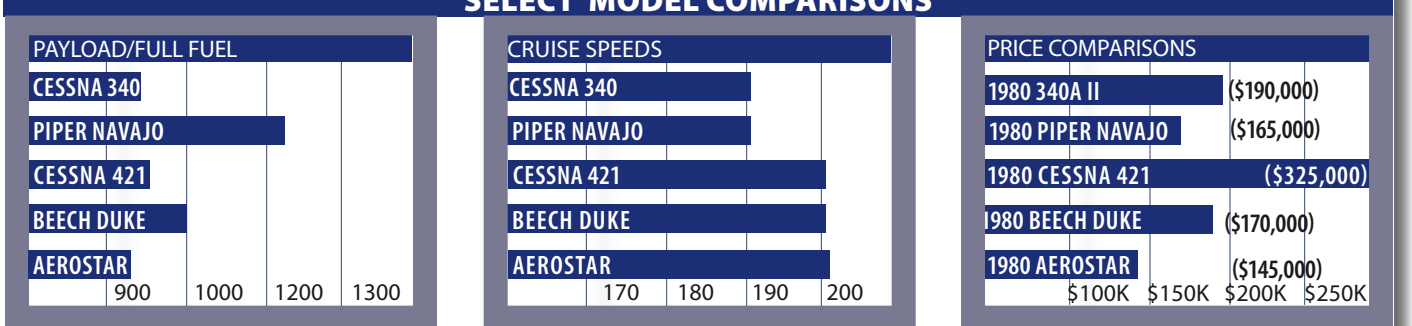
RESALE VALUES



SELECT ADs

AD 00-01-06	EXHAUST SYSTEM REPAIR
AD 98-24-14	EXHAUST SYSTEM COMPONENTS
AD 97-01-13	FUEL, OIL, HYDRAULIC HOSES
AD-87-21-02	FUEL FILLER OPENINGS
AD 82-26-05	RUDDER BALANCE WEIGHT RIB

SELECT MODEL COMPARISONS



A 340 is worthy of modern avionics as proven in Jim O'Day's 340A, top. A five-seat cabin configuration makes for easier ingress, middle, and makes room for storage.

and better climb and single-engine performance. Three-blade McCauley propellers, formerly an option, also became standard equipment in 1976; earlier 340s came with two-blade McCauleys.

Cessna 340s are prized for being all-weather machines, but aircraft certified for flight into known icing conditions, when properly equipped, came only in 1977. The following year, a maximum ramp weight of 6025 pounds was approved, and max weight for takeoff and landing was set at 5990 pounds for the 340A, compared with 5975 pounds for the 340. The last significant change in the line came in 1979, with the switch to TSIO-520NB engines (the B denotes a heavier crankshaft). Subsequent modification of cylinders, valve lifters and piston pins by Continental increased TBO of the NB engines from 1400 to 1600 hours in 1983.

But Cessna didn't build any 340As (or much of anything else) that year and after putting together a scant 17 of the airplanes in 1984, production was terminated for good, with a total of about 1297 aircraft made. Some 872 are still registered.

SYSTEMS

The pressurization system is the same as that found in Cessna's 400-series twins, with a maximum differential of 4.2 PSI providing an 8000-foot cabin up to 20,000 feet. Above that, the cabin climbs with the airplane.

Cessna offered an automatic pressurization control, which activates and deactivates while climbing or descending through 8000 feet, but more buyers opted for the variable-control system.

The variable system maintains a sea-level cabin up to 9000 feet, then delivers the pilot-selected cabin altitude until a 4.2 PSI differential is reached.

As pressurization goes, the 340 is relatively easy, requiring just a quick check and set for each flight. The pilot merely dials in field elevation plus 500 feet before takeoff and landing and selects desired cruise cabin altitude on initial climb. The rest is simply monitoring the system to make sure it's delivering as commanded.

While the pressurization is easy, the same can't be said for the fuel system. Start with the 100-gallon-usable tip tanks, which are the mains in this airplane. Add up to four auxiliary wing tanks, two holding 40 gallons, the other two holding 23 gallons. Throw in locker tanks, which add another 40 gallons. That's up to 203 gallons in tanks peppered throughout the length of the wings.

Where things get tricky for the uninitiated is which tank to use when. Use the mains, alone, for takeoff and landing. The engines can feed directly from the auxiliary tanks, but fuel in the lockers has to be transferred to the mains, which are the tip tanks. You have to make room in the mains first, otherwise you'll vent the pumped fuel over the side.

And if you have only one locker tank (common on 340s), remember to use crossfeed; dump all 120 pounds from a locker into one tip tank, and the imbalance will be enough to upset even your autopilot. Unfortunately, Cessna never got around to simplifying the fuel systems in its 300-series twins (Crusader excepted) as it did in most of the 400s. Calling the tip tanks mains has its own issues. Ramp attendants have filled the wrong tanks ("Just top off the mains ...."). Transitioning pilots have switched to the aux tanks thinking they were drawing from the tips, and vice versa.

Despite this, the 340 hasn't suffered an inordinate number of fuel-related accidents. Jerry Temple, an aircraft dealer specializing in the 340, says, "The fuel system is no big deal. I prove it twice a month to new twin Cessna owners. It can be mastered in one 2.5 hour cross-country."

While known ice certification came in 1977 and up, the majority of 340s have what is called full deice. This usually mean boots on the wing and tail (with the exception of the wing stubs), heated props

and alcohol spray for both sides of the windshield. This is adequate for many 340 owners. The few 340s out there with hot props only are tough to sell, but can be ideal for owners in warmer locations.

Air conditioning might be the factory system, which requires the right engine be running to get cool air. Parts for this system can be challenging to get. The Keith System, also called JB Air by many, is electric and can be powered by a ground APU, although in the real world of FBOs, a 340 rarely gets the APU. Support for the Keith system is good.

PERFORMANCE

The 340 is a high flyer, with a service ceiling of nearly 30,000 feet. But most owners wisely operate in the high teens to mid-20s, where the airplane can be expected to true between 190 and 205 knots on about 30 gallons per hour at 65 percent power, and 200 to 217 knots on 32 to 34 GPH using 75 percent power.

Rate of climb at sea level is a respectable 1650 FPM, but climb performance tapers above 20,000 feet to a dawdling 300 to 400 FPM in the mid-20s. Not bad as twins go, but no turboprop, either.

The 340's claimed single-engine rate of climb is 315 FPM, better than the 414 (290 FPM), Beech P58 Baron (270) and the Piper 601P (240) and 602P (302) Aerostars. Single-engine minimum control speed is 82 knots. Stall speeds are 79 knots, clean, and 71 knots in landing configuration.

Not all twins of the 340's days have accelerate-stop and accelerate-go performance tables but, to Cessna's credit, the 340 does. Under standard conditions, a 340 that loses an engine at liftoff speed (91 knots) can be brought to a full stop within 3000 feet of brake release. The POH also indicates that should a pilot decide to fly after losing one on liftoff, the airplane will clear a 50-foot obstacle after traveling less than 4000 feet over the ground after brake release (assuming the pilot does everything right).

The performance figures above are for 340s with 310-HP engines. Those that still have 285-HP K engines (if any) are nearly 20 knots slower in cruise, use roughly 200 feet more runway for takeoff and climb 1500 FPM on both engines, 250 FPM on one.

An STC from RAM turns the rear deck into a bench seat (increasing total seating capacity to seven) for someone weighing up to 120 pounds, top. An airstair gives the 340 a corporate aircraft feel and look.

HANDLING AND PAYLOAD

Cessna's big twins have a reputation for being comfortable and easy to handle and the 340 fits that mold, although not entirely without warts. The airplane owes its speed to a relatively slick airframe and because it has flap and gear operating speeds that are on the low side, it can be a handful to go down and slow down at the same time.

For example, flaps can be extended 15 degrees at 160 knots (the limit is 156 knots for the first 300 airplanes built) to help slow the airplane to max gear-extension speed, a pitiable 140 knots. But slowing the airplane to 160 knots without stressing the engines can be a problem, if you believe in the shock cooling genie. Owners say descents and approaches require planning and occasional persistence with ATC if a slam dunk is in the offing.

Once the airplane is slowed down with gear and flaps deployed, however, it tends to sink like a rock, and some power must be maintained right into the flare. This is due in part to the split flaps, which are great for drag, but not so good for lift.

Entering the airplane through the luxurious airstair door gives a big-iron feel. But for the pilots, that wears off quickly when they have to squeeze through a narrow (7-inch) opening to their seats. Once you're seated, the cabin is quite comfortable up front. The 340's cabin is 46.5 inches wide and 49 inches high, about the same size as an Aerostar's and 4.5 inches wider than a P-Baron's.

If owners have any consistent complaints about the 340 line, they relate to lack of payload. Load enough gas for a 4.5-hour flight with reserves and you can take along only two passengers and their bags. Fill the seats with 170-pound FAA clones and pack away their 30 pounds of baggage each and you can carry enough fuel for less than two hours of flying.

Considering the payload limitations, the baggage space in the 340 seems a cruel joke. Among the cabin, nose and locker compartments, there's a cavernous 53 cubic feet of space in which a maximum of 930 pounds can be crammed. That is, however, the maximum. Most 340s have at least one fuel tank occupying a locker, and nose baggage compartment space typically is compromised

CESSNA 340 ACCIDENTS: LANDING GEAR

We admit to a certain soft spot for the Cessna 340—thinking of it as one of aviation's finest personal hot rods. Our review of the 100 most recent 340 accidents did nothing to disabuse us of that notion, but it did serve to remind us that its landing gear has to be maintained by the book and also caused us to wonder about the decision-making process of some Cessna 340 pilots.

First the good news about the landing gear-related accidents on Cessna's smallest pressurized twin—to our utter amazement and, to our knowledge, unprecedented in our decades of looking at retractable-gear aircraft accidents, no one forgot to extend the landing gear before making a landing.

The bad news is that there were 14 gear collapse events and one in which the pilot could not get the gear to extend. Of the gear collapse adventures, two were as the airplane was being taxied away from the shop following maintenance on the gear. The electromechanical landing gear of the Cessna 340 cannot be "adjusted" on a piece-by-piece basis—you can't, for instance, rig just one leg of the gear. It has to be rigged as a unit, starting in the middle and working outwards.

The other big area of concern we saw was connected with the sweaty palms on the Cessna 340's yoke when the weather was down. Three pilots killed themselves trying to scud run. There were seven loss of control (LOC) crashes in IMC, two of which involved pilots who weren't on instrument clearances trying to land in dense fog. One LOC accident involved a pilot who told ATC right after departure that he had to stay out of the clouds because of an "instrument problem." Rather than return, he repeated the mantra to subsequent controllers. He eventually flew into clouds, lost control and flew into the ground.

CFIT accidents claimed seven 340 pilots and their passengers—more than half of those involved pilots who decided that approach minimums were for others and flew into the ground before arriving at the airport.

In the "what was he thinking?" department, one 340 pilot, with passengers, decided to buzz his gun club. On the second pass he hit a 50-foot tower 40 feet up, making the airplane unflyable and killing all aboard.

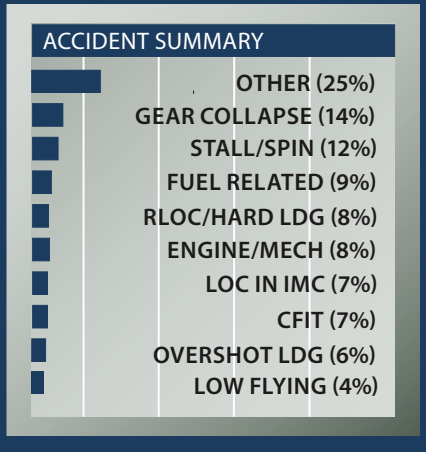
Returning to the good news department, we expect to see a bare minimum of 15 runway LOC (RLOC) accidents per hundred mishaps of nosewheel airplanes. We found only four in our Cessna 340 survey—and three of those involved runways contaminated with snow and ice.

There were, however, six times when the pilot couldn't stop the airplane on the available runway.

In our experience, the 340 is not tolerant of sloppy airspeed control, especially at the lower end of the envelope. There were 12 stall/spin crashes, most of which were in the pattern. One of the pattern stall pilots was found to be badly impaired due to heavy ingestion of painkillers. Four of the stall events were in airplanes that were carrying a load of ice.

The 340's fuel system demands respect; nine pilots either ran out of fuel or mismanaged it, leading to unintended landings.

One pilot tried to take off with the gust lock still installed. Rather than abort, he tried to remove it on the roll. He was unsuccessful.



by avionics and other accessories..

The installation of vortex generators, however, brings a 300-pound gross weight bump. Considering an entire VG kit weighs about as much as the air in your tires, it's about as close to a free lunch as you can get. If you're considering a 340, by all means consider vortex generators.

MAINTENANCE

Like any high-performance airplane, a 340 won't tolerate skimpy maintenance. If rebuilt engine prices in the $50,000 range (times two), annual inspections at several thousand dollars and operating expenses of $400-550 an hour curl your toes (as they do ours), the 340 is not the aircraft for you. While some owners might get lucky with an occasional annual in the $5000-dollar range, experienced twin Cessna salespeople like Jerry Temple (he's sold over 200 Cessna 340s since 1995) tells prospective buyers to expect $10,000 to $15,000 for annual inspections. He's flown 340s with every engine/propeller combination and ones with every major modification. See Temple's comments in the owner feedback section.

Owners we spoke with overwhelmingly agree the annual must be done by a shop with twin Cessna expertise. TAS aviation in Defiance, Ohio, was singled out by a few owners.But those with the budget should get their money's worth out of this airplane. Some things to watch out for: First, there are the TSIO-520 crankcases, which have a history of cracking. In mid-1976, Continental switched to heavier cases, which helped a bit but certainly provided no panacea. A couple of knowledgeable sources estimated that about two-thirds of the engines flying in 340s right now probably are cracked in one place or another.

But not all cracks are critical and there's a general sense that catastrophic engine failures caused by crankcase cracks are on the decline. All big-bore Continentals have a modest predilection for cracked cylinders and heads.

Cracked and blown-out cockpit windows were the subject of several reports, as were cracked Bendix mag housings and distributor blocks, loose horizontal and vertical stabilizer attach bolts and cracked wastegate couplings.

As far as ADs go, the 340 is neither

the best nor the worst. AD 2000-01-16 requires repetitive inspection, repair or replacement of exhaust components in a range of Cessna twins, not just the 340. This AD was issued in response to cracks/failures that led to catastrophic fires. AD 97-0-13 requires replacement of certain hydraulic, oil and fuel hoses while another, 88-03-07, requires inspection of fuel crossfeed lines for chafing and modification of firewall stiffener flanges and fuel lines. AD 87-23-08 calls for ultrasonic inspection of the crankshafts, as does 97-26-17. Speaking of crankshafts, some 340s were involved in the Continental crankshaft recall of 2000. The logbooks should reflect this as AD 2000-08-51.

AD 96-20-7 calls for repetitive inspections of the Janitrol heater while 96-12-22 requires repetitive inspections of the oil filter adapters. 95-24-5 deals with repetitive prop inspections and 90-2-13, a type-specific directive, called for replacement of the main landing gear inner barrel bearings.

One important directive to check for is 82-26-05, which requires visual checks for cracks in the rudder balance weight rib every 100 hours until a new rib is installed. Such cracks have been the subject of numerous service difficulty reports.

Temple told us that aging 340s (or other twin Cessnas) should have annuals by a shop that maintains several of them. The convenience of using a local shop that only works on a couple of them each year could catch up to an owner during the prepurchase inspection made by a twin Cessna specialist.

INSURANCE

While a typical buyer may have a few hundred hours in high-performance singles, insurance is usually obtainable at a reasonable price. The typical requirement is 25 hours dual in the aircraft and attendance at an insurance-approved school, usually with simulators and insurance-approved instructors, such as SimCom. Annual recurrent training is usually required.

Low-time owners also might not get more that $1M with per-seat limits of $100,000 until they have accumulated more 340 time.

MODS, OWNER GROUPS

The 340 fleet has been a popular model for engine modifications performed by RAM Aircraft Corp. Their mods increase the number of powerplant options to five: the standard TSIO-520-NBS (310 HP), the RAM Series IV (325 HP), the RAM Series VI and VII (335 HP each) and the stock 310-HP engine with American Aviation Intercoolers. This last combo provides performance similar to the 325-HP RAM IV. RAM packages include a seventh stud on crankcase cylinder pads, which reduces the stresses in these areas that often cause cracks. (Contact RAM at www.ramaircraft.com or 254-752-8381.)

Improved turbocharger intercooling systems are available from American Aviation and are highly recommended by owners. The installation includes ram-air inlet ducts under the engine nacelles and more efficient (American says 28- to 70-percent more efficient) heat exchanger cores. The company says its system cuts the temperature of air entering the engine from about 170 degrees to 80 degrees, improving rate of climb by up to 300 FPM and adding up to 15 knots in cruise. (Contact American at www.americanaviationinc.com or 800-423-0476).

A STOL mod for 340s was offered by Sierra Industries, and included installation of Robertson-designed Fowler flaps and a trim spring that precludes the need to retrim the elevators when the flaps are raised or lowered. Sierra says the mod decreases accelerate-stop distances by 40 percent and improves short-field performance about 15 percent. Although still supported, the mod isn't available for new installations. Contact Sierra at www.sijet.com or 888-835-9377.

Precise Flight makes speedbrakes for the Cessna 340. They're of novel design and project into the airstream from a snug enclosure at the aft end of the engine nacelles. Contact Precise Flight at www.preciseflight.com or 800-547-2558.

Cessna 340 owner Philip Mattison told us of his switch to four-blade MT composite props that increased climb rates by 200 FPM and cruise speeds by 7 knots as well as giving cooler CHTs and smoother operation.

It's rare to find a 340 without the aforementioned vortex generators, which essentially eliminate Vmc, give great control at low airspeeds and add 300 pounds to the gross weight. If you don't find one, VGs are available from Micro Aerodynamics, Pacific Northwest Aero LLC, through RAM (as part of the company's speed mod kits) and through Boundary Layer Research. Micro Aerodynamics is at www.microaero.com and 800-677-2370; Pacific Northwest is at www.pnwaero.com and 541-388-9902. Robertson STOL kits are still available, but the installation cost is usually prohibitive. If you need this, find a 340 with it already installed.

As for owner groups, there are two: the Twin Cessna Flyer at www.twincessna.org and the Cessna Pilots Association at www.cessna.org or 805-934-0493. TCF offers operations seminars that are highly regarded by owners. According to Jerry Temple, the TCF dues is "the best dinner bill you will ever spend."

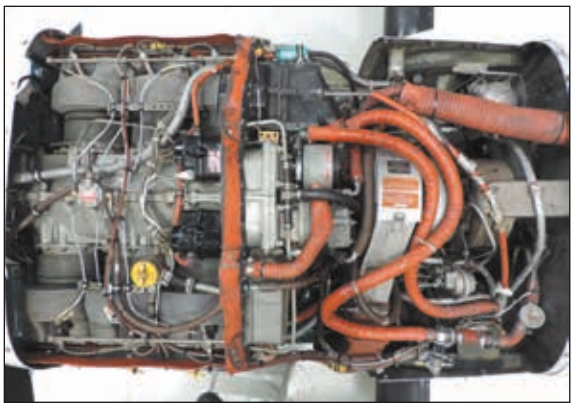
OWNER COMMENTS

I bought my 1980 340A in 2004 and fly it an average of 190 hours per year. This is my sixth airplane and I never expected to keep it so many years. It has proven to be a reliable and capable aircraft for my business travel. I fly probably 50 percent of the time alone and other times with one or two associates along. It is a comfortable and flexible aircraft for hauling three or four adults on 200- to 300-mile trips.

My typical trip is business traveling; usually 200 to 250 miles at 10,000 to 15,000 feet, which is the sweet spot for the airplane. I can fly these trips at 20,000 feet or higher when weather is a factor, but for the most part I only get into the flight levels when flying longer legs. It also has the flexibility to fly high or low to take advantage of the winds aloft without a fuel burn penalty. Speed varies with conditions but, I plan on 190 knots true at 12,000 feet and 215 knots true at FL200, burning 34 to 36 GPH of fuel.

I fly 1000-plus-mile trips a few times a year, but if I was doing that every month, I would be looking for a plane with longer range. My plane has a 183-gallon fuel capacity, but topping the tanks limits people or cargo.

My plane has 310-HP engines with the AA intercooler modifications. The AA mod helps keep the engines cool during high-power operations and produces more power than the stock intercooler-equipped planes. I



The right engine nacelle, top, with the hydraulic pump that powers the factory air conditioning gets rather busy and full with components. Chasing pressurization leaks can get into sizable teardown and expense, bottom.

am on my second set of engines and have had no issues other than things hanging on them like alternators, vacuum pumps and exhaust pipes.

My plane is equipped for FIKI and that just makes it legal. It will handle the icing conditions all right, but only to get to ice-free air. Icing is a frequent event during the winter and this equipment is a must have since I operate from Fargo, North Dakota. I also have the Keith air conditioning in the plane—a must, even in North Dakota.

A couple of years ago I upgraded most of the avionics, but kept the Cessna 400B autopilot because it works really well. I installed the Garmin G500 and GTN series touchscreen navigators, plus the GDL88 ADS-B system. I also installed the GWX70 radar—a big improvement over the legacy radar. I removed all of the primary engine instruments and installed the JP Instruments 960 engine monitoring system. I made this investment primarily for safety and it has been trouble free.

The 340 requires good maintenance by shops with expertise on the type. My 340 has been reliable, but it is expensive to keep it in top condition. I was told that if I could not stomach a $50,000 unplanned maintenance expense, I shouldn't buy a 340. I figure the maintenance costs will run an average of $150 per hour, net of engine and prop reserves. I belong to the Twin Cessna Flyer Association—the best resource for expertise on the airplane. The association sponsors seminars and conventions, plus also has an active forum where questions can answered to help keep the aircraft's reliability and safety at a higher level. I do recurrent training annually, even if it's not required for insurance. It's just a good idea.

My 340 is fun and easy to fly when flown by the numbers. It's also comfortable, quiet and best of all, it's pressurized.

Jim O'Day
Fargo, North Dakota

Our 1982 Cessna 340A with RAM VI and American Intercoolers is a pleasure to fly. It's nicely balanced on the controls with a solid feel that's responsive and predictable, yet somewhat heavy, befitting an aircraft with a gross takeoff weight over 6000 pounds. It's no effort to fly and is very stable in flight. Hand flying in IMC is no problem. It doesn't seem to have any bad habits.

I can achieve nearly 230 KTAS if I'm willing to push (and burn nearly 40 GPH). I choose to run significantly lean of peak for the reduced temperatures and cleaner operation. Interestingly, though, the NM per gallon is about the same. LOP gives me an honest 180 KTAS all day long, burning a bit less than 30 GPH total. I operate in the low flight levels, but it's happy up to about FL230. Above that, the turbos are working pretty hard and the cabin is above 10,000 feet anyway.

The factory air conditioning is a mechanical nightmare, powered by a hydraulic pump on the right engine, driving a hydraulic motor coupled to the compressor. When it works, it's fine. But it's proven to be troublesome to keep working due to Freon leaks. Compared with over $30,000 for a retrofit new electric system, however, one can tolerate a lot of needed repairs. Inflight cabin air circulation needs improvement and that's a project I'll look at during my next annual. It's common for the front two seats to be quite comfortable, while the rear seats are very cold and no amount of existing fans and circulation will smooth out the temperature variations.

With reasonable attention to speed, landings are straightforward, easily controllable, and occasionally reward me with a gratifying roll on. Crosswind performance is predictable and I'll accept up to 20 knots of direct crosswind without concern. The factory brakes are inadequate and although I can easily touch down on the numbers, even with heavy braking it can take close to 3000 feet to stop. I won't operate on less than 4000 feet of runway. RAM has a brake upgrade I'm considering.

Beware of the autopilot. The factory autopilot was from Sperry, but designed in the early 1970s or perhaps before. It's fine when it works and it's pretty reliable, but if it fails, Autopilots Central in Tulsa, Oklahoma, and Executive Autopilots in Sacramento, California, are the top two shops that can still actually repair them. Nobody currently makes a suitable replacement. Although some of the Genesis/S-Tec line is STC'd, I firmly believe that rate-based autopilots have no place in a complex twin flying in serious weather.

The 340 is not a failure-prone aircraft, but there's a lot of it, so failures are inevitable. For example, after about 50 trouble-free hours since annual, on one flight I lost an alternator and an EGT probe. Be prepared to spend the effort and money to keep your machine in top health. Defer maintenance or cut corners, though, and you'll likely experience unpleasant surprises.

That brings up what I see as one of the top fallacies in aviation regarding most used aircraft purchases.

Reader John Gill plans on roughly $600 per hour to fly his 340A pictured above, but that's getting better as he approaches three years of ownership and catches up on maintenance items.

You can find a 340 for perhaps under $200,000. The mindset when doing so is often that you're purchasing a comparatively inexpensive airplane. Then, when the first annual costs $25,000 or more, the unsuspecting owner is shocked. A better way to look at it is that if the 340 were available new today, it'd sell for probably well over $1.5 million. We're required to maintain an aircraft to near-new standards, right? Thus, all 340 owners are maintaining a $1.5 million airplane. In that light, a $25,000 annual doesn't seem unreasonable. (Annuals are typically much less, but can certainly reach that high if the airplane isn't maintained.)

I've chosen not to calculate my costs, but the estimate from the Twin Cessna Flyers of around $500 per-hour seems reasonable. Of course, this is variable based on how aggressively you plan for cheaper fuel purchases and if you participate in your own maintenance.

Starting with a well-chosen aircraft initially and adding extensive panel upgrades, our 340 is equipped with most of the bells and whistles—it's as close to an all-weather GA airplane as is practical. We're diligent about maintenance and the airplane seems to reward that effort. It serves us well for most any mission we undertake and we've never had to go commercial when we'd planned to take the 340.

Frank Bowlin
Santa Fe, New Mexico

Referring to this aircraft as a 340 or 340A is of no consequence since all 1972 thru 1975 340s have had engine upgrades. In over 21 years of selling Twin Cessnas, I've never seen a 285-HP 340. All 340s have 310 HP (per side) or more.

The several horsepower options are: the basic/stock 310 HP, the 325-HP RAM Series IV, the 335-HP RAM Series VI and VII and the 310-HP engine with American Aviation intercoolers. This modification provides RAM IV-like performance.

Propellers will be 76-inch three-blade heated McCauley or Hartzell models. Occasionally a 340 will have a four-blade MT composite propeller. The MT mod is expensive and I do not believe it's worth the cost.

The Aviation Consumer

CESSNA 340

(continued from page 31)

The term 'labyrinth' was once used in *Aviation Consumer* when referencing the Twin Cessna's tip tank fuel system. I have spent years disproving the implication of a hard-to-manage fuel system. With a proper checkout, it isn't an issue. Often on an initial 2.5-hour cross-country where the system can be demonstrated, I've had many a new 340 pilot look at me and say, "Is that it? What was all the talk about?"

Common airframe modifications are VGs, aft fuselage strakes, Power Pak spoilers, wheel covers and the R/STOL systems, which is no longer supported by Sierra Industries. The useful load will vary depending on RAM conversion and VGs, but typical is 1700 to 1800 pounds with payloads of 600 to 800 pounds.

Flight Safety no longer offers twin Cessna training. Simcom uses aging non-motion FTDs and customers report frequent malfunctions. There are several insurance-approved in-aircraft training firms that offer both initial and recurrent training. Dan Moore of Watauga Flight Service receives high marks from twin Cessna owners.

Jerry Temple
Frisco, Texas (www.jtatwins.com)

I've owned a Cessna 340 for about 25 years. It is a great two- to three-person aircraft with full fuel and baggage. If you plan to fill the cabin, do not plan to fill the tanks or take 70 pounds of suitcases. You can get off the ground just fine, but if you lost an engine, you would be in a world of hurt. That being said, single-engine performance is reasonable for a piston twin, based on my personal experience.

I heartily recommend vortex generators and quite frankly, I would not fly the aircraft without them. They create much greater rudder authority and reduce Vmc to below stall speed.

I fly with GAMI fuel injectors and operate LOP running 32 inches MP and 2300 RPM at about 15.5 GPH per side. The best altitude seems to be between 16,000 and 18,000 feet. At those altitudes, the engines stay cool for the most part, and I generally see 195 to 200 knots true. The best part about flying at those altitudes is hardly anyone else is there, so there are rarely traffic callouts or flight plan deviations.

My missions are generally between two and eight hours of flight time, so I generally flight plan for no more than four-hour legs, which gives me about one hour of reserve fuel (163 gallons, no nacelle tank).

Insurance is about $4400 for $1 million smooth and $300,000 hull value. I could not sell the plane for $300,000, but also could not replace it for much less. Annual simulator training is required, which runs about $2500 plus travel expenses.

After 25 hours of dual instruction, I thought I had it all down pretty well until I went to the simulator course. Not only was the single-engine training important and eye opening,

I learned that systems knowledge is critical and especially helpful when telling your mechanics what needs to be fixed. I've had multiple engine outs and only one was after I had the engines overhauled by a great shop.

Annuals run between $5000 and $10,000 depending on what is broken. My most frequent problem was vacuum pump failure, but this was solved with a cooling shroud and changing the in-line filter when the pump fails, which keeps the vane dust from getting into the de-ice system.

Don't expect the boots to work very well above 10,000 feet. The density altitude really takes the oomph out of the pressure side of the vacuum pumps. Also, like you said in a recent tail icing article, the 340 does not like flaps in icing conditions, so land with no flaps. The elevator horns—which are up with flaps down—pick up ice like crazy.

Brent Blue
via email

FEEDBACK WANTED

ERCOUPE/CADET

For the May 2017 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Ercoupe and Cadet. We want to know what it's like to own these aircraft, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs (**full-size, high-resolution please**) you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments. Send correspondence by April 1, 2017, to:

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